



Beyond Dichotomies: Unpacking Paradoxical Tensions in New Zealand's Hybrid Biotechnology Sector

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Abstract

Purpose: This article draws on paradox theory and sensemaking literature to empirically investigate tensions and sensemaking logics at Crown Research Institutes (CRIs) engaging with New Zealand's biotechnology industry.

Design/methodology/approach: A qualitative, abductive approach was used to conduct and analyse 10 semi-structured interviews from four CRIs.

Findings: CRIs experience interrelated and co-occurring performing, organising, belonging and learning tension types due to interconnected environmental factors. Interrelated performing and organising tension types were perceived through dichotomous and business-case logics, whereas interrelated learning and performing tensions were perceived through the paradox logic. Furthermore, performing and organising tensions were more salient to participants, compared to belonging and learning tensions. Based on these findings, we provide a revised Dynamic Equilibrium Model tension framework.

Practical implications: We identify environmental factors that practitioners may constructively engage with to mitigate salient biotechnology tensions between competing stakeholder demands in hybrid R&D institutes.

Research limitations/implications: The findings of this article are not directly transferrable to other contexts, as the tensions and logics identified are situated in a New Zealand biotechnology CRI context.

Originality: This article addresses knowledge gaps in the relationship between Dynamic Equilibrium Model tensions and sensemaking logics in the novel context of hybrid R&D institutes and emerging technological industries. In doing so, we identify novel paradoxical performing tensions at the organisational level, including temporal and cultural tensions in hybrid R&D institutes.

Introduction

This study investigates tensions in Crown Research Institutes (CRIs). CRIs are a network of hybrid research institutes that perform science to benefit New Zealand. CRIs are tasked with stimulating scientific discovery and innovation to support emerging technological industries. Scientific advancements in technological industries are essential for the survival of society in the wake of climate change. However, as hybrid R&D organisations, CRIs balance divergent strategic objectives, resulting in tensions (Ashby *et al.*, 2019; Bednarek *et al.*, 2017). Paradox theory defines tensions as “contradictory yet interrelated elements that exist simultaneously and persist over time” (Smith and Lewis, 2011, p. 386). Organisations can leverage tensions to better attend to competing demands. As a result, organisations can improve capabilities such as innovation (Miron-Spektor *et al.*, 2011), organisational learning (Grewatsch and Kleindienst, 2017), and overall performance (Andriopoulos *et al.*, 2018). But failure to manage tensions may lead to negative organisational outcomes, such as damaged reputation (Gaim *et al.*, 2021), financial losses (Bunders and De Moor, 2023), and intraorganizational conflict and governance issues (Es-Sajjade *et al.*, 2021). Accordingly, this study aims to address the tensions CRIs encounter while engaging with technological industries from a paradox theory and sensemaking perspective.

Little is known about the paradoxical tensions New Zealand’s hybrid R&D organisations experience when engaging with specific technological industries, especially in emerging sectors that span multiple scientific disciplines, such as biotechnology. Biotechnology is a key industry in mitigating climate change mediated threats (Abbass *et al.*, 2022) through the transformation of life science discoveries into technologies applicable in medical, agricultural, food, environmental and industrial fields (Martin *et al.*, 2021). Yet, the biotechnology industry is developed in just a handful of countries (Trump *et al.*, 2023). Tensions in New Zealand’s hybrid biotechnology sector are compelling because New Zealand has a unique cultural and regulatory environment for life science innovation. R&D in public institutions like CRIs is influenced by indigenous Māori culture through the Treaty of Waitangi (Finlay-Smiths *et al.*, 2024). Furthermore, New Zealand has stringent genetic editing and biosecurity regulations to protect the nation’s unique flora and fauna (Everett-Hincks & Henaghan, 2019). Subsequently, CRIs potentially encounter biotechnology R&D tensions that are difficult to sensemake and mitigate. If CRI biotechnology tensions are not well understood and managed, the growth of New Zealand’s biotechnology sector may be hindered, resulting in far reaching consequences for New Zealand’s future. Therefore, it is imperative to address biotechnology tensions in New Zealand’s CRI network.

The remainder of this section introduces relevant paradox theory and sensemaking literature and its gaps, as well as the research questions. The following section explains the research paradigm and methodology undertaken by this paper. Thereafter, the findings are presented, followed by a

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3 discussion of the findings in the form of five propositions and their theoretical and practical
4 implications. The final section concludes this study and discusses limitations and future research
5 directions.
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8 ***Hybrid R&D Tensions***

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11 Empirical research on public research institutes (PRIs) and CRIs has identified two general
12 organisational tensions. Firstly, hybrid R&D organisations encounter tensions between environmental
13 and social welfare goals and financial success goals (Ashby *et al.*, 2019; Bednarek *et al.*, 2017).
14 Secondly, tensions surface between science excellence goals, concerning traditional fundamental
15 research, and science impact goals, concerning applied research targeted at industries (Bednarek *et al.*,
16 2017; Keller *et al.*, 2020). Prior studies investigated these tensions through the seminal Dynamic
17 Equilibrium Model framework by Smith and Lewis (2011). The Dynamic Equilibrium Model divides
18 paradoxical tensions into categories of performing, belonging, organising and learning. Table I
19 defines and summarises tensions previously identified in hybrid R&D organisations.
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26 Insert table I about here

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31 However, CRI biotechnology tensions are not well characterised in literature. Tensions are a
32 prevalent theme in biotechnology due to the high regulatory and economic barriers to life science
33 R&D (Kampers *et al.*, 2021; Smyth *et al.*, 2016; Terblanche, 2008). Unfortunately, there are few
34 studies that examine paradox theory tensions across the entire biotechnology sector. Most relevant
35 paradox studies investigate tensions in specific corporate sub-sectors such as the pharmaceutical and
36 health sectors. These include technology integration tensions (Fort *et al.*, 2014), tensions between
37 incremental and disruptive innovation (Kocabasoglu-Hillmer *et al.*, 2023), and corporate
38 sustainability tensions (Kabel *et al.*, 2024). Whereas CRI innovation is not limited to specific sub-
39 sectors, allowing this study to capture tensions across the entire biotechnology industry and providing
40 an opportunity to uncover varied insights regarding environmental factors such as regulatory
41 frameworks. As a result, CRI biotechnology is a novel context for paradox literature that may
42 elaborate on the conditions and environmental factors that give rise to organisational tensions (Schad
43 *et al.*, 2016). Prior literature also suggests that there is a gap in identifying the environmental factors
44 that contribute to salient Dynamic Equilibrium Model tensions in emerging fields (Smith and Tracey,
45 2016). Consequently, this study aims to enrich academic knowledge on the factors that give rise to
46 organisational tensions in New Zealand's hybrid biotechnology industry.
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57 Furthermore, empirical research of tensions in a novel context provides an opportunity to
58 revise the Dynamic Equilibrium Model. Pina e Cunha and Putnam (2019) suggest that the use of the
59 four tension categories described by Smith and Lewis (2011) as a fully developed category system for
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3 organisational tensions is problematic due to isolation issues. Isolation issues refer to researchers
4 examining the tension types in isolation to one another, without investigating their interrelationships
5 empirically. Whereas paradox studies suggest that tensions are interrelated and knotted (Sheep *et al.*,
6 2016). As a result, this study seeks to investigate Dynamic Equilibrium Model tensions through a
7 holistic perspective that avoids isolation issues. Consequently, our first research question is
8 formulated:
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13 RQ1: What tensions are surfaced by biotechnology in Crown Research Institutes?
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15 ***Sensemaking Logics***

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18 As tensions are both socially constructed and inherent to organisations (Smith and Lewis, 2011),
19 individual perceptions of tensions are important for understanding the nature of organisational
20 tensions. Therefore, this study adopts a sensemaking logics perspective. Sensemaking is broadly
21 defined as “the ongoing retrospective development of plausible images that rationalise what people
22 are doing” (Weick *et al.*, 2005, p. 409). Prior literature navigates paradox sensemaking by relying on
23 the principle that the tension sensemaking process is influenced by a cognitive frame, or logic,
24 adopted by individuals (Hahn *et al.*, 2014). In sensemaking, a logic can be understood as a mental
25 template that filters information and helps assign meaning to the external world (Hahn *et al.*, 2014;
26 Walsh, 1995; Weick, 1995). Distinct sensemaking logics are associated with organisational outcomes
27 as they influence the actions taken by individuals to manage tensions. Paradox sensemaking literature
28 delineates several logics that individuals use to make sense of tensions. For the purposes of our
29 research, we describe three logics: paradox, business-case and dichotomous.
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38 The paradox logic accepts tensions, allowing paradoxical elements to co-exist (Hahn *et al.*,
39 2014). Empirical research associates the paradox logic with positive organisational outcomes such as
40 an improved ability to attend to multiple competing demands (Andriopoulos *et al.*, 2018) and
41 creativity (Miron-Spektor *et al.*, 2011). Conversely, the paradox logic is also associated with worse
42 perceived economic outcomes, compared to social and environmental outcomes (Carmine and De
43 Marchi, 2022), and decreased strategic planning capabilities (Grewatsch and Kleindienst, 2017).
44 However, few studies explicitly connect the paradox logic to the Dynamic Equilibrium Model
45 tensions. Miron-Spektor *et al.* (2018) link the paradox logic to learning and performing tensions and
46 suggests that future research may investigate paradox sensemaking of organising and belonging
47 tensions. Furthermore, prior studies show that different contexts render different results
48 (Andriopoulos *et al.*, 2018; Chen *et al.*, 2021; Sharma and Jaiswal, 2017). Consequently, further
49 research may ascertain how the paradox logic is relevant to CRI biotechnology tensions and
50 investigate the relationship between the paradox logic and Dynamic Equilibrium Model tensions.
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3 As CRIs are known to encounter performing, belonging and organising sustainability tensions
4 (Ashby *et al.*, 2019), the business-case logic is a relevant sensemaking logic. The business-case logic
5 highlights the contradictory nature of sustainability and financial success and therefore pursues
6 alignment of social and environmental goals with economic goals (Hahn *et al.*, 2014). Empirical
7 studies demonstrate the utility of the business-case logic in reducing the uncertainty of managerial
8 CSR decision-making by exclusively considering options that prioritise economic concerns (Lashmar
9 *et al.*, 2023). While certain studies provide evidence supporting the dominance of the business-case
10 logic in CSR tension sensemaking (Lashmar *et al.*, 2023; Sabini and Alderman, 2021), this is not
11 always the case (Chen *et al.*, 2021). The prioritisation of economic concerns is unsurprising in private
12 enterprises; however, it is unclear whether the same can be anticipated in hybrid R&D institutes. As a
13 result, it may be useful to investigate the relevance of the business-case logic in CRIs.

