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Pathways to transformative innovation?

Examining the administrative micro-foundations of net-zero missions across 14 OECD countries

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Pathways to transformative innovation? Examining the administrative micro-foundations of net-zero missions across 14 OECD countries

Iacopo Gronchi

Abstract:

In the face of climate change, governments are committing plentiful resources to 'net-zero missions': ambitious industrial & innovation strategies that aim to accelerate dramatic reductions in greenhouse gas emissions. Yet, there is confusion among researchers and practitioners on missions' ability to yield the promised results. Against this background, this paper leverages a new theoretical framework and original survey data to lead a fuzzy-set Qualitative Comparative Analysis of 35 net-zero missions implemented in 14 OECD countries. By doing so, it compares the administrative micro-foundations of their strategies to assess: first, whether net-zero missions entail relevant changes in management, governance, and policy practice; and second, whether these are linked with intended outcomes. The exploratory analysis shows that, while there is no 'one-size-fits-all' blueprint for net-zero missions, two generalizable 'pathways' to transformative innovation are detected: interventionist (grounded in relationships of dynamic accountability between the public and the private sector) and facilitative (grounded in policy incentives for the formation of innovation commons). However, both pathways imply that effective industrial strategy is always underpinned by a public management able to empower dynamics of 'strategic learning' within their organisation – thus bolstering net-zero missions' ability to cope with uncertainty by embedding experimentation throughout their implementation.

1. Introduction

Across the world, governments are reappraising the role of industrial policy to champion sustainable development[i], tackle long-term challenges such as the twin transition[ii], and fight against multiple crises[iii]. These trends fed into the rise of 'missions': coordinated sets of research and innovation policy through which the state takes a proactive role in steering socio-technical change by setting bold time-bound objectives[iv]. Missions represent a distinctive version of a new generation of industrial and innovation policies that aim not only to enhance the performance of a given economy, but also orient its direction towards broader societal goals[v]. Within current scholarship, there is a shared understanding that effective industrial strategy is based on state capacity[vi]. Indeed, extant literature clearly indicates that implementation is key to any policy[vii]– including industrial and innovation policy[viii]. However, there is limited evidence of how missions work in practice[ix].

Recent studies explore how public sector organisations (PSOs) try to adopt a more 'transformative' role[x] ; how their administrative heritage may impose key constraints on this ambition[xi]; and how such new practices may be 'anchored' in a PSO in order to remove them[xii]. But there remains no consensus about how to assess the implementation dynamics that underlie mission design and delivery[xiii]. As a result, the empirical analysis of mission success or failure is in its early stages – particularly in comparative perspective. On the one hand, most studies only focus on sub-aspects of mission implementation and leverage critical cases with little external validity[xiv]. On the other, critiques fail to provide strong evidence of what works and how[xv].

In the lack of a consolidated approach for how to "take [mission] implementation more seriously"[xvi], this paper argues that the progress of the debate upon missions lies in a theoretical identification and empirical assessment of the administrative 'micro-foundations' of effective mission implementation – and, therefore, public sector capacity. Micro-foundations can be defined as the "proximate causes of a phenomenon […grounded] at a level of analysis lower than the phenomenon itself"[xvii]. In this paper, they refer to the multi-level dynamics of administrative change that a mission shall trigger within in order to fulfil its stated purpose. To develop such an approach, the paper asks these interlinked research questions:

> *RQ. What micro-foundations are necessary, and what combinations of micro-foundations are sufficient for the successful implementation of missions?*

As missions are a new approach to most PSOs, their adoption asks for public innovation both in policy design and PSOs' underlying routines and capabilities[xviii]. As such, mission implementation analysis requires a multi-level approach to show whether changes in policy are reflected in new ways of working within PSOs' routines and new governance processes in PSOs' relationship to their partners[xix]. To provide such an approach, this paper aims to analyse mission implementation with a new framework of public sector innovation: 'Embedded Experimentalism' (EE)[xx]. EE is a new synthesis of extant scholarship, through which I hypothesise, operationalise, and test three micro-foundations of effective missions: *strategic learning* as a form of deliberation within the PSO[xxi]; *dynamic accountability* as an organisational structure for multi-actor coordination[xxii]; and *innovation commons* as a set of incentives for participation[xxiii].

While extant literature focuses on organisational[xxiv], governance[xxv], or systemic change alone[xxvi], EE proposes a programme logic that captures each of these layers and their reciprocal interactions. As such, EE can be used to assess the administrative micro-foundations of any given mission (i.e., 'is this mission *actually* a mission?') and whether those shape missions'

ability to meet its desired goal (i.e., 'is the mission *successful*?)'. The paper aims to test two rival hypotheses:

> *H1. All micro-foundations underlying EE are necessary for successful mission implementation.*
>
> *H2. Different configurations of micro-foundations underlying EE are sufficient for successful mission implementation.*

Taking inspiration from Douglas *et al.*, (2020)'s approach[xxvii], the paper tests these propositions with a fuzzy-set Qualitative Comparative Analysis (fs-QCA): a formalised method for the exploration of complex causal mechanisms in medium-N settings[xxviii]. QCA is peculiarly apt to this study for two reasons: first, due to its ability to support the modelling and assessment of multiple and interrelated conditions (EE) affecting a phenomenon (innovation); second, as it helps overcome the limitations of extant small-N studies of missions built on critical case studies (limited external validity) while retaining strong empirical nuance. The fs-QCA is based on new data gathered through an original survey co-led by the author and the OECD which studied the implementation of missions targeting Greenhouse Gas emission reductions across OECD countries – hereby defined as 'net-zero' missions. The survey covered 35 net-zero missions implemented at the time of writing by 13 national governments and 1 international organisation (EU) and has been administered through 59 expert interviews. Based on the data gathered through the survey and additional desk research on each mission, the fs-QCA identifies both necessary and sufficient (combinations of) micro-foundations of effective missions among the ones specified by EE.

Overall, the paper aims to increase our shared understanding of effective industrial strategy in three ways: i) by articulating and testing a programme logic that can be leveraged within industrial and innovation policy design and evaluation to strengthen present and future action; ii) by providing the debate a new empirical foundation to start doing so – i.e., a new database and analytical approach to net-zero missions; and iii) by shedding new light on the neglected, yet essential role of strategic management of the public sector within effective mission implementation. As a result, it provides exploratory evidence that administrative micro-foundations play a major role in net-zero missions.

The second section of the paper builds on extant literature to define EE; outline its micro-foundations (management; governance; policy) and scope conditions (context; results); and operationalise them. The third section articulates the study's research design by summarising its analytical framework; presenting the data gathered via the survey; introducing the fs-QCA method; and presenting the rationale for data calibration and case selection. The fourth section shows the results of the QCA by identifying necessary and sufficient micro-foundations for effective mission implementation. Last, the fifth section discusses the results of the study; its limitations; and avenues for future research.

2. Defining Embedded Experimentalism

A question haunts contemporary innovation and industrial policy scholarship: 'how'. After decades of stagnation, there is a newfound demand for and supply of frameworks, policy tools, and ideas to support PSOs' attempts to transform society and economy through the green and digital transition – including, notably, via missions[xxix]. Yet, only rarely do these efforts translate into evidence of real impact. This is due to many reasons: the long-term goals of missions limit our ability to assess short-term progress[xxx]; the fragmentation in language used to operationalise them hampers knowledge accumulation[xxxi]; and their complexity escapes traditional evaluation methods[xxxii]. Underlying all these challenges, there seems to lie a fundamental lack of granularity in defining and assessing their implementation dynamics: indeed, research and policy communities often perceive missions as a broad philosophy of governance but rarely grasp its implications for public strategy. This insight can be substantiated by considering the extant literature on missions at three distinct, yet inter-dependent levels of analysis: policy, governance, and management strategy.

1. *Policy strategy*. A growing literature aims to provide guidance to PSOs using missions[xxxiii]. Yet, policymakers still report profound unclarity about how to specify it into distinct policy features – e.g., targets, policy mixes, or evaluation approaches[xxxiv].

2. *Governance strategy*. Beyond the plea for multi-actor experimentation[xxxv], available research offers PSOs only early ideas for how to ensure that collaboration is paired with accountability – e.g., the duty to invest public money in ways that are legitimate, despite the uncertain nature of innovation processes[xxxvi].

3. *Management strategy*. Even as scholars acknowledge the role of PSOs' dynamic capabilities in mission implementation[xxxvii], there is still limited insight on where they come from; how they operate in practice; and how they can be nurtured proactively within any given PSO[xxxviii].

A byproduct of this fuzziness is the risk for missions to become 'boundary objects' with different meanings for different actors[xxxix]. On the one hand, this may favour their diffusion: thanks to their malleability, missions may be used as a narrative to advance policy change in different contexts. On the other, this may risk hampering knowledge accumulation on how missions work – if not dilute their meaning and slipper into 'mission washing'. Despite early attempts[xl], researchers and policy makers still lack a shared language to evaluate missions and thus foster collective learning. While the literature keeps expanding missions' ambition, there is still little work mapping and diagnosing implementation[xli]. In this context, two goals seem key to the progress of scholarship. The first goal is to develop a definition of mission implementation to specify how a 'mission-oriented' approach differs from a 'traditional' one beyond high-level principles and in 'nitty-gritty' design and implementation. The second is to test the link between implementation and success: *how* missions work – if they do at all. Tackling both issues therefore requires a probing definition of both mission implementation ('what is a mission?') *and* mission success ('if the case is a mission, how to gauge its success?').

Doing so is far from easy. The first challenge is system complexity: as previously observed, mission implementation cuts across policy, governance, and management – wherein each presents attributes with a distinctive impact. The second is empirical diversity: missions are often layered on pre-extant, context-specific institutional settings that shape implementation[xlii]. This is a conundrum for analysis and evaluation: system complexity requires greater granularity

to empower case study analysis; yet empirical diversity requires greater abstraction to enable comparative analysis. Navigating it entails developing a 'middle ground theory' of missions where operationalisation can be granular enough as to enable strong hypothesis testing, and yet abstract enough as to allow for comparative analysis. The reward for tackling this conundrum lies in the possibility to strengthen our knowledge of missions by satisfying complementary epistemic needs still to be covered in the literature: namely, stronger internal validity (case-specific causal inference); and external validity (generalizable causal inference).

To do so, I adopt an abductive approach called 'systematic combining'[xliii]. Akin to the efforts of Elinor Ostrom[xliv] and other top governance scholars[xlv], systematic combining straddles a third way between inductive and deductive reasoning by iterating a preliminary definition of a concept under study via exploration of the case studies it aims to cover[xlvi]. Accordingly, the concept of mission is hereby operationalised based on the results of the literature review – here synthesised as 'Embedded Experimentalism' (EE) – as well as on the data gathered via the survey behind this research. The first source serves to identify three micro-foundations of mission implementation (here serving as independent variables) and two conditions defining its operating context and intended results (dependent variables). The second source helps calibrate these five components into more granular proxies – hence triggering further theoretical development and strengthening empirical analysis.[1] The result was the articulation of EE into a multi-level framework of public sector innovation that includes 18 sub-components and 36 indicators. The remainder of this section describes each of these component (see also Appendix A), paving ground for a new empirical strategy to assess mission implementation and success. [2]

2.1. Context: Strategic uncertainty

By definition, missions aspire to tackle ambitious societal challenges. In policy sciences, a societal challenge is understood in terms of the degree of structure imposed on its problem definition and on its potential solution[xlvii]. Its 'wicked' character arises from the difficulty of stakeholders attending the policy process to converge on a shared definition of a feasible problem-solution coupling[xlviii]. This is especially true for today's missions – the breadth and depth of which is relatively higher than traditional industrial and innovation policy. In this view, the context of the policymaker leading a mission can defined as strategic uncertainty: the inability to know how to pursue the mission before implementation[xlix]. There are three main reasons why this could be the case: epistemic ignorance; organisational complexity; and political contestation[l].

i. *Epistemic ignorance* is the lack of sufficient/actionable knowledge on how to define a problem or develop a solution to it[li].

ii. *Organisational complexity* is the noise aroused in mission implementation by gaps in horizontal and vertical coordination within or beyond the leading PSO[lii].

iii. *Political contestation* is the presence of multiple framings by different actors competing for shaping the focus of a mission[liii].

The implication is that strategic uncertainty is not intrinsic to aby societal challenge, but to the complexity of the epistemic, organisational, political context behind its problem-solution

1 For more detail on the mechanics of this process, see Section 3.3 on 'data calibration'.

2 It is important to observe that the results of systematic combining claim no completeness and are open to future revision, thus serving two developments: first, as a framework enabling progress in mission implementation research; second, as a starting point to integrate future developments in mission implementation theory and practice within it.

space[liv]. As such, 'challenge-solving' is defined as iterative adjustment among competing views, roles, and interests rather than as clear, linear, and technocratic process. The next sub-sections identify three micro-foundations ('M1-2-3') on how such dynamics may be navigated.

2.2. M1: Mission management as strategic learning

The role of management in the implementation of industrial strategy is highlighted for two reasons: first, due to the authority of public managers in the "promotion and protection of the values" that reflect and propel their PSOs' mandate[lv]; second, due to the latitude they enjoy influencing in many ways the deployment and evolution of the routines behind strategy implementation[lvi]. Researchers are exploring how public managers could spark change within a PSO by looking at their dynamic capabilities[lvii], transformative capacity[lviii], organisational processes[lix]. Yet, neo-institutional theory has long time distilled four 'design principles' showing how norms evolve in a PSO when pursuing a new organisational goal[lx].

i. *Managerial directionality* reflects the ability to lead a PSO towards a new mission while safeguarding its identity[lxi].

ii. Managerial experimentation reflects the ability to facilitate trial-and-error in the PSO to pursue practices in line with a new mission[lxii].

iii. Managerial learning reflects the ability to monitor the rise of new practices and steer the process of their implementation within the PSO[lxiii].

iv. Managerial revision reflects the ability to embed new practices within the PSO and the broader institutional environment[lxiv].

Altogether, these principles can be synthesised into a distinctive management strategy for missions – i.e., its first micro-foundation (M1). This is named *strategic learning* for its focus on embedding a new set of 'mission-oriented' routines within the PSO leading the mission by mobilising extant routines toward a new organisational goal[lxv]:

> *M1. Mission management leverages strategic learning to mobilize the PSO's routines towards a new organisational goal[lxvi].*

In other words, M1 suggests that, to cope with strategic uncertainty, public managers must lead their PSO towards the routinisation of the experimentalist processes that lie at the core of effective policy implementation and, more broadly, institutional capacity building. Without strategic learning, the use of 'mission' as policy label may not be reflected in real change of how public action is carried on. Conversely, when strategic learning happens, the PSO may start growing new routines and support the adoption of a governance *and* policy strategy coherent with a mission-oriented approach. The next sub-section explores the first of these two levels.

2.3. M2: Mission governance as dynamic accountability

The role of governance in effective industrial strategy is broadly recognised as paramount to success. This is peculiarly relevant to missions, the very logic of which relies on a multi-stakeholder effort that requires the coordination of complex systems[lxvii] and hence the development of shared rules of conduct among its participants[lxviii]. In this perspective, missions demand PSOs to bolster actor-led experimentation and use it to revise their problem-solution definition iteratively[lxix]. This runs against traditional accountability rules of PSOs, which often pursue rigid objectives in hierarchical ways[lxx]. To close this gap, researchers are exploring how mission governance can be organised in 'transition tasks'[lxxi] or 'innovation bureaucracies'[lxxii]. Yet, governance theory shows that accountability rules that welcome decentralized experimentation are widespread across the public sector[lxxiii]. At the core of these relationships lie four 'functions'

which can be identified as follows[lxxiv]:

i. *Governance directionality* is the identification of a consensus among mission partners about the purpose and ultimate goal of their joint efforts[lxxv].

ii. *Governance experimentation* is the promotion of decentralized action to explore different solutions to a mission – namely, through different experiments[lxxvi].

iii. *Governance learning* is the provision of mutual support for the exchange of knowledge and information among the actors involved across experiments[lxxvii].

iv. *Governance revision* is the resort to conditionalities that determine how the cooperation between partners evolves depending on the results of experiments[lxxviii].

Altogether, these functions can be synthesised into a distinctive governance strategy for missions – i.e., its second micro-foundation (M2). This is named *dynamic accountability* due to its focus on developing a dynamic relationship between public, private, and societal actors, where a PSO leading the mission engages proactively with its partners to enable continuous learning and ensure progress.

> *M2. Mission governance establishes dynamic accountability among PSOs and its partners[lxxix].*

In other words, M2 suggests that governance processes must enable a relationship characterised by dynamic accountability between the PSO implementing the mission and the public, private, societal stakeholders contributing to it for the mission to be successful. Without dynamic accountability, the mission may either fall back into top-down winner-picking or into the undifferentiated support to bottom-up experimentation. Conversely, a mission grounded in dynamic accountability helps embed deeper collaboration among mission partners and help them progress to a shared goal[lxxx]. In turn, dynamic accountability can also complement the role of a policy strategy encouraging stakeholders' participation in the mission. The next sub-section explores this remaining level of analysis.