21 Since R&D in research institutes may surface tensions that are not directly related to
22 sustainability, such as learning tensions (Keller *et al.*, 2020), it is necessary to consider the
23 dichotomous logic. The dichotomous logic emphasises the contradictory nature of tensions and seeks
24 to eliminate tensions (Chen *et al.*, 2021), but unlike the business-case logic, it is not strictly limited to
25 social, environmental, and economic concerns. The relationship between the dichotomous logic and
26 Dynamic Equilibrium Model tensions is not well understood. However, prior literature has linked
27 dichotomous sensemaking with boundary conditions and resource scarcity (Hahn *et al.*, 2014; Sharma
28 and Jaiswal, 2017), cultural traits (Keller *et al.*, 2017) and epistemic motivation (Miron-Spektor *et al.*,
29 2022). Scholars have called for further research into the factors that influence sensemaking of tensions
30 (Al Hasan and Micheli, 2022), particularly in different industries and countries (Andriopoulos *et al.*,
31 2018). By understanding the salient tensions in CRI biotechnology, this study aims to elucidate the
32 conditions surrounding sensemaking logics. Therefore, the second research question is formulated:

41 RQ2: How are biotechnology tensions perceived and understood by Crown Research Institute
42 employees?
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45 **Methodology & Research Design**

48 Grounded in interpretivism, a qualitative, abductive research approach is adopted by this study.
49 Interpretivism embraces subjective and unique interpretations of reality (Bunniss and Kelly, 2010),
50 thereby providing an apt lens for investigating tensions and sensemaking logics. Abductive reasoning
51 in interpretive research supports effective linkage between established theory and data by prioritising
52 flexibility (Chen and Eweje, 2019; Gioia *et al.*, 2022). Furthermore, abductive approaches that move
53 between data and theory have been used in prior sensemaking logic (Chen *et al.*, 2021) and hybrid
54 R&D tension research (Bednarek *et al.*, 2017; Keller *et al.*, 2020). By adopting a similar approach in
55 our study, we may better compare our findings to prior empirical literature.
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Methods

Semi-structured interviews are used by this study to capture individual interpretations of tensions. Similar prior research suggests that semi-structured interviews elicit rich accounts from participants (Ashby *et al.*, 2019), providing important context for understanding individual views on tensions (Keller *et al.*, 2020). Moreover, semi-structured interviews were chosen as opposed to open interviews because the purpose for each interview was the same (Abreu Pederzini, 2018). To maintain the purpose of each interview, an interview guide was used. Using an interview guide, researchers may improve the trustworthiness of their findings (Kallio *et al.*, 2016). The interview guide, found in Appendix A, is comprised of introductory and primary questions. Introductory questions served the purpose of providing background information about participants' roles at CRIs and building rapport. The primary questions were designed to inquire about each category of tension from the Dynamic Equilibrium Model (Smith and Lewis, 2011) and attempted to gauge participants' views of each tension type. Questions avoided use of the words 'tension', 'paradox' and 'logic', as they are academic constructs (Ashby *et al.*, 2019). Questions were instead directed towards the challenges of life science and biotechnology projects. Questions to identify participant views of tensions were altered to suit participant answers, and additional questions were asked by the researcher to follow up on issues raised by participants.

Participant Selection

Due to the small size of the CRI network, industry connections were leveraged to identify participants with biotechnology experience through purposive and snowball sampling. Participants from the entire CRI network were chosen through purposive sampling based on whether they have been directly involved in CRI biotechnology projects previously. In addition, primarily senior commercial role employees with decision-making responsibilities were selected as commercial expertise is essential for biotechnology commercialisation (Engez and Aarikka-Stenroos, 2023). Furthermore, prior literature is predominantly focused on scientists' views (Ashby *et al.*, 2019; Keller *et al.*, 2020). However, junior and intermediate role participants were also chosen to participate in the study as organisational tensions span across organisational levels and are experienced differently as a result (Jarzabkowski *et al.*, 2013). Environmental triangulation (Stahl and King, 2020) was achieved by interviewing participants from several CRIs, thereby improving the findings' trustworthiness. The participant pool is depicted in Table II, where participants are differentiated based on role type and role seniority. CRI experience in years and prior background is included to provide further context. Participants provided written informed consent for participation in interviews.

Insert Table II about here

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3 As data analysis was based on Braun and Clarke (2006), data analysis and interviews were
4 concurrent. Participants were interviewed to identify codes that were subsequently grouped into
5 themes or ‘repeated patterns of meaning’ (Braun and Clarke, 2006, p.86). The authors suggest that
6 themes may be developed through a theoretical approach that is oriented towards research questions.
7 In this case, complete thematic analysis requires relationships to be drawn between codes, themes,
8 prior literature and research questions. Accordingly, interviews were ceased once themes and codes
9 attained sufficient ‘depth’ to answer the research questions.
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15 ***Data Analysis***

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17 Interview data was recorded, transcribed and thematically analysed following the six-phase guide by
18 Braun and Clarke (2006). To maintain the context of the data, each transcript was analysed separately,
19 and extracts were recorded together with their corresponding interview questions in a sequential
20 manner (Braun and Clarke, 2006). During coding, label assignment was informed by patterns
21 identified in the data and theoretical knowledge on paradox theory. Specific attention was given to
22 identifying Dynamic Equilibrium Model tension types, relationships between tension types, and
23 sensemaking logics. Hence data analysis followed an abductive approach. Following the generation of
24 codes, the third and fourth phases of thematic analysis took place recursively (Braun and Clarke,
25 2006). Codes were subsequently grouped and categorised into themes and themes were defined.
26 Codes and corresponding themes are detailed in the following section in Table III. The final phase of
27 thematic analysis involved the selection of extract examples (see Table III) and the relation of the
28 analysis back to the research question and literature.
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41 **Findings**

42 The findings of this study suggest that CRI biotechnology surfaces a range of performing, organising,
43 belonging and learning tension types. Participants engaged with paradox, dichotomous and business
44 case logics to sensemake tensions. Themes, corresponding codes and illustrative quote examples
45 summarise the findings in Table III.
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48 Insert Table III about here

49 ***CRI Biotechnology Tensions***

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51 Our findings support prior empirical literature suggesting tensions occur at organisational, team and
52 individual levels (Jarzabkowski *et al.*, 2013). Tensions intersected and co-occurred, consistent with
53 knotted and interwoven tensions identified in prior literature (Sheep *et al.*, 2016). Interrelated tensions
54 were surfaced by the saliency factors of scarcity, plurality and change (Smith and Lewis, 2011)
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3 specific to CRI biotechnology. Performing and organising tensions were the most salient for
4 individuals in comparison to belonging and learning tension types.
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7 *Theme 1: Uncertain New Zealand Biotechnology Conditions*

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10 *So, we didn't have a particular template or a success story to follow and that's tricky because you*
11 *don't have that organizational knowledge about 'here's a project that was similar and we did it this*
12 *way and this is the outcome'. So, we were kind of going into a bunch of things without necessarily*
13 *knowing how to approach them and we didn't have the organisational experience or knowledge to*
14 *draw on.*
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19 - Participant 6, senior commercial & scientific role, CRI 1
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22 Uncertain conditions that gave rise to tensions were comprised of three aspects, including
23 cultural, regulatory, and R&D uncertainties. Biotechnology spans multiple emerging sectors that are
24 poorly defined through regulations or established protocols. Uncertain New Zealand biotechnology
25 conditions spurred tensions due to the plurality of stakeholders in CRI biotechnology projects, leading
26 to multiple competing interpretations of goals and strategies (Lewis, 2000). Change was identified as
27 an additional external saliency factor (Smith and Lewis, 2011), as shifting regulatory and
28 technological landscapes complicate science research management. While scarcity (Smith and Lewis,
29 2011) limited project budgets and created boundary conditions for achieving CRI goals. Our results
30 support prior empirical evidence suggesting that resource scarcity, regulatory issues and technological
31 disruption create uncertain conditions that surface performing tensions (Morais *et al.*, 2018).
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38 ***Cultural Uncertainty.*** The CRI research agenda for “improved outcomes for Māori”
39 (Ministry of Business, Innovation and Employment, 2020, p. 14), implicate Māori as a separate CRI
40 stakeholder group. CRI biotechnology projects described by participants often involved collaboration
41 with Māori partners, as certain projects were developed from taonga Māori flora and fauna species.
42 Taonga is a Māori concept for intangible or tangible assets that require guardianship, as opposed to
43 ownership (Craig *et al.*, 2012). According to participants, the inclusion of taonga in biotechnology
44 projects required the integration of te ao Māori with CRI R&D. Te ao Māori is a holistic, cultural
45 worldview grounded in Māori tradition, whereas scientific research is based in reductionism and is not
46 well equipped to embrace cultural worldviews. Furthermore, Māori are a heterogenous group that
47 have varying stances towards biotechnology (Hudson *et al.*, 2019). Hence, CRIs encounter an
48 organisational performing tension between te ao Māori and CRI R&D.
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57 When confronted with the uncertainty of taonga projects, participants experienced belonging
58 and belonging-performing tensions with internal and external stakeholders, as interpretations of te ao
59 Māori varied depending on individual values. Furthermore, once engaged with Māori stakeholders,
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3 organising and performing tension types became salient for commercial role participants, as the
4 values associated with te ao Māori required a corresponding cultural approach comprised of unique
5 goals and strategies. Participant 8 noted that cultural approaches “can get a little confusing and a bit of
6 a minefield”, requiring flexibility and deviation from standard CRI R&D practises. For example,
7 Participant 5 recounted that CRI financial and time constraints limited the ability of CRI teams and
8 Māori stakeholders to explore the potential consequences of making taonga genetic material globally
9 accessible. Whereas Participant 4 suggested that intellectual property protection, necessary for
10 successful biotechnology commercialisation, became an issue due to differing definitions of
11 ownership between Māori partners. Therefore, organising tensions co-occurred with learning tensions
12 for participants, as there was no established protocol for engaging with Māori stakeholders, requiring
13 CRI employees to balance new and existing R&D processes.
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21 **Regulatory Uncertainty.** In the absence of regulations for certain biotechnology
22 innovations, CRIs encounter performing tensions between social good and commercial success
23 (Ashby *et al.*, 2019; Bednarek *et al.*, 2017). Without distinct regulatory roadmaps, internal
24 stakeholders struggle to achieve consensus on the prioritisation of public and private interests.
25 Individual interpretations of CRI success implicated team and individual role identities and values,
26 thereby surfacing belonging tensions. Boundary conditions implicate how organisational actors
27 achieve desired outcomes (Smith and Lewis, 2011). Thus, undefined regulatory environments of
28 biotechnology projects spurred multiple stakeholder approaches to research commercialisation,
29 resulting in organising tensions.
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36 Similarly, CRIs perform research in unrealised scientific sectors in New Zealand due to
37 regulatory barriers, such as genetic manipulation. The regulations surrounding genetic manipulation
38 restrict CRI engagement with genetic biotechnology research. Yet, research in these fields is
39 necessary to CRIs, as CRIs have a duty to anticipate future solutions to future problems for the benefit
40 of New Zealand (Crown Research Institutes, 2021). Furthermore, the future of genetic modification
41 regulations in New Zealand is uncertain (Ishii and Araki, 2016). Thus, an organisational level
42 learning-performing tension was surfaced for CRIs between present and future science for the benefit
43 of New Zealand. The management of research and commercialisation activities in unrealised
44 biotechnology sectors surfaces additional organising and organising-performing tensions for CRI
45 decision makers.
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53 **R&D Uncertainty.** Scientific endeavours potentiate positive outcomes for society.
54 However, research outcomes are impossible to predict, and scientific endeavours are associated with
55 high investment costs (Edelman, 2004; Vuong, 2018). In our findings, R&D uncertainty surfaced
56 exploration-exploitation learning tensions, similar to those discussed by Andriopoulos and Lewis
57 (2009). Participants grappled with the pursuit of conflicting and interrelated scientific research and
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3 commercialisation opportunities. A lack of financial, time and human capital resources restricted the
4 pursuit of multiple scientific and commercial pathways. In part, this reflects the high investment
5 burden associated with life science R&D, commonly known as the *Valley of Death* that life science
6 innovations must cross to reach the market (Kampers *et al.*, 2021).
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10 *Theme 2a: Processes and Goals*

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13 *It always seems that in our projects that we enter, things take a lot longer than what we anticipate...
14 When it goes out to the commercial company, there's then a couple of years of them playing around
15 with it, refining the design. And then there's the vagaries of them trying to take it to market, and
16 whether they're truly motivated or whether they've got other things to do... Because they've got other
17 things that they're shopping around for and doing – and the new commercial product that we see as
18 being something really big is maybe not so up their list of priorities, depending on the company.*
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24 - Participant 3, CRI 4, senior commercial role
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26 Consistent with prior literature, participants experienced an overarching organisational
27 performing tension between science impact and science excellence (Bednarek *et al.*, 2017). The shift
28 from being a purely fundamental science focused network to a network of applied and fundamental
29 research institutes occurred over thirty years ago for CRIs (Davenport and Bibby, 2007), yet its effects
30 were still found to ripple through these organisations today.
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35 Participants described an incompatibility between CRI R&D processes, driven by project
36 funding mechanisms, and science impact goals. Performing tensions emerged for commercial
37 personnel as they attempted to make sense of life science projects with few commercial opportunities.
38 Furthermore, when tasked with commercialisation activities, participants found that impact goals were
39 not a perfect fit with existing life science projects, resulting in performing-organising and organising
40 tensions. Participants reported that their ability to commercialise research was affected by a lack of
41 involvement from industry stakeholders. For example, Participant 2 discussed the challenges of
42 entering a biotechnology research project in its later stages and pivoting the project towards
43 commercially relevant channels. In turn, organising tensions surfaced performing tensions for
44 participants, as inefficient integration of commercial and scientific research protocols at CRIs raised
45 questions about the overarching purpose of CRIs.
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53 *Theme 2b: Role Identity*