2.4. M3: Mission policy as innovation commons

The importance of policy for innovation is at least fourfold: influencing its direction; structuring its process; enabling its assessment; and support the sharing of its risks and rewards[lxxxi]. Researchers explore the different failures that policy should address[lxxxii], the varieties of available tools[lxxxiii], their design[lxxxiv], and their implications for public-private cooperation[lxxxv]. Yet, there is still little analysis of how policy can push stakeholders to cooperate into mission-oriented experimentation. An exception can be found in efforts to reinterpret innovation as a 'collective action dilemma' defined by two types of uncertainty: the one intrinsic to innovation (which may encourage collaboration) and one intrinsic to the stakes at play in multi-actor collaboration (which may fuel mistrust)[lxxxvi]. Along these lines, it has been hypothesized that such 'collective action dilemma' is best overcome under institutional incentives akin to those that characterise the effective governance of 'knowledge commons'[lxxxvii]. Below, the eight principles identified in the original research by Ostrom for these incentives to be met are presented as four 'rules'[lxxxviii].

i. *Policy directionality* (PDi) regards the design of policy objectives and the role of actors in contributing to their design[lxxxix].

ii. *Policy experimentation* (PEx) regards the design for the multi-stakeholder collaboration and the nature of the shared innovation efforts[xc].

iii. *Policy learning* (PLe) regards the design of a set of mechanisms for knowledge sharing, peer learning and uptake of their related insights[xci].

iv. *Policy revision* (PRe) regards the design of mechanisms for monitoring and evaluation of the mission throughout its implementation[xcii].

Altogether, the third micro-foundation of EE identifies a policy strategy for mission implementation. Its four key rules identify a policy strategy that can be termed innovation commons for its focus on devising institutional incentives that encourage the pooling of decentralized innovation resources and thus promote collaborative experimentation between mission partners.

> *M3. Mission policy triggers, accelerates, and supports the formation of mission-oriented innovation commons to reshape mission partners' rules of collective action challenges[xciii].*

In other words, M3 suggests that, to accelerate transformative innovation, policy tools must be able to induce partners towards committing to pool decentralized innovation resources – hence promoting forms of cooperation that can be defined innovation commons. Without so, the mission may fail to integrate promising innovation processes that take place in multiple and diverse organizations into a cohesive innovation system. Conversely, a mission grounded in innovation commons may push stakeholders to work as partners to elucidate the 'entrepreneurial discovery' opportunities behind the mission[xciv]. When underscored by a PSO that is capable of strategic learning and holding mission partners accountable in a dynamic context, such a policy is hypothesised to help accelerate processes of transformative innovation. The next sub-section defines how such outcome can be assessed.

2.5. Results: Transformative innovation

In science and technology studies, transformative innovation is the set of processes that cumulatively lead to the transformation of an existing socio-technical regime (e.g., fossil fuels) due to the rise, expansion, and affirmation of emerging niches (e.g., hydrogen fuels)[xcv]. This concept is premised upon a view of socio-technical change as a political and societally embedded process in which the rules of conduct behind a socio-technical system (regime) are gradually hollowed out by the rise of alternative ones (niches) and (or) by external shocks (landscape)[xcvi]. Such process is repleted with choices among several socio-technical possibilities that actors with diverse interests have to navigate despite high strategic uncertainty[xcvii]. Nonetheless, as previously showed, the public sector plays an active role in influencing their choices. Its ability to do so can be assessed by operationalising transformative innovation in three key macro-processes: niche-building; niche-mainstreaming; regime-unlocking[xcviii].

i. *Niche-building* (Nb) is the macro-process by which spaces to develop alternative socio-technical practices are created and protected[xcix].

ii. *Niche-mainstreaming* (Nm) is the macro-process by which new socio-technical practices gain acceptance and credibility outside their niche[c].

iii. *Regime-unlocking* (Ru) is the macro-process by which existing socio-technical practices become vulnerable to the expansion of alternative ones and phased out[ci].

Taking stock of the five key components described across this section, EE can thus be described as a theory suggesting that a mission can tackle strategic uncertainty successfully – and thus advance the transformative innovation as just described – only if and when its implementation strategy is translated into distinctive types of change (at least) across (some of) the management, governance, and policy practice(s) undergirding the PSO implementing it. The next section takes stock of EE and articulates the research design through which its empirical relevance is assessed.

3. Introducing the fs-QCA research design

As mentioned, the five conditions identified in the previous section are synthesised into a multi-level framework of public sector innovation – 'Embedded Experimentalism' (EE) that paves the ground for a strategy to test the link between mission implementation and success. Overall, I define EE as:

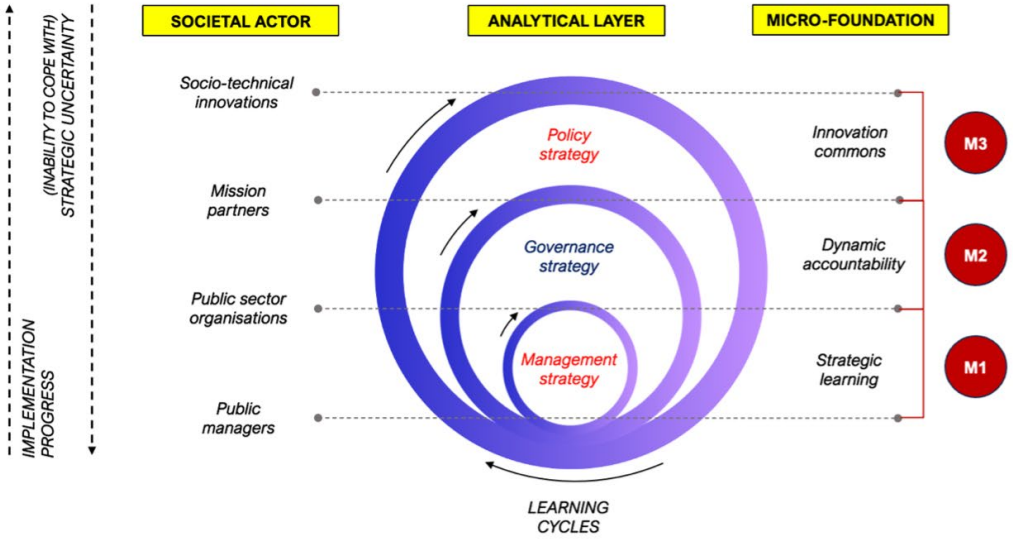
> *A form of public action that makes a routinised use of recursive processes of provisional goal setting, experimentation, learning, and revision in order to trigger, accelerate, and ultimately support forms of collective action aimed at solving a shared societal challenge.*

This definition stresses the three administrative micro-foundations hypothesised as key to mission implementation: a PSO that makes routinised use of learning; a mission that mobilises accountable stakeholders; and accountable stakeholders that pool their own resources to solve a given mission. The three micro-foundations previously highlighted specify how mission implementation shall differ from traditional industrial and innovation policies.

- From a managerial perspective, missions require a commitment to continuous adaptation and learning-based revision that is traditionally absent in the public sector (H1).
- From a governance perspective, missions demand strong partners' engagement and the ability to hold them accountable for sharing the results of their actions throughout the innovation process rather than just standard reporting (H2).
- From a policy perspective, missions solicit deep behavioural change by aiming to forge 'communities' of partners that share similar pursuits, rather than using only firm-based incentives or supporting any kind of cooperation (H3).

Overall, these three micro-foundations therefore define a programme logic for mission implementation wherein successive cycles of strategy iteration unfold across the policy, governance, and management level in order to progress the mission towards success despite high strategic uncertainty (see Figure 1).

Figure 1. *Embedded Experimentalism framework*



Source: Author's elaboration

Based on this framework, the paper addresses the research question below:

> *RQ. What micro-foundations are necessary, and what combinations of micro-foundations are sufficient for the successful implementation of missions?*

Aiming to identify the micro-foundations underpinning successful mission implementation, this paper aims to use EE by weighing in empirical evidence for and against two propositions:

> *H1. All micro-foundations underlying EE are necessary for successful mission implementation.*

> *H2. Different configurations of micro-foundations underlying EE are sufficient for successful mission implementation.*

According to the first hypothesis, successful mission implementation requires all micro-foundations identified by EE: strategic learning; dynamic accountability; and innovation commons. According to the second hypothesis, progress can be achieved also through the satisfaction of some of them. Both can be falsified in the case in which none of the three micro-foundations turns to be conducive to progress towards transformative innovation. The remainder of this section presents information on the data collection process, the methodology, and the calibration approach to find out.