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55 *I guess there was some frustration in the background. You're trying to move things along or things
56 are taking time, but it's outside of your control. And also, working with people in the organization that
57 might not have as much experience with that sort of stuff, so there's almost a bit of hand holding. I'd
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3 *send them documents to try and get information out of them, but the type of information that they*
4 *provided wasn't what I needed, so I needed to take a step back and be like – OK well I need to*
5 *communicate this better and really outline what I need from them.*
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9 - Participant 5, CRI 3, intermediate commercial role

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11 Participants in commercialisation focused roles experienced belonging tensions as their role
12 responsibilities were unclear to other stakeholders. Commercial personnel engaged with processes
13 unfamiliar to other project stakeholders to commercialise research. As champions of science impact,
14 commercial personnel collaborate with a range of internal and external stakeholders. When met with
15 resistance from stakeholders, commercial role participants struggled to effectively commercialise
16 scientific research, and experienced belonging-organising tensions.
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20 21 ***CRI Biotechnology Sensemaking Logics***

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23 Consistent with prior sensemaking literature (Chen *et al.*, 2021; Sharma and Jaiswal, 2017),
24 participants perceived tensions through paradox, dichotomous and business-case logics. Within
25 biotechnology projects, performing and organising tension types were associated with dichotomous
26 and business-case logics, due to resource constraints. In contrast, learning-performing tensions from
27 the management of multiple biotechnology projects over time were interpreted through the paradox
28 logic.
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33 34 ***Theme 3: Complexity Reduction Logics Within Projects***

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37 *In this particular instance, the actual issue is that we can get more of A, less of B. But B is more*
38 *valuable than A – so there is a trade-off. And then in this case we got to that [stage], and we said –*
39 *look let's go with this one, we can debate if we go with A or B forever. Someone just had to make a*
40 *decision that we'll go with A and see what happens. Scientifically it's probably even a spectrum, but*
41 *we've targeted A or B, otherwise, it gets too complicated.*
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46 - Participant 7, CRI 3, senior commercial and scientific role

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48 Within biotechnology projects, commercial personnel encountered multiple co-occurring
49 performing and organising tension types between scientific and commercial pathways and social-
50 environmental-economic CRI missions. Social-environmental-economic missions were viewed as
51 performing tensions by participants and resolved through the business-case logic. Conversely,
52 multiple scientific pathways emerging from a single scientific discovery were perceived both as
53 performing tensions between distinct opportunities and as organising tensions between strategies to
54 achieve CRI goals. According to participants, resource constraints made both-and approaches to
55 opportunities and strategies unachievable. Consequently, participants deferred to the dichotomous
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3 logic to interpret performing and organising tensions between scientific pathways, framing them as
4 trade-offs. Similarly, distinct commercialisation pathways facilitated engagement with the
5 dichotomous logic. Participant 1 described commercialisation pathways as “either-or decisions” that
6 do not have a “middle ground”. According to participants, commercial personnel are only involved in
7 projects once research outputs are delivered, as CRI projects are sectioned into funding types with
8 financial and time budgets. This protocol presents commercial personnel with a set of either-or
9 commercialisation pathway decisions bounded by financial and time resources.
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15 *Theme 4: CRI Horizons*

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17 *Taking a longer-term view and training new people to expand and give you more capability, takes*
18 *longer and costs a bit more, but is something that's necessary if you really want to have good, solid*
19 *teams with competent skills and not just one person who happens to be really good at something and*
20 *always does it. So, there are those kind of conflicts between do you take a more holistic view of the*
21 *organisation, or do you do the fastest route to deliver the outcome from the project? Well, there's*
22 *always a balance, but unfortunately, the reality is that big projects have [also] got the capacity to*
23 *absorb a little bit of that individual development and too many small projects just kills you eventually*
24 *because you can't train anyone, you can't develop staff properly.*
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31 - Participant 9, CRI 2, senior commercial role
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33 Senior commercial role participants discussed the challenges of managing short-, medium-,
34 and long-term CRI project horizons. The management of these project types surfaced two tensions.
35 Firstly, learning-performing tensions were surfaced between allocating resources towards improving
36 scientific capabilities to benefit New Zealand’s future and towards present-day success. Similarly, the
37 allocation of resources towards commercialisation activities and scientific research activities surfaced
38 science impact and science excellence tensions. The management of multiple projects required senior
39 commercial role participants to embrace all CRI goals simultaneously. By considering biotechnology
40 project outcomes from a strategic, temporal perspective, participants perceived relevant learning-
41 performing and performing tensions through the paradox logic.
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49 **Discussion**

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51 Based on the findings of this study, we provide a revised Dynamic Equilibrium Model tension
52 framework that offers a nuanced perspective on CRI biotechnology tensions, linking tensions and
53 sensemaking logics. The revised tension framework, shown in Figure 1, is divided into two phases.
54 Phase I represents salient tensions as circles and distinguishes between the saliency of tension types
55 by illustrating more salient tensions as larger circles. Hence, performing and organising tensions are
56 represented by larger circles. Furthermore, the framework depicts the interrelatedness of tension types
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3 by linking tensions together. Tensions co-occurred; hence all tension circles are linked in the
4 framework, with the exception of learning and belonging tensions, which were not observed to
5 intersect in the data. Additionally, tension types are framed by uncertain New Zealand biotechnology
6 and CRI impact shift conditions, which contribute to tension saliency. These conditions are amplified
7 by scarcity, plurality and change (Smith and Lewis, 2011). The association between conditions and
8 different tension types is represented by Greek alphabetical symbols. R&D uncertainty (α), surfaces
9 learning and performing tensions. Regulatory uncertainty (β) and cultural uncertainty (γ) surface all
10 tension types. Impact shift refers to the ongoing changes related to CRIs embracing science impact
11 and science excellence goals. Changing CRI processes and goals (δ) surface performing and
12 organising tensions. Whereas changing role identities (ϵ) surface belonging and organising tension
13 types.
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21 Phase II in the framework links salient tensions of Phase I to sensemaking logics.
22 Dichotomous and business-case logics are shown as opposite to paradox logics on a spectrum. As
23 resource constraints intensify, illustrated by the red arrow, individuals tend towards dichotomous and
24 business-case logics. Organising-performing tensions are associated with dichotomous and business-
25 case sensemaking due to the intense resource constraints that accompany organising and performing
26 tensions. As resource constraints recede, represented by the blue arrow, individuals tend towards
27 paradox logics. Due to fewer resource constraints, learning-performing tensions are associated with
28 the paradox logic.
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41 ***Theoretical Contributions***

42 The empirical findings of this study demonstrate that CRIs experience a range of performing,
43 organising, belonging and learning tensions when engaging with the biotechnology industry. Hence,
44 our findings address the knowledge gap on paradoxical tensions in different contexts (Schad *et al.*,
45 2016). Based on these findings, we generate five propositions. The findings of this study support prior
46 literature that suggests hybrid R&D organisations experience organisational performing tensions
47 between social good and commercial success (Ashby *et al.*, 2019; Bednarek *et al.*, 2017), as well as
48 applied science and fundamental science (Ashby *et al.*, 2019; Keller *et al.*, 2020). However, our
49 findings also demonstrate that CRIs experience two additional performing tensions at an
50 organisational level in a biotechnology context. Firstly, there are temporal learning-performing
51 tensions, between performing science to benefit New Zealand in the present and the future. Secondly,
52 there are cultural performing tensions, between te ao Māori and CRI R&D. This finding opens an
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avenue for future research, as little is known about the paradoxical tensions between cultural and scientific approaches in hybrid environments. Consequently, the first proposition is generated:

Proposition 1: When engaging with New Zealand's emerging biotechnology industry, CRIs experience organisational performing tensions that extend beyond tensions between commercial success and social good or science impact and science excellence. Such as cultural tensions between te ao Māori and CRI R&D, and temporal tensions between future and present success.

The four organisational performing tensions identified by this study are associated with further organising, belonging and learning tensions at team and individual levels. Our findings differ from prior literature where distinct tension dynamic patterns at different organisational levels are identified (Jarzabkowski *et al.*, 2013), likely due to contextual differences between the biotechnology projects discussed by participants. Unlike prior hybrid R&D literature (Ashby *et al.*, 2019; Bednarek *et al.*, 2017; Keller *et al.*, 2020) tension types were found to intersect and co-occur; hence they could not be definitively separated in our analysis. Therefore, the revised framework reflects that CRI biotechnology tensions are interconnected and inherently complex. Complex tensions were associated with interrelated environmental conditions, including CRI biotechnology uncertainty and impact shift. Uncertainty is inherent to scientific R&D and the regulatory and cultural environments of CRI biotechnology. While impact shift conditions reflect ongoing institutional changes affecting organisational structure of CRIs. The external saliency factors of change, plurality and scarcity described by Smith and Lewis (2011) amplify the conditions that surface tensions. Consequently, we enrich prior literature by identifying environmental conditions that give rise to organisational tensions (Schad *et al.*, 2016) in emerging fields (Smith and Tracey, 2016) and contextualise the saliency factors that give rise to Dynamic Equilibrium Model tension types (Miron-Spektor *et al.*, 2018). Furthermore, our findings identify the environmental conditions that surface complex tensions (Sheep *et al.*, 2016). The revised framework further addresses the isolation issues suggested by Pina e Cunha and Putnam (2019) by providing a holistic perspective on tension categories that emphasises the interconnectedness of paradoxical tensions. As a result, the second proposition is generated:

Proposition 2: Amplified by scarcity, plurality and change, CRI biotechnology is fraught with interrelated environmental conditions including regulatory, cultural, and R&D uncertainty, and impact shift, which give rise to interconnected performing, organising, belonging and learning tensions.