3.1. Data collection: MGMS

To test the two propositions underscoring EE, this paper explores 'net-zero missions' adopted by national and international organisations operating in OECD countries. The rationale is twofold: first, the OECD Mission-Oriented Innovation Policy database is the most comprehensive and up to date list of such missions; second, it is based on an authoritative definition of missions. In this sense, 'net-zero' missions are defined as missions that pursue direct or indirect reductions of Greenhouse Gas (GHG) emissions in a given timeframe. The OECD dataset maps 86 net-zero missions nested in 31 initiatives adopted by 20 countries plus the European Union. These initiatives are implemented by PSOs sitting at different levels of public administration – Prime Minister's Offices, one or more ministries, innovation agencies, or public funds. The large majority of missions and initiatives are concentrated in European countries (56 missions) followed by Asian Pacific (11 missions), the UK (9), North American (8) and Latin American

(2). Even as they pursue the same general goal, they identify a variety of targets that can be grouped in four categories:

- Decarbonisation missions (34 missions) target transformations in clearly identified systems of production and consumption either by reducing or off setting their emissions.
- Energy missions (21) target the development and/or deployment of technologies to support a transition towards low- or zero-emissions sources of energy.
- Circular missions (15) target changes in the sourcing or recovery of materials circulating in production and consumption systems (i.e., reuse, repair, remanufacturing, recycling).
- Systems missions (14) target the transformation of key socio-ecological contexts rather than a specific domain or technology.

The data collection strategy relies on the Mission Governance and Management Survey (MGMS). The MGMS is an original interviewer-administered survey composed of 6 item pools. The first pool gathers general information about the case study (timeline, resources, projects funding, key policies). The other five pools focus on the five components of EE defined in the previous section – each being composed of 6-8 closed-ended questions and one optional open-ended question for the provision of integrative evidence. Each item in the pools derives from the operationalisation of EE described in the previous section and further specified in Appendix A.

The MGMS was administered via semi-structured interviews lasting from '45 to '90 and targeted all mission managers (86) and initiative directors (31) in the database (for a total of 117 interviews).[3] Survey data has been complemented by a systematic scanning of publicly available online data on the design and implementation of each net-zero mission – including earlier peer-reviewed research, grey literature, and public documentation. To minimize total survey error, the usual quality checks have been applied – including the resubmission of standardized mini-case study reports to each respondent aimed at verifying data and analytical accuracy.[4]

Overall, the first wave of the MGMS (February-July 2024) targeted 94 contacts – with 59 interviews completed, 25 missing responses, 10 contacts discarded due to unavailability.[5] Overall, 35 net-zero missions have been analysed and are thus included in this paper. Table 1 presents an overview of the net-zero missions currently mapped in the context of the research. The next two sub-sections describe how their data has been utilized to perform hypothesis testing.

3 The MGMS survey and full case database with scores can be shared by the author under request.

4 Against measurement error, I performed two expert reviews of the item pools with key experts of the topic within the university department; two preliminary cognitive interviews with potential interviewees; and four pre-tests of the survey with members of the target population. Against processing error, I resubmitted to the respondents the results of the survey in those cases where the data was unclear. Against coverage error, I used the most updated database of 'net-zero missions' globally available. Due to time- and funding-related constraints, I avoided sampling and directly interviewing only the leadership of each mission: while this creates a clear bias, it also provides a distinctive perspective on the issue under study. Finally, to minimize nonresponse error, I have cooperated with key knowledge brokers in the mission-oriented policy space (i.e., UCL IIPP and OECD) to streamline communication with the respondents.

5 The total number of potential interviews is calculated as up 105 instead of 117 due to the ability of some respondents to provide information for more than one mission implemented within the context of the same initiative.

Table 1: Overview of the MGMS case database (20.07.2024).

Country	Domain	Type of mission
Australia (2)	Decarbonisation (15)	Accelerator Type 1 (0)
Austria (2)	Energy (8)	Accelerator Type 2 (9)
Belgium (3)	Circular (5)	Transformer Type 1 (4)
Canada (1)	System (7)	Transformer Type 2 (22)
Denmark (4)		
European Union (4)		
Finland (1)		
France (1)		
Ireland (1)		
Netherlands (5)		
Norway (2)		
Spain (1)		
Sweden (3)		
United Kingdom (5)		

Source: Author's elaboration

3.2. Methodology: fs-QCA

To analyse the data collected in the MGMS, I rely upon fuzzy-set Qualitative Comparative Analysis (fs-QCA). QCA is a method to standardise outcomes explanation in medium-N comparative case study settings via the modelling and exploration of complex causal mechanisms[cii]. To do so, QCA differs from correlational methods grounded in statistical inference in that it aims not to "specify a single causal model that fits the data best" but rather "to determine the number and character of the different causal models […] among comparable cases"[ciii]. In practice, this entails determining and assessing the validity of any potential configuration of causal conditions ('pathways') leading to the same outcome. This is done by use of set-theoretic logic that enables the cross-case identification of the role played by different (combinations of) conditions in producing the outcome. Specifically, 'fuzzy set' QCA provides the possibility to indicate degrees of presence for each condition (i.e., from 0 to 1) in those cases where this is not simply binary.

As shown in Section 2, EE presents a total of 5 conditions. These 'variables' can be illustrated as a three-tiered concept tree which identifies the whole empirical scope of our analytical framework: i) one scope condition (strategic uncertainty); ii) three micro-foundations (strategic learning, dynamic accountability, innovation commons); and iii) one outcome (i.e., transformative innovation). Based on the combination of literature review and critical interpretation during the data collection described in Section 2, these have been eventually operationalised into 18 sub-components and 36 indicators which constitute the key unit of analysis for the study (see Appendix A and Section 3.3 for more). Following the fs-QCA methodology, their empirical appraisal and assessment follows three steps. First, *data calibration* translates the raw survey data collected via the MGMS to assign 'membership scores' that range from 0 to 1 for each of 36 sub-indicators identified by EE for each case in the database (see Section 3.3). This is done through the NVivo-assisted coding of every interview transcript and additional material collected

through the MGMS, and by validation of the analysis by part of the original respondents. Second, the *analytical moment* identifies all the necessary and/or sufficient (combinations of) determinants of the outcome by using the categories specified by EE (Section 4.1-5.2). This is done by two means: truth table analysis – which maps out the empirical basis behind all possible 'pathways' to the outcome; and the measurement of each pathway's logical consistency (i.e., the degree to which they link with the expected outcome) and coverage (i.e., the degree to which they account for multiple instances of the outcome). Third, the *robustness check* assesses analysis reliability by exploring the sensitivity of the results to the calibration thresholds set in the first step (Section 4.3).

3.3. Data calibration

Following Douglas et al. (2020), the data calibration was informed by the conceptualisation of EE; the conventional guidelines for QCA calibration used in the scholarship (Rihoux and Ragin, 2008); and the type of information gathered through the MGMS. More specifically, I relied on the 'anchored calibration' approach to translate the qualitative data gathered through the MGMS into membership scores[civ]. First, this required the development of a preliminary conceptualisation of how each of the 36 sub-indicators in EE could be operationalised in a range of scores from 0 to 1. Second, it required the identification of 'data anchors' in the available case study material to match each discreet point in the chosen range of scores. Third, it required the revision of the earlier conceptualisation of sub-indicators in every instance where data brought to light theoretical gaps or proved insufficient to specify the range. The result is a calibration framework (see Appendix A) which aims to make the choices made in transforming the raw survey data into scores transparent and, hence, the method as much replicable as possible.