Although the Dynamic Equilibrium Model divides tensions into four equal categories, performing and organising tensions were more salient. As participants discussed the same organisational goals, performing tensions were more inherent to the shared organisational reality of CRIs and therefore more salient to participants. Conversely, organising tensions were more varied between individuals. However, tensions between different approaches and processes towards achieving CRI goals were highly prevalent. Prior literature in similar settings has identified

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3 performing and belonging tensions as more salient to individuals (Keller *et al.*, 2020). Conversely, our
4 findings suggest that belonging and learning tensions are less salient and are surfaced alongside
5 performing or organising tension types. These differences are likely due to the situatedness of tensions
6 (Schad *et al.*, 2016; Smith and Lewis, 2011). Additionally, our findings show that commercial CRI
7 personnel experience belonging tensions related to role identity, extending prior hybrid R&D
8 literature (Ashby *et al.*, 2019; Keller *et al.*, 2020). Therefore, the revised framework builds on the
9 Dynamic Equilibrium Model by making the saliency of different tension types explicit. As a result,
10 the third proposition is generated:
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16 Proposition 3: Performing and organising tensions are more salient in CRI biotechnology than
17 belonging and learning tension types.
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20 Additionally, this study contributes to paradox sensemaking literature by linking sensemaking
21 logics with Dynamic Equilibrium Model tensions. Based on these findings, we generate two further
22 propositions. Firstly, biotechnology tensions were perceived through three sensemaking logics:
23 paradox, dichotomous and business-case. In contrast to prior literature based on sustainability tensions
24 (Lashmar *et al.*, 2023; Sabini and Alderman, 2021), the business-case logic was less common because
25 performing tensions between social, environmental and economic goals were not always relevant to
26 CRI biotechnology. Instead, the dichotomous logic was engaged by participants to eliminate
27 organising and performing tension types in commercialisation and scientific pathway decisions within
28 projects, and therefore conserve resources and mitigate risk. Hence, the revised framework depicts a
29 sensemaking phase that shows the three logic types and associates logics with Dynamic Equilibrium
30 Model tensions. Similar to prior findings, we draw a connection between learning-performing
31 tensions to paradox logics (Miron-Spektor *et al.*, 2018). Our findings extend prior knowledge on
32 sensemaking logics and Dynamic Equilibrium Model tensions by linking performing, organising and
33 performing-organising tensions to dichotomous logics. Consequently, the fourth proposition is
34 generated:
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45 Proposition 4: CRI biotechnology tensions are sensemade through three logics. The paradox
46 logic is engaged to sensemake temporal learning-performing tensions. Within biotechnology projects,
47 commercialisation and scientific pathway performing-organising tensions are sensemade through the
48 dichotomous logic. Performing tensions between social, environmental and economic concerns are
49 sensemade through the business-case logic.
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53 The three logics co-existed as participants did not adhere to a single specific logic. Therefore,
54 our findings do not support the view that logics are a fixed sensemaking mechanism that individuals
55 adhere to over time (Hahn *et al.*, 2014). Instead, our findings reflect prior empirical literature that
56 suggests individuals deviate between sensemaking logics based on perception of resources (Sharma
57 and Jaiswal, 2017). Resource constraints pertaining to project time and finances influenced whether
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3 participants engaged with dichotomous and business-case logics or the paradox logic to sensemake
4 tensions. Therefore, the revised framework depicts logics on a spectrum mediated by resource
5 constraints. These findings support prior literature that sensemaking is influenced by contextual
6 conditions (Klarin and Sharmelly, 2021). Therefore, this study extends our understanding of
7 sensemaking logics and elaborates on the conditions that influence logics in a novel context (Al Hasan
8 and Micheli, 2022; Andriopoulos et al., 2018; Miron-Spektor *et al.*, 2011). As a result, the final
9 proposition is generated:
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15 Proposition 5: Sensemaking logics co-exist on a spectrum, mediated by resource constraints.
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17 In summary, the propositions and revised framework make several contributions to paradox
18 theory and sensemaking scholarship. By identifying two additional organisational-level CRI tensions,
19 P1 contributes to knowledge on paradox theory tensions in hybrid R&D organisations engaging with
20 emerging technological industries. Furthermore, P1 contributes to paradox theory by introducing a
21 cultural R&D tension that is novel to paradox theory. P2 contributes to paradox theory by supporting
22 tension complexity in paradox theory and addresses knowledge gaps pertaining to the environmental
23 conditions that give rise to organisational tensions. P3 reveals the nature of salient tensions in CRI
24 biotechnology R&D and therefore contributes to knowledge on Dynamic Equilibrium Model tensions
25 in hybrid R&D organisations. P4 contributes to sensemaking literature by identifying dichotomous
26 and paradox logics in the novel context of CRI biotechnology, as prior literature predominantly
27 examined logics from a sustainability perspective. Furthermore, sensemaking logics are associated
28 with Dynamic Equilibrium Model tensions, contributing to our understanding of the relationship
29 between paradox theory and sensemaking. Finally, P5 contributes to sensemaking literature by
30 showing that sensemaking logics are mediated by resource constraints in hybrid R&D contexts.
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40 ***Practical Implications***

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42 The findings of this study present practical implications for tension management in hybrid R&D
43 organisations engaging with emerging technological industries. Firstly, the revised tension framework
44 raises awareness of paradoxical tensions in hybrid R&D environments (Pina e Cunha *et al.*, 2024).
45 Secondly, the revised framework indicates that tension management should be holistic, due to the
46 interrelatedness of tensions and environmental conditions. Practitioners may address tensions
47 holistically by mitigating the environmental conditions that surface tensions. For example, providing
48 expert opinion to support commercialisation personnel in navigating uncertain cultural and regulatory
49 contexts of biotechnology projects. Secondly, the prevalence of performing and organising tensions
50 suggests that CRIs and similar hybrid R&D institutes may benefit from more flexible processes for
51 achieving organisational goals. For example, flexibility in timing commercialisation team entry points
52 to research projects may increase time resources and thereby encourage engagement with the paradox
53 logic to sensemake commercialisation and scientific pathway decisions. Biotechnology is an
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3 inherently innovative field, and engagement with the paradox logic improves organisational creativity
4 and innovation (Miron-Spektor *et al.*, 2018). Therefore, practitioners may benefit from strategically
5 engaging with the paradox logic by managing resource constraints. Thirdly, financial and time
6 scarcity conditions remain a primary factor in the saliency of CRI biotechnology tensions. Scarcity
7 conditions limit the-mitigation of tensions through the paradox logic. Financial constraints may result
8 in poor performance across environmental and social goals (Amoah and Eweje, 2022; Mohamad Ariff
9 *et al.*, 2024). Consequently, change is required at an institutional level to improve CRI access to
10 financial resources so that CRIs may better support emerging technological industries.
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16 17 18 **Conclusions, Limitations and Future Research** 19

20 This study reveals that CRI biotechnology R&D surfaces complex performing, organising, belonging
21 and learning tension types due to interrelated environmental conditions unique to New Zealand's
22 biotechnology sector and the CRI network. The empirical findings of this study present several
23 theoretical contributions to paradox theory and sensemaking logics literature.
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27 However, this study has some limitations. The primary limitation of this study is its
28 generalisability or transferability to other contexts. The tensions investigated by this study are highly
29 situated in New Zealand's CRI biotechnology context. As a result, the tensions and logics identified
30 by this study may not be reflective of the tensions surfaced and their associated logics in other types
31 of organisations or industries. Organisations that have a similar hybrid business model and R&D
32 focus to CRIs, such as PRIs in other countries, may not experience the same tensions or logics
33 identified by this study, as other countries may have a different set of biotechnology and science
34 ecosystem conditions. Subsequently, future research may investigate the relevance of the revised
35 framework to other organisations and R&D industries. Similarly, this study identified novel cultural
36 tensions. Future research may investigate te ao Māori tensions further in hybrid R&D environments or
37 investigate cultural R&D tensions in other countries, as cultural tensions in R&D are not well
38 understood in paradox literature. Finally, the scope of this study was limited to investigating salient
39 tensions and sensemaking logics. As the findings of this study identified a relationship between time
40 and logics, future longitudinal research may further investigate tension responses and outcomes and
41 connect them to Dynamic Equilibrium Model tensions and sensemaking logics.
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Abstract

Purpose: This article draws on paradox theory and sensemaking literature to empirically investigate tensions and sensemaking logics at Crown Research Institutes (CRIs) engaging with New Zealand's biotechnology industry.

Design/methodology/approach: A qualitative, abductive approach was used to conduct and analyse 10 semi-structured interviews from four CRIs.

Findings: CRIs experience interrelated and co-occurring performing, organising, belonging and learning tension types due to interconnected environmental factors. Interrelated performing and organising tension types were perceived through dichotomous and business-case logics, whereas interrelated learning and performing tensions were perceived through the paradox logic. Furthermore, performing and organising tensions were more salient to participants, compared to belonging and learning tensions. Based on these findings, we provide a revised Dynamic Equilibrium Model tension framework.

Practical implications: We identify environmental factors that practitioners may constructively engage with to mitigate salient biotechnology tensions between competing stakeholder demands in hybrid R&D institutes.

Research limitations/implications: The findings of this article are not directly transferrable to other contexts, as the tensions and logics identified are situated in a New Zealand biotechnology CRI context.

Originality: This article addresses knowledge gaps in the relationship between Dynamic Equilibrium Model tensions and sensemaking logics in the novel context of hybrid R&D institutes and emerging technological industries. In doing so, we identify novel paradoxical performing tensions at the organisational level, including temporal and cultural tensions in hybrid R&D institutes.

Introduction

This study investigates tensions in Crown Research Institutes (CRIs). CRIs are a network of hybrid research institutes that perform science to benefit New Zealand. CRIs are tasked with stimulating scientific discovery and innovation to support emerging technological industries. Scientific advancements in technological industries are essential for the survival and adaptation of society in the wake of climate change. However, as hybrid R&D organisations, CRIs balance divergent strategic objectives, resulting in tensions (Ashby *et al.*, 2019; Bednarek *et al.*, 2017). Paradox theory defines tensions as “contradictory yet interrelated elements that exist simultaneously and persist over time” (Smith and Lewis, 2011, p. 386). Organisations can leverage tensions to better attend to competing demands. As a result, organisations can improve capabilities such as innovation (Miron-Spektor *et al.*, 2011), organisational learning (Grewatsch and Kleindienst, 2017), and overall performance (Andriopoulos *et al.*, 2018). But failure to manage tensions may lead to negative organisational outcomes, such as damaged reputation (Gaim *et al.*, 2021), financial losses (Bunders and De Moor, 2023), and intraorganizational conflict and governance issues (Es-Sajjade *et al.*, 2021). Accordingly, this study aims to address the tensions CRIs encounter while engaging with technological industries from a paradox theory and sensemaking perspective.

Little is known about the paradoxical tensions New Zealand’s hybrid R&D organisations experience when engaging with specific technological industries, especially in emerging sectors that span multiple scientific disciplines, such as biotechnology. Biotechnology is a key industry in mitigating climate change mediated threats (Abbass *et al.*, 2022) through the transformation of life science discoveries into technologies applicable in medical, agricultural, food, environmental and industrial fields (Martin *et al.*, 2021). Yet, the biotechnology industry is developed in just a handful of countries (Trump *et al.*, 2023). Tensions in New Zealand’s hybrid biotechnology sector are compelling because New Zealand has a unique cultural and regulatory environment for life science innovation. R&D in public institutions like CRIs is influenced by indigenous Māori culture through the Treaty of Waitangi (Finlay-Smiths *et al.*, 2024). Furthermore, New Zealand has stringent genetic editing and biosecurity regulations to protect the nation’s unique flora and fauna (Everett-Hincks & Henaghan, 2019). Subsequently, CRIs potentially encounter biotechnology R&D tensions that are difficult to sensemake and mitigate. If CRI biotechnology tensions are not well understood and managed, the growth of New Zealand’s biotechnology sector may be hindered, resulting in far reaching consequences for New Zealand’s future. Therefore, it is imperative to address biotechnology tensions in New Zealand’s CRI network.