In this paper, the most critical choices taken in the calibration process were two: first, the reliance on a 4-point range for each of the 36 EE indicators (0.00, 0.33, 0.67, 1.00); second, the identification of the mission level (35 missions) rather than initiative (14 initiatives) as the most suitable to empirical analysis. Another critical step of the anchored calibration process is the identification of membership thresholds for indicators and aggregation rules for their sub-components and components. To determine the presence or absence of a given proxy within a case, a threshold must be decided against which the attributed score can be assessed. Similarly, to determine the presence or absence of a (sub-)component based on the scores attributed to indicators, rules must be decided so to aggregate the multiple indicators (sub-components) scores pertaining to a same sub-component (component) in one. As membership threshold, based on QCA conventions, I define 0.50 as the state where a condition is neither present nor absent. As aggregation rule, I adopt different rules based on component (see Tables 2-3).[6]

6 At the indicator level, I assume substitutability for the scope conditions (i.e., the highest score attributed to related indicators defines sub-component score) and indispensability for the micro-foundations (i.e., the lowest score). The rationale for this criterion lies in the fact that, while scores for scope conditions refer to different manifestations of the same phenomenon (e.g., lack of knowledge on solving a mission versus deploying the mission), scores for the micro-foundations refer to intended and realised strategy – both of which seem essential to mission implementation (e.g., presence of a mission roadmap and, at the same time, of a clear narrative around its implementation). At the component level, I assume instead family resemblance for all sub-components (i.e., the number of sub-components identified as present determines the score of the whole condition). This choice derives from the fact that each sub-component belonging to the same component presents autonomous yet interdependent facets, the assessment of which would be challenging without a joint understanding of them.

Table 2: Calibrating the EE micro-foundations and their sub-components.

Set membership rules	Calibration from case format
Strategic learning ▪ 1 sub-component present = 0.00 ▪ 2 sub-components present = 0.33 ▪ 3 sub-components present = 0.67 ▪ 4 sub-components present = 1.00	Sub-component is present if both its indicators score >0.5: ▪ MDi: Mandate AND Resources ▪ MEx: Design AND Delivery ▪ MLe: Flexibility AND Agility ▪ MRe: Codification AND Dissemination
Dynamic accountability ▪ 1 sub-components present = 0.00 ▪ 2 sub-components present = 0.33 ▪ 3 sub-components present = 0.67 ▪ 4 sub-components present = 1.00	Sub-component is present if both its indicators score >0.5: ▪ GDi: Roadmap AND Initiating ▪ GEx: Portfolio AND Promoting ▪ GLe: Network AND Brokering ▪ GRe: MEL AND Moderating
Innovation commons ▪ 1 sub-components present = 0.00 ▪ 2 sub-components present = 0.33 ▪ 3 sub-components present = 0.67 ▪ 4 sub-components present = 1.00	Sub-component is present if both its indicators score >0.5: ▪ PDi: Target AND Benefit ▪ PEx: Format AND Collaboration ▪ PLe: Knowledge sharing AND Seizing ▪ PRe: Codification AND Dissemination

Source: Author's elaboration

Table 3: Calibrating the EE scope conditions and their sub-components.

Set membership rules	Calibration from case format
Strategic uncertainty ▪ 0 sub-components present = 0.00 ▪ 1 sub-component present = 0.33 ▪ 2 sub-components present = 0.67 ▪ 3 sub-components present = 1.00	Sub-component is present if any of its indicators scores >0.5: ▪ Ec: Knowledge OR Deployment ▪ Oc: Implementation OR Division ▪ Pc: Trust OR Incentives
Transformative innovation ▪ 0 sub-components present = 0.00 ▪ 1 sub-component present = 0.33 ▪ 2 sub-components present = 0.67 ▪ 3 sub-components present = 1.00	Sub-component is present if any of its indicators scores >0.5: ▪ Nb: Engagement OR Readiness ▪ Nm: Expansion OR Diffusion ▪ Ru: Opt-out OR Phase-out

Source: Author's elaboration

The next section shows the results of the fs-QCA in the order recommended by standard QCA practice[cv]: analysis of necessary conditions; analysis of sufficient conditions; and robustness checks. Alternative thresholds to check the robustness of the chosen calibration approach and its impact on the findings are further explored in Appendix B.

4. Analysing pathways to transformative innovation

The end result of the calibration process is illustrated in Table 4, wherein each of the 35 net-zero missions gathered in the MGMS case database is presented with its set membership scores for the five components of EE: context (strategic uncertainty), three micro-foundations (strategic learning; dynamic accountability; innovation commons); and results (transformative innovation). Considering 0.5 as the threshold determining the presence or absence of any given condition, it is possible to run a rapid diagnostic analysis to understand the dataset and its internal variance. The component of strategic uncertainty is present in the quasi-totality of the cases in the sample (97.14%). Each of the three micro-foundations is present only in half of them – with strategic learning occurring the most (54.29%) followed by dynamic accountability (48.57%) and innovation commons (45.71%). Lastly, transformative innovation is also found to happen in slightly less than half cases (45.71%). Table 4 presents the complete list of all 35 cases against their relative scores for each component.

Table 4: Overview of the cases gathered through the MGMS Survey (20.07.2024)

Code	Strategic Uncertainty	Strategic Learning	Dynamic accountability	Innovation commons	Transformative innovation
A	1	1	0.330	0.330	0.330
B	0.670	0.670	0.330	0.670	1
C	0.670	0.330	0.330	0.330	0.330
D	0.670	0.670	0.670	0.670	0.670
E	0.670	0.330	0.330	0.330	0.330
F	1	0.330	0.330	0.330	0.330
G	1	0.330	0.330	0.330	0.330
H	0.670	0.330	0.670	0.330	0.330
I	0.670	1	1	0.670	1
J	1	1	0.670	0.670	0.670
K	1	0.670	0.330	0.330	0.330
L	0.670	0.670	0.670	0.670	0.670
M	1	0.670	1	0.670	0.670
N	1	0.330	0.330	0.330	0.330
O	1	0.670	1	0.670	0.670

P	1	0.670	0.670	0.670	0.330
Q	1	0.330	0.330	0.330	0.330
R	0.670	0.330	0.670	0.330	0.330
S	0.670	1	0.670	0.670	0.670
T	0.670	0.330	0.330	0.330	0.330
U	0.670	0.330	0.330	0.670	0.330
V	0.670	0.330	0	0	0.330
W	1	0.330	0.330	0.330	0.330
X	0.670	0.330	0	0.330	0.330
Y	0.670	0.670	1	0.330	0.670
Z	1	0.330	0.330	0.330	0.330
AA	0.330	0	0.330	0.330	0
BB	0.670	1	0.670	1	1
CC	0.670	0.670	0.670	0.670	0.670
DD	0.670	1	0.670	1	0.670
EE	0.670	1	0.330	0.670	0.670
FF	1	1	0.670	0.670	0.670
GG	0.670	1	0.670	1	1
HH	0.670	0.670	0.670	0.330	0.670
II	0.670	0.330	0.330	0.330	0.330

Source: Author's elaboration

From this diagnostic analysis, three main insights can be derived. First, it confirms the conceptual consistency of strategic uncertainty – earlier framed as the 'problem definition' of net-zero mission implementation. Second, it confirms the ability of the proposed calibration framework to capture sufficient variance in the manifestation of our hypotheses and outcomes in our sample of cases – thus enabling us to proceed to the fs-QCA with confidence. Third, in line with earlier academic and policy insights, it provides confirmatory evidence that a noticeable amount of the cases in the study sample shows little presence – if not total absence – of what have been earlier defined as the 'micro-foundations' of effective mission implementation. In the next sub-sections, the fs-QCA will show whether such micro-foundations can predict the emergence of transformative innovation, and thus the degree to which they can be deemed necessary and/or sufficient to mission success.

4.1. Analysis of necessity

The first step of the QCA is an assessment of the necessity of each separate component in the model for the occurrence of the outcome (see Table 5). The first test is the indicator of consistency, which shows the extent to which the cases with the desired outcome are a full 'sub-set' of those that present the condition: here, the accepted threshold in the literature is 0.9[cvi]. The second test is the indicator of relevance, showing the extent to which a given condition appears to be associated both to the outcome and to the negation of the outcome:

here, while there is no fixed threshold, any indicator close to 0.5 can be deemed a concern[cvii]. Table 5 shows that: i) only two conditions score above the consistency threshold – namely, strategic uncertainty (0.925) and strategic learning (0.981): ii) only one of those shows meaningful relevance – i.e., strategic learning (0.773). Thus, the only necessary condition to the occurrence of transformative innovation appears to be strategic learning.