The remainder of this section introduces relevant paradox theory and sensemaking literature and its gaps, as well as the research questions. The following section explains the research paradigm and methodology undertaken by this paper. Thereafter, the findings are presented, followed by a

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3 discussion of the findings in the form of five propositions and their theoretical and practical
4 implications. The final section concludes this study and discusses limitations and future research
5 directions.
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8 *Hybrid R&D Tensions*

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10 Empirical research on public research institutes (PRIs) and CRIs has demonstrated identified two
11 general organisational tensions. Firstly, hybrid R&D organisations encounter tensions between
12 environmental and social welfare goals and financial success goals (Ashby *et al.*, 2019; Bednarek *et*
13 *al.*, 2017). Secondly, tensions surface between science excellence goals, concerning traditional
14 fundamental research, and science impact goals, concerning applied research targeted at industries
15 (Bednarek *et al.*, 2017; Keller *et al.*, 2020). Prior studies investigated these tensions through the
16 seminal Dynamic Equilibrium Model framework by Smith and Lewis (2011). The Dynamic
17 Equilibrium Model divides paradoxical tensions into categories of performing, belonging, organising
18 and learning. Table I defines and summarises tensions previously identified in hybrid R&D
19 organisations.
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28 Insert table I about here

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30 However, little is known about the paradoxical tensions New Zealand's hybrid R&D
31 organisations experience when engaging with specific technological industries, especially in emerging
32 sectors that span multiple scientific disciplines, such as biotechnology. Biotechnology is a key
33 industry in mitigating climate change mediated threats (Abbass *et al.*, 2022) through the
34 transformation of life science discoveries into technologies applicable in medical, agricultural, food,
35 environmental and industrial fields (Martin *et al.*, 2021). Yet, the biotechnology industry is developed
36 in just a handful of countries (Trump *et al.*, 2023). However, CRI biotechnology tensions are not well
37 characterised in literature. Tensions are a prevalent theme in biotechnology due to the high regulatory
38 and economic barriers to life science R&D (Kampers *et al.*, 2021; Smyth *et al.*, 2016; Terblanche,
39 2008). Unfortunately, there are few studies that examine paradox theory tensions across the entire
40 biotechnology sector. Most relevant paradox studies investigate tensions in specific corporate sub-
41 sectors such as the pharmaceutical and health sectors. These include technology integration tensions
42 (Fort *et al.*, 2014), tensions between incremental and disruptive innovation (Kocabasoglu-Hillmer *et*
43 *al.*, 2023), and corporate sustainability tensions (Kabel *et al.*, 2024). Whereas CRI innovation is not
44 limited to specific sub-sectors, allowing this study to capture tensions across the entire biotechnology
45 industry and providing an opportunity to uncover varied insights regarding environmental factors such
46 as regulatory frameworks. As a result, CRI biotechnology is a novel context for paradox literature that
47 may elaborate on the conditions and environmental factors that give rise to organisational tensions
48 (Schad *et al.*, 2016). Prior literature also suggests that there is a gap in identifying the environmental
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factors that contribute to salient Dynamic Equilibrium Model tensions in emerging fields (Smith and Tracey, 2016). Prior literature suggests that there is a gap in identifying the environmental factors that contribute to salient Dynamic Equilibrium Model tensions in emerging fields (Smith and Tracey, 2016). Consequently, this study aims to enrich academic knowledge on the factors that give rise to organisational tensions in New Zealand's hybrid biotechnology industry.

Furthermore, empirical research of tensions in a novel context provides an opportunity to revise the Dynamic Equilibrium Model. Pina e Cunha and Putnam (2019) suggest that the use of the four tension categories described by Smith and Lewis (2011) as a fully developed category system for organisational tensions is problematic due to isolation issues. Isolation issues refer to researchers examining the tension types in isolation to one another, without investigating their interrelationships empirically. Whereas paradox studies suggest that tensions are interrelated and knotted (Sheep *et al.*, 2016). As a result, this study seeks to investigate Dynamic Equilibrium Model tensions through a holistic perspective that avoids isolation issues. Consequently, our first research question is formulated:

RQ1: What tensions are surfaced by biotechnology in Crown Research Institutes?

Sensemaking Logics

As tensions are both socially constructed and inherent to organisations (Smith and Lewis, 2011), individual perceptions of tensions are important for understanding the nature of organisational tensions. Therefore, this study adopts a sensemaking logics perspective. Sensemaking is broadly defined as “the ongoing retrospective development of plausible images that rationalise what people are doing” (Weick *et al.*, 2005, p. 409). Prior literature navigates paradox sensemaking by relying on the principle that the tension sensemaking process is influenced by a cognitive frame, or logic, adopted by individuals (Hahn *et al.*, 2014). In a sensemaking context, a logic can be understood as a mental template that filters information and helps assign meaning to the external world (Hahn *et al.*, 2014; Walsh, 1995; Weick, 1995). Distinct sensemaking logics are associated with organisational outcomes as they influence the actions taken by individuals to manage tensions. Paradox sensemaking literature delineates several logics that individuals use to make sense of tensions. For the purposes of our research, we describe three logics: paradox, business-case and dichotomous.

The paradox logic accepts tensions, allowing paradoxical elements to co-exist (Hahn *et al.*, 2014). Empirical research associates the paradox logic with positive organisational outcomes such as an improved ability to attend to multiple competing demands (Andriopoulos *et al.*, 2018) and creativity (Miron-Spektor *et al.*, 2011). Conversely, the paradox logic is also associated with worse perceived economic outcomes, compared to social and environmental outcomes (Carmin and De Marchi, 2022), and decreased strategic planning capabilities (Grewatsch and Kleindienst, 2017).

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3 However, few studies explicitly connect the paradox logic to the Dynamic Equilibrium Model
4 tensions. Miron-Spektor *et al* (2018) links the paradox logic to learning and performing tensions and
5 suggests that future research may investigate paradox sensemaking of organising and belonging
6 tensions. Furthermore, prior studies show that different contexts render different results
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8 (Andriopoulos *et al.*, 2018; Chen *et al.*, 2021; Sharma and Jaiswal, 2017). Consequently, further
9 research may ascertain how the paradox logic is relevant to CRI biotechnology tensions and
10 investigate the relationship between the paradox logic and Dynamic Equilibrium Model tensions.
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15 As CRIs are known to encounter performing, belonging and organising sustainability tensions
16 (Ashby *et al.*, 2019), the business-case logic is a relevant sensemaking logic. The business-case logic
17 highlights the contradictory nature of sustainability and financial success and therefore pursues
18 alignment of social and environmental goals with economic goals (Hahn *et al.*, 2014). Empirical
19 studies demonstrate the utility of the business-case logic in reducing the uncertainty of managerial
20 CSR decision-making by exclusively considering options that prioritise economic concerns (Lashmar
21 *et al.*, 2023). While certain studies provide evidence supporting the dominance of the business-case
22 logic in CSR tension sensemaking (Lashmar *et al.*, 2023; Sabini and Alderman, 2021), this is not
23 always the case (Chen *et al.*, 2021). The prioritisation of economic concerns is unsurprising in private
24 enterprises; however, it is unclear whether the same can be anticipated in hybrid R&D institutes. As a
25 result, it may be useful to investigate the relevance of the business-case logic in CRIs.
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33 Since R&D in research institutes may surface tensions that are not directly related to
34 sustainability, such as learning tensions (Keller *et al.*, 2020), it is necessary to consider the
35 dichotomous logic. The dichotomous logic emphasises the contradictory nature of tensions and seeks
36 to eliminate tensions (Chen *et al.*, 2021), but unlike the business-case logic, it is not strictly limited to
37 social, environmental, and economic concerns. The relationship between the dichotomous logic and
38 Dynamic Equilibrium Model tensions is not well understood. However, prior literature has linked
39 dichotomous sensemaking with boundary conditions and resource scarcity (Hahn *et al.*, 2014; Sharma
40 and Jaiswal, 2017), cultural traits (Keller *et al.*, 2017) and epistemic motivation (Miron-Spektor *et al.*,
41 2022). Scholars have called for further research into the factors that influence sensemaking of tensions
42 (Al Hasan and Micheli, 2022), particularly in different industries and countries (Andriopoulos *et al.*,
43 2018). By understanding the salient tensions in CRI biotechnology, this study aims to elucidate the
44 conditions surrounding sensemaking logics. Therefore, the second research question is formulated:
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52 RQ2: How are biotechnology tensions perceived and understood by Crown Research Institute
53 employees?
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Methodology & Research Design

Grounded in interpretivism, a qualitative, abductive research approach is adopted by this study. Interpretivism embraces subjective and unique interpretations of reality (Bunniss and Kelly, 2010), thereby providing an apt lens for investigating tensions and sensemaking logics. Abductive reasoning in interpretive research supports effective linkage between established theory and data by prioritising flexibility (Chen and Eweje, 2019; Gioia *et al.*, 2022). Furthermore, abductive approaches that move between data and theory have been used in prior sensemaking logic (Chen *et al.*, 2021) and hybrid R&D tension research (Bednarek *et al.*, 2017; Keller *et al.*, 2020). By adopting a similar approach in our study, we may better compare our findings to prior empirical literature.

Methods

Semi-structured interviews are used by this study to capture individual interpretations of tensions. Similar prior research suggests that semi-structured interviews elicit rich accounts from participants (Ashby *et al.*, 2019), providing that provide important context for understanding individual views on tensions (Keller *et al.*, 2020). Moreover, semi-structured interviews were chosen as opposed to open interviews because the purpose for each interview was the same (Abreu Pederzini, 2018). To maintain the purpose of each interview, an interview guide was used. Using an interview guide, researchers may improve the trustworthiness of their findings (Kallio *et al.*, 2016). The interview guide, found in Appendix A, is comprised of introductory and primary questions. Introductory questions served the purpose of providing background information about participants' roles at their CRIs to the researcher and building rapport. The primary questions were designed to inquire about each category of tension from the Dynamic Equilibrium Model (Smith and Lewis, 2011) and attempted to gauge participants' views of each tension type. Questions avoided use of the words 'tension', 'paradox' and 'logic', as they are academic constructs (Ashby *et al.*, 2019). Questions were instead directed towards the challenges of life science and biotechnology projects. Questions to identify participant views of tensions were altered to suit participant answers, and additional questions were asked by the researcher to follow up on issues raised by participants.

Participant Selection

Due to the small size of the CRI network, industry connections were leveraged to identify participants with biotechnology experience through purposive and snowball sampling. Participants from the entire CRI network were chosen through purposive sampling based on whether they have been directly involved in CRI biotechnology projects previously. In addition, primarily senior commercial role employees with decision-making responsibilities were selected as commercial expertise is essential for biotechnology commercialisation (Engez and Aarikka-Stenroos, 2023). Furthermore, prior - Furthermore, similar literature is predominantly focuses focused on scientists' views (Ashby *et al.*,

2019; Keller *et al.*, 2020). Consequently, primarily senior commercial role employees with decision-making responsibilities were selected. However, junior and intermediate role participants were also chosen to participate in the study as organisational tensions span across organisational levels and are experienced differently as a result (Jarzabkowski *et al.*, 2013). Hence, participants with junior and intermediate roles were also chosen. Environmental triangulation (Stahl and King, 2020) was achieved by interviewing participants from several CRIs, thereby improving the findings' trustworthiness. The participant pool is depicted in Table II, where participants are differentiated based on role type and role seniority. CRI experience in years and prior background is included to provide further context. Participants provided written informed consent for participation in interviews.

Insert Table II about here

As data analysis was based on Braun and Clarke (2006), data analysis and interviews were concurrent. Participants were interviewed to identify codes that were subsequently grouped into themes or 'repeated patterns of meaning' (Braun and Clarke, 2006, p.86). The authors suggest that themes may be developed through a theoretical approach that is oriented towards research questions. In this case, complete thematic analysis requires relationships to be drawn between codes, themes, prior literature and research questions. Accordingly, interviews were ceased once themes and codes attained sufficient 'depth' to answer the research questions.

Data Analysis

Interview data was recorded, transcribed and thematically analysed following the six-phase guide by Braun and Clarke (2006). To maintain the context of the data, each transcript was analysed separately, and extracts were recorded together with their corresponding interview questions in a sequential manner (Braun and Clarke, 2006). During coding, label assignment was informed by patterns identified in the data and theoretical knowledge on paradox theory. Specific attention was given to identifying Dynamic Equilibrium Model tension types, relationships between tension types, and sensemaking logics. Hence data analysis followed an abductive approach. Following the generation of codes, the third and fourth phases of thematic analysis took place recursively (Braun and Clarke, 2006). Codes were subsequently grouped and categorised into themes and themes were defined. Codes and corresponding themes are detailed in the following section in Table III. The final phase of thematic analysis involved the selection of extract examples (see Table III) and the relation of the analysis back to the research question and literature.

Findings

The findings of this study suggest that CRI biotechnology projects surfaces a range of performing, organising, belonging and learning tension types. Participants engaged with paradox, dichotomous

and business case logics to sensemake tensions. Themes, corresponding codes and illustrative quote examples summarise the findings in Table III.

Insert Table III about here

CRI Biotechnology Tensions

Our findings support prior empirical literature suggesting tensions occur at organisational, team and individual levels (Jarzabkowski *et al.*, 2013). Tensions intersected and co-occurred, consistent with knotted and interwoven tensions identified in prior literature (Sheep *et al.*, 2016). Interrelated tensions were surfaced by the saliency factors of scarcity, plurality and change (Smith and Lewis, 2011) specific to CRI biotechnology. Performing and organising tensions were the most salient for individuals in comparison to belonging and learning tension types.

Theme 1: Uncertain New Zealand Biotechnology Conditions

So, we didn't have a particular template or a success story to follow and that's tricky because you don't have that organizational knowledge about 'here's a project that was similar and we did it this way and this is the outcome'. So, we were kind of going into a bunch of things without necessarily knowing how to approach them and we didn't have the organisational experience or knowledge to draw on.

- Participant 6, senior commercial & scientific role, CRI 1

Uncertain conditions that gave rise to tensions were comprised of three aspects, including cultural, regulatory, and R&D uncertainties. Biotechnology spans multiple emerging sectors that are poorly defined through regulations or established protocols. Uncertain New Zealand biotechnology conditions spurred tensions due to the plurality of stakeholders in CRI biotechnology projects, leading to multiple competing interpretations of goals and strategies (Lewis, 2000). Change was identified as an additional external saliency factor (Smith and Lewis, 2011), as due to shifting regulatory and technological landscapes that complicate science research management. While scarcity (Smith and Lewis, 2011) limited project budgets and created boundary conditions for achieving CRI goals. Our results support prior empirical evidence suggesting that resource scarcity, regulatory issues and technological disruption create uncertain conditions that surface performing tensions (Morais *et al.*, 2018).

Cultural Uncertainty. The CRI research agenda for “improved outcomes for Māori” (Ministry of Business, Innovation and Employment, 2020, p. 14), implicate Māori as a separate CRI stakeholder group. CRI biotechnology projects described by participants often involved collaboration with Māori partners, as certain projects were developed from taonga Māori flora and fauna species.

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3 Taonga is a Māori concept for intangible or tangible assets that require guardianship, as opposed to
4 ownership (Craig *et al.*, 2012). According to participants, the inclusion of taonga in biotechnology
5 projects required the integration of te ao Māori with CRI R&D. Te ao Māori is a holistic, cultural
6 worldview grounded in Māori tradition, whereas scientific research is based in reductionism and is not
7 **well** equipped to embrace cultural worldviews. Furthermore, Māori are a heterogenous group that
8 have varying stances towards biotechnology (Hudson *et al.*, 2019). Hence, CRIs encounter an
9 organisational performing tension between te ao Māori and CRI R&D.
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15 When confronted with the uncertainty of taonga projects, participants experienced belonging
16 and belonging-performing tensions with internal and external stakeholders, as interpretations of te ao
17 Māori varied depending on individual values. Furthermore, once engaged with Māori stakeholders,
18 organising and performing tension types became salient for commercial role participants, as the
19 values associated with te ao Māori required a corresponding cultural approach comprised of unique
20 goals and strategies. Participant 8 noted that cultural approaches “can get a little confusing and a bit of
21 a minefield”, requiring flexibility and deviation from standard CRI R&D practises. For example,
22 Participant 5 recounted that CRI financial and time constraints limited the ability of CRI teams and
23 Māori stakeholders to explore the potential consequences of making taonga genetic material globally
24 accessible. Whereas Participant 4 suggested that intellectual property protection, necessary for
25 successful biotechnology commercialisation, became an issue due to differing definitions of
26 ownership between Māori partners. Therefore, organising tensions co-occurred with learning tensions
27 for participants, as there was no established protocol for engaging with Māori stakeholders, requiring
28 CRI employees to balance new and existing R&D processes.
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38 **Regulatory Uncertainty.** In the absence of regulations for certain biotechnology
39 innovations, CRIs encounter performing tensions between social good and commercial success
40 (Ashby *et al.*, 2019; Bednarek *et al.*, 2017). Without distinct regulatory roadmaps, internal
41 stakeholders struggle to achieve consensus on the prioritisation of public and private interests.
42 Individual interpretations of CRI success implicated team and individual role identities and values,
43 thereby surfacing belonging tensions. Boundary conditions implicate how organisational actors
44 achieve desired outcomes (Smith and Lewis, 2011). Thus, undefined regulatory environments of
45 biotechnology projects spurred multiple stakeholder approaches to research commercialisation,
46 resulting in organising tensions.
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53 Similarly, CRIs perform research in unrealised **scientific** sectors in New Zealand due to
54 regulatory barriers, such as genetic manipulation. The regulations surrounding genetic manipulation
55 restrict CRI engagement with genetic biotechnology research. Yet, research in these fields is
56 necessary to CRIs, as CRIs have a duty to anticipate future solutions to future problems for the benefit
57 of New Zealand (Crown Research Institutes, 2021). Furthermore, the future of genetic modification
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3 regulations in New Zealand is uncertain (Ishii and Araki, 2016). Thus, an organisational level
4 learning-performing tension was surfaced for CRIs between present and future science for the benefit
5 of New Zealand. The management of research and commercialisation activities in unrealised
6 biotechnology sectors surfaces additional organising and organising-performing tensions for CRI
7 decision makers.
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11 ***R&D Uncertainty.*** Scientific endeavours potentiate positive outcomes for society.

12 However, research outcomes are impossible to predict, and scientific endeavours are associated with
13 high investment costs (Edelman, 2004; Vuong, 2018). In our findings, R&D uncertainty surfaced
14 exploration-exploitation learning tensions, similar to those discussed by Andriopoulos and Lewis
15 (2009). Participants grappled with the pursuit of conflicting and interrelated scientific research and
16 commercialisation opportunities. A lack of financial, time and human capital resources restricted the
17 pursuit of multiple scientific and commercial pathways. In part, this reflects the high investment
18 burden associated with life science R&D, commonly known as the *Valley of Death* that life science
19 innovations must cross to reach the market (Kampers *et al.*, 2021).
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27 *Theme 2a: Processes and Goals*

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30 *It always seems that in our projects that we enter, things take a lot longer than what we anticipate ...*
31 *When it goes out to the commercial company, there's then a couple of years of them playing around*
32 *with it, refining the design. And then there's the vagaries of them trying to take it to market, and*
33 *whether they're truly motivated or whether they've got other things to do... Because they've got other*
34 *things that they're shopping around for and doing – and the new commercial product that we see as*
35 *being something really big is maybe not so up their list of priorities, depending on the company.*
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40 - Participant 3, CRI 4, senior commercial role
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43 Consistent with prior literature, participants experienced an overarching organisational
44 performing tension between science impact and science excellence (Bednarek *et al.*, 2017). The shift
45 from being a purely fundamental science focused network to a network of applied and fundamental
46 research institutes occurred over thirty years ago for CRIs (Davenport and Bibby, 2007), yet its effects
47 were still found to ripple through these organisations today.
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51 Participants described an incompatibility between CRI R&D processes, driven by project
52 funding mechanisms, and science impact goals. Performing tensions emerged for commercial
53 personnel as they attempted to make sense of life science projects with few commercial opportunities.
54 Furthermore, when tasked with commercialisation activities, participants found that impact goals were
55 not a perfect fit with existing life science projects, resulting in performing-organising and organising
56 tensions. Participants reported that their ability to commercialise research was affected by a lack of
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involvement from industry stakeholders. For example, Participant 2 discussed the challenges of entering a biotechnology research project in its later stages and pivoting the project towards commercially relevant channels. In turn, organising tensions surfaced performing tensions for participants, as inefficient integration of commercial and scientific research protocols at CRIs raised questions about the overarching purpose of CRIs.

Theme 2b: Role Identity

I guess there was some frustration in the background. You're trying to move things along or things are taking time, but it's outside of your control. And also, working with people in the organization that might not have as much experience with that sort of stuff, so there's almost a bit of hand holding. I'd send them documents to try and get information out of them, but the type of information that they provided wasn't what I needed, so I needed to take a step back and be like – OK well I need to communicate this better and really outline what I need from them.

- Participant 5, CRI 3, intermediate commercial role

Participants in commercialisation focused roles experienced belonging tensions as their role responsibilities were unclear to other stakeholders. Commercial personnel engaged with processes unfamiliar to other project stakeholders to commercialise research. As champions of science impact, commercial personnel collaborate with a range of internal and external stakeholders. When met with resistance from stakeholders, commercial role participants struggled to effectively commercialise scientific research, and experienced belonging-organising tensions.

CRI Biotechnology Sensemaking Logics

Consistent with prior sensemaking literature (Chen *et al.*, 2021; Sharma and Jaiswal, 2017), participants perceived tensions through paradox, dichotomous and business-case logics. Within biotechnology projects, performing and organising tension types were associated with dichotomous and business-case logics, due to resource constraints. In contrast, learning-performing tensions from the management of multiple biotechnology projects over time were interpreted through the paradox logic.

Theme 3: Complexity Reduction Logics Within Projects

In this particular instance, the actual issue is that we can get more of A, less of B. But B is more valuable than A – so there is a trade-off. And then in this case we got to that [stage], and we said – look let's go with this one, we can debate if we go with A or B forever. Someone just had to make a decision that we'll go with A and see what happens. Scientifically it's probably even a spectrum, but we've targeted A or B, otherwise, it gets too complicated.

- Participant 7, CRI 3, senior commercial and scientific role

Within biotechnology projects, commercial personnel encountered multiple co-occurring performing and organising tension types between scientific and commercial pathways and social-environmental-economic CRI missions. Social-environmental-economic missions were viewed as performing tensions by participants and resolved through the business-case logic. Conversely, multiple scientific pathways emerging from a single scientific discovery were perceived both as performing tensions between distinct opportunities and as organising tensions between strategies to achieve CRI goals. According to participants, resource constraints made both-and approaches to opportunities and strategies unachievable. Consequently, participants deferred to the dichotomous logic to interpret performing and organising tensions between scientific pathways, framing them as trade-offs. Similarly, distinct commercialisation pathways facilitated engagement with the dichotomous logic. Participant 1 described commercialisation pathways as “either-or decisions” that do not have a “middle ground”. According to participants, commercial personnel are only involved in projects once research outputs are delivered, as CRI projects are sectioned into funding types with financial and time budgets. This protocol presents commercial personnel with a set of either-or commercialisation pathway decisions bounded by financial and time resources.

Theme 4: CRI Horizons

Taking a longer-term view and training new people to expand and give you more capability, takes longer and costs a bit more, but is something that's necessary if you really want to have good, solid teams with competent skills and not just one person who happens to be really good at something and always does it. So, there are those kind of conflicts between do you take a more holistic view of the organisation, or do you do the fastest route to deliver the outcome from the project? Well, there's always a balance, but unfortunately, the reality is that big projects have [also] got the capacity to absorb a little bit of that individual development and too many small projects just kills you eventually because you can't train anyone, you can't develop staff properly.