Table 5. Analysis of necessary conditions for transformative innovation

	Consistency	Coverage	Relevance
Strategic uncertainty	0.925	0.596	0.407
Strategic learning	0.981	0.812	0.773
Dynamic accountability	0.849	0.832	0.849
Innovation commons	0.867	0.883	0.897
~ Strategic uncertainty	0.393	0.912	0.976
~ Strategic learning	0.468	0.604	0.797
~ Dynamic accountability	0.638	0.662	0.758
~ Innovation commons	0.638	0.636	0.729

Source: Author's elaboration

Two observations shall be added. First, the limited relevance of strategic uncertainty as a necessary condition (0.407) is due to its high occurrence confirms its role as 'problem definition' for mission implementation. Second, both remaining micro-foundations score considerably high both in terms of consistency (0.849; 0.867) and relevance (0.849; 0.897) albeit below the chosen threshold – thus leaving up to debate and, more interestingly, case-by-case interpretation whether they can also be considered necessary to transformative innovation. Exploring relationships of sufficiency, the next section further explores and clarifies their distinctive role.

4.2. Analysis of sufficiency

The next step of the QCA is an assessment of the sufficiency of any logically possible *configuration* of multiple components for the occurrence of the outcome. To do so, a so-called 'truth table' is used wherein each row represents one such configuration and illustrates whether the configuration has occurred in the sample; how many cases are representing it; and its consistency with the occurrence of the outcome (Table 6). Excluding the outcome component, EE contains 4 components that can be either present (1) or absent (0); thus, there are 16 possible configurations in theory (2^4). However, only 8 of those showed up in our sample of 35 missions and only 3 present the outcome. For example, the first row shows that the sample includes 3 cases in which transformative innovation is associated with strategic uncertainty; strategic learning; and dynamic accountability. Vice versa, the fourth row shows that the sample includes 3 cases in which the absence of transformative innovation is linked to the exclusive presence of strategic uncertainty and strategic learning.

Table 6. Truth table for the occurrence of transformative innovation

Innovation commons	Dynamic accountability	Strategic learning	Strategic uncertainty	Transformative innovation	Number of cases	Raw consistency	PRI	Cases
0	1	1	1	1	3	1	1	R,Y,HH
1	0	1	1	1	3	1	1	B,U,EE
1	1	1	1	1	13	0.909		D,I,J,L,M,O, P,S,BB,CC, DD,FF,GG
0	0	1	1	0	2	0.931		A,K
0	1	0	1	0	2	0.883		H,N
0	0	0	0	0	1	0.873		AA
0	0	0	1	0	11	0.651		
0	0	1	0	?	0			
0	1	0	0	?	0			
0	1	1	0	?	0			
1	0	0	0	?	0			
1	0	0	1	?	0			
1	0	1	0	?	0			
1	1	0	0	?	0			
1	1	0	1	?	0			
1	1	1	0	?	0			

Source: Author's elaboration

In the truth table, the first test of sufficiency is the indicator of consistency, which shows the extent to which the cases with a given configuration are a full 'sub-set' of those that present the condition: here, the commonly accepted threshold in the literature is 0.8[cviii]. The second test is the indicator of Proportional Reduction in Inconsistency (PRI), showing the extent to which a given configuration appears to be associated only to the outcome rather than to the negation of the outcome too: in this case, any indicator below to 0.5 cannot be deemed sufficient[cix]. Accordingly, Table 6 shows that only 19 cases out of 35 in the sample present sufficient configurations for occurrence of the outcome. These are grouped in three configurations: each has strategic uncertainty and strategic learning (coherently with the necessity analysis) but show either *both* dynamic accountability and innovation commons (13 cases; 3rd truth table raw) or *one* of the two (3 cases each; 1st and 2nd truth table raw).

By logical minimization, the three solutions identified by the truth table can be better simplified into a solution formula composed of two 'pathways' to transformative innovation: i) one that combines strategic learning with innovation commons; ii) one that combines strategic learning with dynamic accountability (Table 7). Both pathways meet the required threshold for consistency (>0.750) and coverage (>0.250) used in the literature[cx] and represent a reliable source of outcome explanation – due to their high level of consistency (0.915 for both) – as well as a very significant portion of the successful cases of transformative innovation (0.830

for both). As it has been identified in the truth table, the two pathways largely overlap – with 13 of 19 'successful' cases showing both dynamic accountability and innovation commons. This is reflected in Table 7, where the proportion of cases that can be uniquely attributed to each pathway is very small (0.058). Accordingly, the consistency and coverage of the whole solution formula is only slightly higher than that of the two pathways (0.920 and 0.888 respectively).

Table 7. Analysis of sufficient conditions for transformative innovation

	Consistency	PRI	Raw coverage	Unique coverage	Cases
(SU AND) Strategic learning AND Dynamic accountability	0.915	0.799	0.830	0.058	B,U,EE
(SU AND) Strategic learning AND Innovation commons	0.915	0.799	0.830	0.058	R,Y,HH
Solution	0.920	0.825	0.888		

Source: Author's elaboration

4.3. Robustness of the evidence

The evidence highlighted above should be last complemented by an assessment of its robustness to different analytical decisions made in the fs-QCA. According to the most advanced protocol in the literature, this can be done by pondering three elements: sensitivity analysis; fit-oriented robustness; and case-oriented robustness. Results for each of these three steps are synthesized below and shown in the tables provided in Appendix B:

- Sensitivity analysis identifies the range in which the consistency threshold or frequency cut-off applied in the analysis of sufficiency could be modified without a parallel change in the solution formula. Table B1 shows that such range corresponds respectively to 0.932-0.999 (consistency) and to 1-2 cases per configuration (frequency).

- Fit-oriented robustness identifies the degree to which concurrent parametric modifications beyond such range weaken the solution. Hypothesizing a test set holding solutions with three looser consistency thresholds (0.931, 0.9, 0.8) and a stricter frequency cut-off (2), Table B2 shows the solution formula to be very robust despite its narrow sensitivity range.

- Case-oriented robustness identifies whether there are cases that turn from typical to deviant or vice versa in response to the hypothesised parametric modifications. Table B3 shows that most 'typical' cases are robust; no 'shaky' case changes from typical to deviant or vice versa; and there are four 'possible' deviant cases that, while partially overlapping with the solution formula, do not show the presence of the outcome.

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Appendix B provides additional tables where the analysis of necessity and sufficiency have been replicated for the *absence* of the outcome, in line with similar studies in governance scholarship[cxi]. All considered, every element provides a strong confirmation of the robustness of the evidence provided by the fs-QCA.

5. Discussing varieties of embedded experimentalism

The main thesis of EE is that, for missions to succeed (i.e., generate transformative innovation), their implementation must establish three administrative micro-foundations: foster strategic learning via management; ensure dynamic accountability via governance; forge innovation commons via policy. Using this theory, 35 missions across 14 OECD countries have been investigated to find out whether any of these micro-foundations is necessary, or configuration sufficient to such outcome. In this section, the results and limitations of the study are qualitatively interpreted, and their implications for next steps in both theory and practice highlighted.

5.1. Hypothesis testing

The analysis started from two hypotheses which *prima facie* seemed rival: *H1) All micro-foundations underlying EE are necessary for successful mission implementation; H2) Different configurations of the micro-foundations underlying EE are sufficient for successful mission implementation.* The results of the fs-QCA suggest that the available empirical evidence points at a 'third way' among these extremes: namely, that whereas only 1 of 3 conditions underpinning EE is necessary but insufficient for successful mission implementation, any combination of such condition with one or both of the remaining conditions is sufficient to success. Paired with the analysis of the case studies underpinning the fs-QCA, it is thus possible to advance a third hypothesis:

> *H3. Successful mission implementation relies on the ability of its management to leverage strategic learning within their PSO and, with the new routines thereby activated, enable i) forms of dynamic accountability, and/or ii) forge innovation commons targeting a given societal challenge.*

This hypothesis builds on several preliminary findings unearthed by this analysis. The first is that, without a management strategy capable of fostering strategic learning within the PSO, the net-zero mission is highly likely to fail: indeed, this seems to be the case for a large number of the missions in the sample (16 cases out of 35). Yet, strategic learning is insufficient to trigger transformative innovation (3 cases out of 35). The second finding is that strategic learning must be accompanied by a governance and/or a policy strategy capable of 'embedding' the mission in the targeted ecosystem of stakeholders. In this respect, the analysis reveals two pathways to transformative innovation: one based on enforcing dynamic accountability, the other on forging innovation commons.

- The former pathway can be defined as 'interventionist' due to the (relatively) more proactive control exerted by the PSO on how its funding and resources are spent and used by partners, and on whether their activities are effectively contributing to the mission (3 cases out of 35).

- The latter pathway can be defined as 'facilitative' due to the (relatively) more proactive role played by the PSO in convening the ecosystem of partners that may be critical to the success of the mission, and in ensuring in-depth collaboration among them (3 cases out of 35).