- Participant 9, CRI 2, senior commercial role

Senior commercial role participants discussed the challenges of managing short-, medium-, and long-term CRI project horizons. The management of these project types surfaced two tensions. Firstly, learning-performing tensions were surfaced between allocating resources towards improving scientific capabilities to benefit New Zealand’s future and towards present-day success. Similarly, the allocation of resources towards commercialisation activities and scientific research activities surfaced science impact and science excellence tensions. The management of multiple projects required senior commercial role participants to embrace all CRI goals simultaneously. By considering biotechnology

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3 project outcomes from a strategic, temporal perspective, participants perceived relevant learning-
4 performing and performing tensions through the paradox logic.
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8 Discussion

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10 Based on the findings of this study, we provide a revised Dynamic Equilibrium Model tension
11 framework that offers a nuanced perspective on CRI biotechnology tensions, linking tensions and
12 sensemaking logics. The revised tension framework, shown in Figure 1, is divided into two phases.
13 Phase I represents salient tensions as circles and distinguishes between the saliency of tension types
14 by illustrating more salient tensions as larger circles. Hence, performing and organising tensions are
15 represented by larger circles. Furthermore, the framework depicts the interrelatedness of tension types
16 by linking tensions together. Tensions co-occurred; hence all tension circles are linked in the
17 framework, with the exception of learning and belonging tensions, which were not observed to
18 intersect in the data. Additionally, tension types are framed by uncertain New Zealand biotechnology
19 and CRI impact shift conditions, which contribute to tension saliency. These conditions are amplified
20 by scarcity, plurality and change (Smith and Lewis, 2011). The association between conditions and
21 different tension types is represented by Greek alphabetical symbols. R&D uncertainty (α), surfaces
22 learning and performing tensions. Regulatory uncertainty (β) and cultural uncertainty (γ) surface all
23 tension types. Impact shift refers to the ongoing changes related to CRIs embracing science impact
24 and science excellence goals. Changing CRI processes and goals (δ) surface performing and
25 organising tensions. Whereas changing role identities (ϵ) surface belonging and organising tension
26 types.
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38 Phase II in the framework links salient tensions of Phase I to sensemaking logics.
39 Dichotomous and business-case logics are shown as opposite to paradox logics on a spectrum. As
40 resource constraints intensify, illustrated by the red arrow, individuals tend towards dichotomous and
41 business-case logics. Organising-performing tensions are associated with dichotomous and business-
42 case sensemaking due to the intense resource constraints that accompany organising and performing
43 tensions. As resource constraints recede, represented by the blue arrow, individuals tend towards
44 paradox logics. Due to fewer resource constraints, learning-performing tensions are associated with
45 the paradox logic.
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53 Insert Figure 1 about here

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Theoretical Implications Contributions

The empirical findings of this study demonstrate that CRIs experience a range of performing, organising, belonging and learning tensions when engaging with the biotechnology industry. Hence, our findings address the knowledge gap on paradoxical tensions in different contexts (Schad *et al.*, 2016). Based on these findings, we generate **five** three-propositions. The findings of this study support prior literature that suggests hybrid R&D organisations experience organisational performing tensions between social good and commercial success (Ashby *et al.*, 2019; Bednarek *et al.*, 2017), as well as applied science and fundamental science (Ashby *et al.*, 2019; Keller *et al.*, 2020). However, our findings also demonstrate that CRIs experience two additional performing tensions at an organisational level in a biotechnology context. Firstly, there are temporal learning-performing tensions, between performing science to benefit New Zealand in the present and the future. Secondly, there are cultural performing tensions, between te ao Māori and CRI R&D. This finding opens up an avenue for future research, as little is known about the paradoxical tensions between cultural and scientific approaches in hybrid environments. Consequently, the first proposition is generated:

Proposition 1: When engaging with New Zealand's emerging biotechnology industry, CRIs experience organisational performing tensions that extend beyond tensions between commercial success and social good or science impact and science excellence. Such as cultural tensions between te ao Māori and CRI R&D, and temporal tensions between future and present success.

The four organisational performing tensions identified by this study are associated with further organising, belonging and learning tensions at team and individual levels. Our findings differ from prior literature that identifies **where** distinct tension dynamic patterns at different organisational levels **are identified** (Jarzabkowski *et al.*, 2013), likely due to contextual differences between the biotechnology projects discussed by participants. ~~Furthermore, our research is situated in an emerging industry context (Smith and Tracey, 2016).~~ Unlike prior hybrid R&D literature (Ashby *et al.*, 2019; Bednarek *et al.*, 2017; Keller *et al.*, 2020) tension types were found to intersect and co-occur; hence they could not be definitively separated in our analysis. Therefore, the revised framework reflects that CRI biotechnology tensions are interconnected and inherently complex. Complex tensions were associated with interrelated environmental conditions, including CRI biotechnology uncertainty and impact shift. Uncertainty is inherent to scientific R&D and the regulatory and cultural environments of CRI biotechnology. While impact shift conditions reflect ongoing institutional changes affecting organisational structure of CRIs. The external saliency factors of change, plurality and scarcity described by Smith and Lewis (2011) amplify the conditions that surface tensions. Consequently, we enrich prior literature by identifying environmental conditions that give rise to **complex organisational** tensions (Sheep **Schad** *et al.*, 2016) in emerging fields (Smith and Tracey, 2016) and contextualise the saliency factors that give rise to Dynamic Equilibrium Model tension types (Miron-Spektor *et al.*,

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3 2018). Furthermore, our findings identify the environmental conditions that surface complex tensions
4 (Sheep et al., 2016). The revised framework further addresses the isolation issues suggested by Pina e
5 Cunha and Putnam (2019) by providing a holistic perspective on tension categories that emphasises
6 the interconnectedness of paradoxical tensions. As a result, the second proposition is generated:
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10 Proposition 2: Amplified by scarcity, plurality and change, CRI biotechnology is fraught with
11 interrelated environmental conditions including regulatory, cultural, and R&D uncertainty, and impact
12 shift, ~~that~~ which give rise to interconnected performing, organising, belonging and learning tensions.
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15 Although the Dynamic Equilibrium Model divides tensions into four equal categories,
16 performing and organising tensions were more salient. As participants discussed the same
17 organisational goals, performing tensions were more inherent to the shared organisational reality of
18 CRIs and therefore more salient to participants. Conversely, organising tensions were more varied
19 between individuals. However, tensions between different approaches and processes towards
20 achieving CRI goals were highly prevalent. Prior literature in similar settings has identified
21 performing and belonging tensions as more salient to individuals (Keller et al., 2020). Conversely, our
22 findings suggest that belonging and learning tensions are less salient and are surfaced alongside
23 performing or organising tension types. These differences are likely due to the situatedness of tensions
24 (Schad et al., 2016; Smith and Lewis, 2011). Additionally, our findings show that commercial CRI
25 personnel experience belonging tensions related to role identity, extending prior hybrid R&D
26 literature (Ashby et al., 2019; Keller et al., 2020). Therefore, the revised framework builds on the
27 Dynamic Equilibrium Model by making the saliency of different tension types explicit. As a result,
28 the third proposition is generated:
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38 Proposition 3: Performing and organising tensions are more salient in CRI biotechnology than
39 belonging and learning tension types.
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42 Additionally, this study contributes to paradox sensemaking literature by linking sensemaking
43 logics with Dynamic Equilibrium Model tensions. Based on these findings, we generate two further
44 propositions. Firstly, biotechnology tensions were perceived through three sensemaking logics:
45 paradox, dichotomous and business-case. In contrast to prior literature based on sustainability tensions
46 (Lashmar et al., 2023; Sabini and Alderman, 2021), the business-case logic was less common because
47 performing tensions between social, environmental and economic goals were not always relevant to
48 CRI biotechnology. Instead, the dichotomous logic was engaged by participants to eliminate
49 organising and performing tension types in commercialisation and scientific pathway decisions within
50 projects, and therefore conserve resources and mitigate risk. Hence, the revised framework depicts a
51 sensemaking phase that shows the three logic types and associates logics with Dynamic Equilibrium
52 Model tensions. Similar to prior findings, we draw a connection between learning-performing
53 tensions to paradox logics (Miron-Spektor et al., 2018). Our findings extends prior knowledge on
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3 sensemaking logics and Dynamic Equilibrium Model tensions by linking performing, organising and
4 performing-organising tensions to dichotomous logics. Consequently, the fourth proposition is
5 generated:
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9 Proposition 4: CRI biotechnology tensions are sensemade through three logics. The paradox
10 logic is engaged to sensemake temporal learning-performing tensions. Within biotechnology projects,
11 commercialisation and scientific pathway performing-organising tensions are sensemade through the
12 dichotomous logic. Performing tensions between social, environmental and economic concerns are
13 sensemade through the business-case logic.
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17 The three logics co-existed as participants did not adhere to a single specific logic. Therefore,
18 our findings do not support the view that logics are a fixed sensemaking mechanism that individuals
19 adhere to over time (Hahn *et al.*, 2014). Instead, our findings reflect prior empirical literature that
20 suggests individuals deviate between sensemaking logics based on perception of resources (Sharma
21 and Jaiswal, 2017). Resource constraints pertaining to project time and finances influenced whether
22 participants engaged with dichotomous and business-case logics or the paradox logic to sensemake
23 tensions. **Therefore, the revised framework depicts logics on a spectrum mediated by resource**
24 **constraints.** These findings support prior literature that sensemaking is influenced by contextual
25 conditions (Klarin and Sharmelly, 2021). Therefore, **our findings this study** extends our understanding
26 of sensemaking logics and elaborates on the contextual conditions that influence them **logics in a**
27 **novel context** (Al Hasan and Micheli, 2022; Andriopoulos *et al.*, 2018; Miron-Spektor *et al.*, 2011).
28 As a result, the final proposition is generated:
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37 Proposition 5: Sensemaking logics co-exist on a spectrum, mediated by resource constraints.
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39 **In summary, the propositions and revised framework make several contributions to paradox**
40 **theory and sensemaking scholarship. By identifying two additional organisational-level CRI tensions,**
41 **P1 contributes to knowledge on paradox theory tensions in hybrid R&D organisations engaging with**
42 **emerging technological industries. Furthermore, P1 contributes to paradox theory by introducing a**
43 **cultural R&D tension that is novel to paradox theory. P2 contributes to paradox theory by supporting**
44 **tension complexity in paradox theory and addresses knowledge gaps pertaining to the environmental**
45 **conditions that give rise to organisational tensions. P3 reveals the nature of salient tensions in CRI**
46 **biotechnology R&D and therefore contributes to knowledge on Dynamic Equilibrium Model tensions**
47 **in hybrid R&D organisations. P4 contributes to sensemaking literature by identifying dichotomous**
48 **and paradox logics in the novel context of CRI biotechnology, as prior literature predominantly**
49 **examined logics from a sustainability perspective. Furthermore, sensemaking logics are associated**
50 **with Dynamic Equilibrium Model tensions, contributing to our understanding of the relationship**
51 **between paradox theory and sensemaking. Finally, P5 contributes to sensemaking literature by**
52 **showing that sensemaking logics are mediated by resource constraints in hybrid R&D contexts.**
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Practical Implications

The findings of this study present practical implications for tension management in hybrid R&D organisations engaging with emerging technological industries. Firstly, the revised tension framework raises awareness of paradoxical tensions in hybrid R&D environments (Pina e Cunha *et al.*, 2024). Secondly, the revised framework indicates that tension management should be holistic, due to the interrelatedness of tensions and environmental conditions. Practitioners may address tensions holistically by mitigating the environmental conditions that surface tensions. For example, providing expert opinion to support commercialisation personnel in navigating uncertain cultural and regulatory contexts of biotechnology projects. Secondly, the prevalence of performing and organising tensions suggests that CRIs and similar hybrid R&D institutes may benefit from more flexible processes for achieving organisational goals. For example, flexibility in timing commercialisation team entry points to research projects may increase time resources and thereby encourage engagement with the paradox logic to sensemake commercialisation and scientific pathway decisions. Biotechnology is an inherently innovative field, and engagement with the paradox logic improves organisational creativity and innovation (Miron-Spektor *et al.*, 2018). Therefore, practitioners may benefit from strategically engaging with the paradox logic by managing resource constraints. Thirdly, financial and time scarcity conditions remain a primary factor in the saliency of CRI biotechnology tensions. **Scarcity conditions** limiting their mitigation of **tensions** through the paradox logic. Financial constraints may result in poor performance across environmental and social goals (Amoah and Eweje, 2022; Mohamad Ariff *et al.*, 2024). Consequently, change is required at an institutional level to improve CRI access to financial resources so that CRIs may better support emerging technological industries.

Conclusions, Limitations and Future Research

This study reveals that CRI biotechnology projects R&D surfaces complex performing, organising, belonging and learning tension types due to interrelated environmental conditions unique to New Zealand's biotechnology sector and the CRI network. The empirical findings of this study present several theoretical contributions to paradox theory and sensemaking logics literature.