At the same time, it is critical to observe that the relevance of these pathways in the sample is very limited relative to those of missions that show both micro-foundations (13 out of 35). This leads to a third finding: the potential interdependency among the three conditions. In empirical terms, this finding is coherent with the insight detected in interviews that public managers leading 'successful' missions point at the 'tinkering' of governance processes and policy features as key to their work. In theoretical terms, this insight implies a plausible role for what may be called 'mission maturity' as a predictor of success. The idea of 'mission maturity' implies that because net-zero missions tend to demand PSOs the adoption of new ways of doing strategy, the deeper and the more protracted the engagement of a PSO with net-zero missions – and the stronger its learning over each strategy cycle – the higher the likelihood that their implementation may yield the expected results.

5.2. Present limitations

The three findings highlighted above must be considered in the light of the limitations of the study. The first limitation concerns the problem of missing data, which makes the insights highlighted thus exploratory. During the first wave of the MGMS – i.e., from February to July 2024 – information has been gathered data on 35 of the 86 net-zero missions currently underway across OECD countries. While the MGMS recorded a very high response rate (62.8%; i.e., 59 interviews done on total of 94) and thus provides an encouraging starting point for future efforts based on a similar approach, future replications of the study may provide additional granularity to the interpretation provided above. On top of that, future efforts may elicit more data on each net-zero mission by enlarging and diversifying the pool of respondents (e.g., street-level bureaucrats; private partners; societal actors).

The second limitation concerns the depth of the analysis of the relationship between EE components. For example, exploring which facets of strategic uncertainty (e.g., epistemic ignorance) may occur with other facets of net-zero missions (e.g., experimentation at any level of EE) would help identify patterns in public managers' mission implementation choices. Similarly, exploring which facets of these strategies tend to co-occur with other facets of transformative innovation (e.g., niche-building) may clarify how each aspect of mission implementation links to success at a more granular level.

The third limitation concerns the lack of insight on the drivers behind the resort to one 'pathway' to transformative innovation versus the other. While such analysis is beyond the scope of this paper, different explanations may be hypothesized: e.g., political resistance by incumbents may prompt an 'interventionist' approach; coordination issues among innovators may need a more 'facilitative' one; and epistemic gaps may prompt either based on whether the gap is well- or ill-identified. Still, only further comparative and longitudinal case study analysis could test any of these hypotheses.

The fourth limitation concerns the findings' ambiguity to necessary or sufficient causes. The skewed distribution of successful cases towards missions with all conditions (13 vs. 6 cases) and evidence from interviews suggests that, conditional on strategic learning, dynamic accountability may trigger innovation commons and vice versa. The implication is that, even as learning may 'spark' effective mission implementation, PSOs may balance out both 'interventionist' and 'facilitative' role so as to achieve missions, rather than pick one pathway. Again, exploring this hypothesis needs further work.

The fifth and last limitation concerns the problem of revising the framework in light of new evidence. The fit of the case studies and the analytical framework has been achieved by unifying the literature on the topic (systematic combining); and bridging its gap with empirical data (anchored calibration). Yet, other factors may play a role in mission implementation which are still undetected. In this sense, revisiting the data with more open-ended approaches to

qualitative analysis – e.g., grounded theory or thematic analysis – may yield new information to integrate or amend the framework.

5.3. Research avenues

A first effort to operationalise and test hypotheses on effective industrial strategy in the context of net-zero missions, this study demonstrated the EE framework's ability to explore how they may usher experimentalist "forms of deliberation […] organisational structure […] and set of incentives" to address bottlenecks towards transformative innovation (cf. Sabel and Victor, 2022, 35). Overall, while mainstream literature argues that state capacity is a key *precondition* for industrial strategy to succeed[cxii], the exploratory results of this work point out that, in a context of strategic uncertainty, state capacity and industrial strategy should be cultivated *hand in hand* – namely, through strategic learning[cxiii]. To sum up: that the more transformative the goal of a given industrial strategy, the more limited the use of rigid long-term planning, and the greater the role of learning by experience[cxiv].

Yet, this study is just a starting point for an urgent agenda on the topic. Beyond the abovementioned, its findings yield themselves to further research in several ways: indeed, each component of EE is a 'microcosm' worthy of deeper theoretical and empirical research in itself. The role of 'strategic learning' calls for deeper analysis of the processes by which PSOs address the issues they face in mission implementation, and the managerial choices behind them. The 'interventionist' pathway to transformative innovation suggests that more work is needed to grasp the ability of mission governance to steer public-private-society cooperation. Similarly, the 'facilitative' pathway demonstrates the potential for research to explore the link between policy features and actors' incentives in pooling efforts for socio-technical change.

The vast array of ambitious, long-term net-zero missions across OECD countries highlights both the importance of the issue and the availability of a wide, yet largely untapped evidence base to unearth to address such open questions. From a methodological standpoint, the adoption of a pluralist, multi-method approach appears promising thanks to the ability of different epistemic and analytical tools to unveil different facets of missions' complexity. Within a multi-method research design, different types of (comparative) case study analysis may best complement fs-QCA by enabling both the exploration of key micro-foundations of mission implementation as well as the potential appraisal of relevant factors not yet accounted for within EE. Similarly, further scrutiny and operationalisation of the indicators proposed (see Appendix A) in its framework may help perform quantitative studies – thus enabling mixed method research designs. In both scenarios, the data gathering process started with our survey provides a foundational starting point from which to draw from in order to deepen our understanding of mission implementation.

Relative to extant scholarship, this effort aims to reduce theoretical redundancy within the literature and amplify the empirical precision of industrial strategy analysis to the benefit of both theory and practice[cxv]. In terms of theory, the EE framework helps structure empirical data; test new hypotheses; and evaluate the findings in order to confirm, rebut or revise assumptions about the effectiveness of different implementation strategies. In terms of practice, it can also be used as a 'heuristic device' to support managers in their strategy work by providing a lens to critically assess extant practice, identify implementation bottlenecks, and conceive pathways to tackle them[cxvi].

Appendices

Appendix A: Calibration framework

Context: Strategic uncertainty

There are three reasons why this may be the case: epistemic ignorance; organisational complexity; and political contestation[cxvii]. Each of these can be interpreted in terms of their implications for both problem and solution definition.

i. *Epistemic ignorance* (Ei) is the lack of sufficient/actionable knowledge on how to define a problem or develop a solution to it[cxviii]. As problem, it concerns a lack of *knowledge* on how to tackle a mission (cf. 'clarity of problem'; Ei1); as solution, on how to *deploy* a potential solution in practice (cf. 'clarity of solution'; Ei2).

ii. *Organisational complexity* (Oc) is the noise aroused in mission implementation by gaps in horizontal and vertical coordination within or beyond the leading PSO[cxix]. As problem, it concerns the lack of a mission *implementation* plan (cf. 'coherence'; Oc1); as solution, the lack of a clear *division of labour* (cf. 'consistency'; Oc2).

iii. *Political contestation* (Pc) is the presence of multiple framings by different stakeholders competing for shaping the focus of a mission[cxx]. As problem, it entails the lack of mutual trust among stakeholders (cf. 'power'; Pc1); as solution, the lack of *incentives* facilitating cooperation (cf. 'interests'; Pc2).

Table A1. Calibration framework – Strategic uncertainty

Indicator	Sub-indicator	Score	Characteristic
Epistemic uncertainty (Ec)	Knowledge (Ec1)	0.00	There is full knowledge of how to solve the mission.
		0.33	There is sizeable knowledge of how to solve the mission.
		0.67	There is limited knowledge of how to solve the mission.
		1.00	There is no knowledge of how to solve the mission.
	Deployment (Ec2)	0.00	There is full knowledge of how to integrate the components of the mission.
		0.33	There is sizeable knowledge of how to integrate the components of the mission.
		0.67	There is limited knowledge of how to integrate the components of the mission.
		1.00	There is no knowledge of how to integrate the components of the mission.

Organisational complexity (Oc)	Implementation (Oc1)	0.00	There is full clarity on how to execute the mission.
		0.33	There is considerable clarity on how to execute the mission.
		0.67	There is limited clarity on how to execute the mission.
		1.00	There is no clarity on how to execute the mission.
	Division of labour (Oc2)	0.00	There is full clarity on the division of labour for the mission.
		0.33	There is considerable clarity on the division of labour for the mission.
		0.67	There is limited clarity on the division of labour for the mission.
		1.00	There is no clarity on the division of labour for the mission.
Political contestation (Pc)	Trust (Pc1)	0.00	Mission partners have a long pre-history of engagement with each other.
		0.33	Mission partners have occasionally cooperated with each other.
		0.67	Mission partners have never cooperated with each other.
		1.00	Mission partners have different views on how to address the mission.
	Incentives (Pc2)	0.00	Mission partners see strong incentives for cooperation.
		0.33	Mission partners see some incentives for cooperation.
		0.67	Mission partners see no incentive for cooperation.
		1.00	Mission partners see strong disincentives to cooperation.