However, this study has some limitations. The primary limitation of this study is its generalisability or transferability to other contexts. The tensions investigated by this study are highly situated in New Zealand's CRI biotechnology context. As a result, the tensions and logics identified by this study may not be reflective of the tensions surfaced and their associated logics in other types of organisations or industries. Organisations that have a similar hybrid business model and R&D focus to CRIs, such as PRIs in other countries, may not experience the same tensions or logics identified by this study, as other countries may have a different set of biotechnology and science ecosystem conditions. Subsequently, future research may investigate the relevance of the revised

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3 framework to other organisations and R&D industries. Similarly, this study identified novel cultural
4 tensions. Future research may investigate te ao Māori tensions further in hybrid R&D environments or
5 investigate cultural R&D tensions in other countries, as cultural tensions in R&D are not well
6 understood in paradox literature. Finally, the scope of this study was limited to investigating salient
7 tensions and sensemaking logics. As the findings of this study identified a relationship between time
8 and logics, future longitudinal research may further investigate tension responses and outcomes and
9 connect them to Dynamic Equilibrium Model tensions and sensemaking logics.
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Table I*Dynamic Equilibrium Model Tension Types and Examples*

| Tension | Adapted Smith & Lewis (2011) definition | Example from hybrid R&D environment | Example source |
|----------------|---|---|--|
| Performing | Tensions between competing goals or strategies. | Tension between performing scientific activities to achieve public good and commercial success goals. | (Ashby et al., 2019; Bednarek et al., 2017) |
| | | Tension between science excellence or fundamental science and science impact or applied science goals. | (Bednarek et al., 2017; Keller et al., 2020) |
| Belonging | Tensions between competing identities and roles. | Tension between traditional, fundamental-science focused scientific identity, and entrepreneurial, applied-science or commercially-focused scientific identity. | (Ashby et al., 2019; Keller et al., 2020) |
| Organising | Tensions between competing processes to achieve a desired outcome. | Tension between commercial and scientific activities associated with hybrid R&D work. | (Keller et al., 2020) |
| | | Tension between communicating research scientifically or commercially. | (Ashby et al., 2019) |
| | | Tension between research publication and research commercialisation. | (Ashby et al., 2019) |
| Learning | Tensions between the integration of new knowledge and the destruction of the old. | Tension between knowledge exploration through scientific research and knowledge exploitation for research commercialisation. | (Keller et al., 2020) |

Table II
Interview Participants

| Participant | CRI | Role type | Seniority | CRI experience (years) | Background | Interview duration (mins) |
|--------------------|------------|-------------------------|------------------|-------------------------------|----------------------|----------------------------------|
| 1 | 2 | Commercial | Intermediate | 5-10 | Business | 32 |
| 2 | 2 | Commercial | Junior | <1 | Business and science | 31 |
| 3 | 4 | Commercial | Senior | 10-20 | Business and science | 36 |
| 4 | 2 | Commercial | Senior | <1 | Business and science | 43 |
| 5 | 3 | Commercial | Intermediate | 5-10 | Business and science | 39 |
| 6 | 1 | Commercial & Scientific | Senior | 20+ | Science | 26 |
| 7 | 3 | Commercial & Scientific | Senior | 10-20 | Science | 28 |
| 8 | 3 | Commercial & Scientific | Senior | 20+ | Science | 32 |
| 9 | 2 | Commercial | Intermediate | 5-10 | Business and science | 37 |
| 10 | 1 | Scientific | Senior | 5-10 | Science | 31 |

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Table III
Themes, Codes and Quote Examples

| Theme | Codes | Participants | Illustrative Quote Examples |
|--|---|------------------|--|
| 1. Uncertain New Zealand biotechnology conditions Tensions: Performing, belonging, organising, belonging-performing, organising-performing, learning, belonging-organising, learning-organising, learning-performing | Cultural uncertainty | 4, 5, 8 | Q: <i>Even people within your own project team would have different backgrounds, different values, different norms around that and acceptance of something being or not being [a cultural issue]. Its putting a lot of scientists off in terms of progressing some of the science projects. [Participant 4, CRI 2, senior commercial role]</i> |
| | Regulatory uncertainty | 8, 9 | Q: <i>So if you're CRI then it's kind of difficult because we are required to keep customers happy and generate income. In the work that [the CRI does], very seldom is that defined by a regulatory environment, as perhaps it would be if you are developing a pesticide or a medicine or whatever. So it's not like you can just say no, we do what we do, what we absolutely have to, and it's predefined and it's the standard. [Participant 9, CRI 2, senior commercial role]</i> Q: <i>It was probably less about the disagreement and more about the uncertainty, and that was a part for each person involved in the decision-making or involved in the project to come to terms with around stepping into that unknown – could we? What would happen if we did? What would happen if we didn't? [Participant 6, CRI 1, senior commercial & scientific role]</i> |
| | R&D uncertainty | 6, 10 | |
| 2. CRI impact orientation shift 2a. Process and goals Tensions: Organising, performing, organising-performing 2b. Role identity Tensions: Belonging, belonging-organising, performing | CRI process disconnect with industry goals | 1, 2, 3, 4 | Q: <i>So, we have this struggle that when we apply for internal money, even if it's a small amount, like, how do you see this progressing to commercialisation and making a thing we can put in a box and– no idea and I don't care, because we need to do this fundamental research to better our knowledge, to better human health, the environment, whatever. But unless we're supporting this fundamental research – we're not going to get anywhere. [Participant 10, CRI 1, senior scientific role]</i> Q: <i>So, there's nobody that I saw, in the big list that we had, that was an open invitation to try – 'we'll just try any compounds that are possible if only we've got a means of screening them'. No. People tend to have something that they think would work and then they set up a company and get venture capital and run with it for a while. [Participant 3, CRI 4, senior commercial role]</i> Q: <i>And then there was some expectation around coming to the commercialisation office to identify what the highest value chemical is, which in and of itself is too big of an ask of a question. There's too many. [Participant 5, CRI 3, intermediate commercial role]</i> |
| | Impact fit on science | 1, 10 | |
| | Organising tensions surface performing tensions | 1, 2, 10 | |
| | Murky commercial roles | 2, 4, 5, 9 | |
| | Resource-constraint pathway logic | 1, 3, 5, 6, 7, 8 | Q: <i>It's an either-or, if you go start up approach then you've got to be all in, right? Like you've got to raise money and do that whole thing. If it's licensing, then, once you license it, you've</i> |

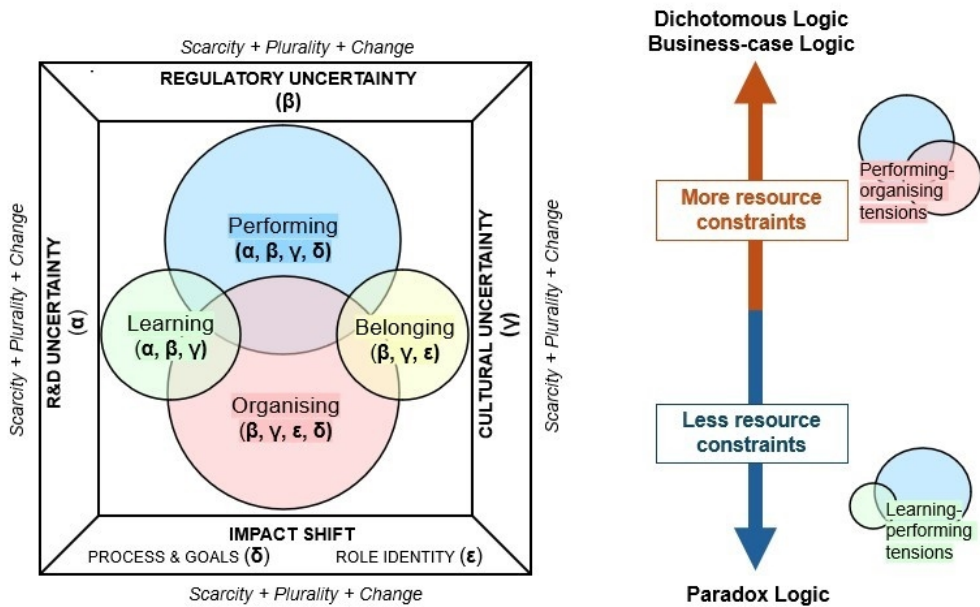
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|---|---|-------------------|--|
| <p>3. Complexity reduction logics within projects</p> <p>Tensions: Performing, organising, organising-performing</p> | <p>Performing tension elimination through business case logic</p> | <p>3, 5, 8, 9</p> | <p><i>got to work with that partner as well.</i> [Participant 1, CRI 2, intermediate commercial role]</p> <p><i>Q: Everyone tends to have an opinion on the way to investigate a hypothesis and ultimately, you've got to decide on one way or the other that you're going to do something. Just your lack of resources, time, money, people.</i> [Participant 8, CRI 3, senior commercial & scientific role]</p> |
| | <p>One tension gives rise to another</p> | <p>6, 9, 10</p> | <p><i>Q: Some of the social and environmental positives underpin the whole basis for the business.</i> [Participant 3, CRI 4, senior commercial role]</p> |
| <p>4. CRI horizons</p> <p>Tensions: Performing, learning-performing</p> | <p>CRI ahead of industry</p> | <p>7, 8</p> | <p><i>Q: And I guess where there was a little bit of conflict, was not the fact that it could be licensed, but the fact that the active licensing would bring with it a considerable amount of restraint of trade in terms of future research opportunities, which may or may not have been more valuable than the actual licensing deal... Everybody's trying to get revenue and run a successful business, but one can prevent the other.</i> [Participant 9, CRI 2, senior commercial & scientific role]</p> <p><i>Q: So that was short-term gain because [a different CRI team] wanted to, but it probably wasn't strategically wise in the long-term to notify the rest of the world and the competition that we are doing this, but we don't have any patents in place yet and we're not close to launching a product.</i> [Participant 2, CRI 2, junior commercial role]</p> <p><i>Q: I guess the difference here was that, organisationally, we saw the potential and the value to New Zealand and mankind in the sustainable options. And then to work with people who don't necessarily see that, for example, who would say – why do we need to make stuff out of [these] resources? We're not going to run out of oil.</i> [Participant 7, CRI 3, senior commercial & scientific role]</p> |
| <p>Role responsibilities influence tension interpretation</p> | <p>3, 4, 5, 10</p> | | |
| <p>Strategic IP tension</p> | <p>2, 6, 9</p> | | |
| <p>Science excellence-impact paradox</p> | <p>6, 7, 9</p> | | |

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Phase I – Tension saliency → Phase II – Sensemaking



Revised Dynamic Equilibrium Model Tension Framework

270x191mm (72 x 72 DPI)

Appendix A: Interview Guide

a. Introductory Questions

1. *What is your role at this CRI? Is this the only role you've had here?*
2. *How long have you been employed here?*
3. *Have you participated in many life-science projects or very few?*
4. *What is your professional/academic background?*

b. Performing

1. *Was there a situation where you had different opinions with others [stakeholders] while working on a [specific] life-science project?*
2. *Can you describe the situation and why there were different opinions?*
3. *What do you think of these opinions and how do you understand them?*
4. *Do you see them as more conflicting or complementary?*
5. *How do you understand the relationship between the opinions?*

c. Organising

1. *In life-science projects, have you found that you had different approaches to others [stakeholders] on how to achieve success?*
2. *Can you describe the situation and what the different approaches were?*
3. *What do you think of these approaches and how do you understand them?*
4. *Do you see them as more conflicting or complementary?*
5. *How do you understand the relationship between the approaches?*

d. Belonging

1. *Have there been situations in life-science projects where you found you had different values, assumptions, or norms to people you're collaborating with?*
2. *Can you describe the situation and what the different values, assumptions, or norms were?*
3. *What do you think of these values and how do you understand them?*
4. *Do you see them as more conflicting or complementary?*

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3 5. *How do you understand the relationship between the values/assumptions/norms?*
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5 e. Learning
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7 1. *In life science projects, have you found it challenging to accommodate short term and long-*
8 *term considerations?*
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11 2. *Can you describe the situation and what the different considerations were?*
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13 3. *What do you think of these considerations and how do you understand them?*
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15 4. *Do you see them as more conflicting or complementary?*
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17 5. *How do you understand the relationship between them?*
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19 f. Snowballing
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22 • *Do you know anyone else from commercial or scientific teams who have been involved in life-*
23 *science projects who I can speak to?*
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