H1: Strategic learning

Neo-institutional theory has distilled four 'design principles' demonstrating how norms evolve in a PSO when pursuing a novel organisational objective[cxxi]. Below, each is operationalised as both 'intended' and 'realized' strategy[cxxii].

i. *Managerial directionality* (MDi) reflects the ability to lead a PSO towards a new mission while safeguarding its identity. As intended strategy, it concerns availability of a public *mandate* to pursue the mission (MDi1); as realized, the availability of *resources* – both financial and non – to do so (MDi2)[cxxiii].

ii. *Managerial experimentation* (MEx) reflects the ability to induce trial-and-error in a PSO to pursue practices in line with a new goal. As intended strategy, it concerns innovation in policy *design* (MEx1); realized, innovation enabled in policy *delivery* (Mex2)[cxxiv].

iii. *Managerial learning* (MLe) reflects the ability to monitor the rise of new practices and steer the process by which they are implemented within the PSO. As intended strategy, it concerns policy design *flexibility* (MLe1); realized, policy delivery *agility* (MLe2) [cxxv].

iv. *Managerial revision* (MRe) reflects the ability to embed new practices within the PSO. As intended strategy, it concerns the *depth* of mission-oriented practices as apprehended routines, tools, processes (MRe1); as realized, their *expansion* beyond the PSO – e.g., by triggering broader policy change (MRe2)[cxxvi].

Table A2. Calibration framework – Strategic learning

Indicator	Sub-indicator	Score	Characteristic
Managerial directionality (MDi)	Mandate (MDi1)	0.00	The mission falls out of the PSO's mandate and/or enjoys little political buy-in.
		0.33	The mission stretches the PSO's mandate and/or enjoys limited political buy-in.
		0.67	The mission lies in the PSO's mandate and/or enjoys sufficient political buy-in.
		1.00	The mission is at the core of the PSO's mandate and/or enjoys political buy-in.
	Resource (MDi2)	0.00	As of now, the PSO has insufficient resources for delivering the mission.
		0.33	As of now, the PSO has only tight resources for delivering the mission.
		0.67	The PSO has sufficient resources for delivering the mission.
		1.00	The PSO has considerable resources for delivering the mission.
Managerial experiment (MEx)	Design (MEx1)	0.00	The PSO has adopted no innovation in policy design.
		0.33	The PSO has adopted only limited innovation in policy design.
		0.67	The PSO has adopted considerable innovation in policy design.
		1.00	The PSO has adopted radical innovation in policy design.
	Delivery (MEx2)	0.00	The PSO has adopted no innovation in policy delivery.
		0.33	The PSO has adopted only limited innovation in policy delivery.
		0.67	The PSO has adopted considerable innovation in policy delivery.
		1.00	The PSO has adopted radical innovation in policy delivery.
Managerial learning (MLe)	Flexibility (MLe1)	0.00	In implementation, the PSO shows no adaptability in policy design.
		0.33	In implementation, the PSO shows limited adaptability in policy design.
		0.67	In implementation, the PSO shows much adaptability in policy design.
		1.00	In implementation, the PSO shows radical adaptability in policy design.
	Agility (MLe2)	0.00	In implementation, the PSO shows no adaptability in policy delivery.
		0.33	In implementation, the PSO shows limited adaptability in policy delivery.
		0.67	In implementation, the PSO shows considerable adaptability in policy delivery.
		1.00	In implementation, the PSO shows radical adaptability in policy delivery.

Managerial revision (MRe)	Depth (MRe1)	0.00	The PSO has consolidated no specific mission-oriented way of working.
		0.33	The PSO has only started to consolidate mission-oriented ways of working.
		0.67	The PSO has consolidated some mission-oriented practices / ways of working.
		1.00	The PSO has consolidated many mission-oriented practices / ways of working.
		0.00	The PSO does not aim to trigger policy change beyond its own borders.
		0.33	The PSO tries to trigger policy change beyond its borders with little success.
		0.67	The PSO can advocate for mission-oriented policy change beyond its borders.
		1.00	The PSO is capable of triggering major policy change beyond its borders.

H2: Dynamic accountability

Governance theory shows that accountability rules that welcome decentralized experimentation can be distilled into four 'functions'[cxxvii]. Below, each is operationalised as both 'intended' and 'realized' strategy[cxxviii].

i. *Governance directionality* (GDi) is the identification of a thin consensus among mission partners the joint effort. Given strategic uncertainty, this should prioritise the definition of a broad goal rather than a rigid plan. As intended strategy, it concerns the definition of a *roadmap* approach or similar (GDi1); as realized, the ability of a PSO to act as an *initiator* by championing a strong target/narrative (GDi2)[cxxix].

ii. *Governance experimentation* (GEx) is the promotion of decentralized experimentation to explore different ways to tackle a mission. Given strategic uncertainty, the focus of the experimentation should not be prescribed in advance in detail but seize on stakeholders' knowledge. As intended strategy, it concerns the use of a *portfolio management* approach or similar (GEx1); as realized, the ability of a PSO to act as a *promoter* of autonomous experimentation by partners (GEx2)[cxxx].

iii. *Governance learning* (GLe) is the provision of mutual support across many experiments. Given strategic uncertainty, partners should build upon each other's attempts, strengths, and resources. As intended strategy, it concerns the adoption of a *network management* approach or similar (GLe1); as realized, the ability of a PSO to act as a *broker* of peer learning and support among partners (GLe2)[cxxxi].

iv. *Governance revision* (GRe) is the resort to conditionalities as means for steering partners. As intended strategy, it concerns the use of *conditionalities* to induce partner behaviour in support of the mission (GRe1); as realized, the mode of *enforcement* to which such conditionalities come into force (GRe2)[cxxxii].

Table A3. Calibration framework – Dynamic accountability

Indicator	Sub-indicator	Score	Characteristic
Governance directionality (GDi)	Roadmap (GDi1)	0.00	The mission has no Theory of Change / Roadmap / similar tool.
		0.33	The mission makes use of a generic ToC / Roadmap / equivalent.
		0.67	The mission makes use of a broadly accepted ToC / Roadmap.
		1.00	The mission makes large use of a broadly accepted ToC / Roadmap / similar.
	Initiator (GDi2)	0.00	The PSO leading the mission has no guiding target or narrative.
		0.33	The PSO leading the mission has a broad, non-time bound target / narrative.
		0.67	The PSO leading the mission has a long-term, distant target / narrative.
		1.00	The PSO leading the mission has a mid-term, urgent target / narrative.
Governance experiment (GEx)	Portfolio (GEx1)	0.00	The mission has no portfolio management approach.
		0.33	The mission funds a portfolio of different socio-technical solutions.
		0.67	The mission funds a portfolio of connected socio-technical solutions.
		1.00	The mission funds and adapts a portfolio of connected socio-technical solutions.
	Promoter (GEx2)	0.00	The PSO is very prescriptive about the solutions to address the mission.
		0.33	The PSO leaves little autonomy to partners proposing solutions to the mission.
		0.67	The PSO leaves some autonomy to partners proposing solutions to the mission.
		1.00	The PSO leaves extensive autonomy to partners proposing solutions.

Governance learning (GLe)	Network (GLe1)	0.00	The mission does not curate regular interaction for a network of stakeholders.
		0.33	The mission seeds new networks of public, private, and/or societal stakeholders.
		0.67	The mission reorients/expands extant networks of public/ private/societal actors.
		1.00	The mission empowers the active management of old/new networks of actors.
	Broker (GLe2)	0.00	The PSO does not provide peer learning and support for its stakeholders.
		0.33	The PSO invests some resources in peer learning and support for its partners.
		0.67	The PSO holds regular meetings on peer learning and support for its partners.
		1.00	The PSO puts extensive effort in peer learning and support for its partners.
Governance revision (GRe)		0.00	The mission provides funding/support to participants with no strings attached.
		0.33	The mission provides funding/support conditional on mission contribution.
		0.67	The mission provides funding/support conditional on knowledge sharing.
		1.00	The mission provides funding/support conditional on IPR/profit sharing.
	Moderator (GRe2)	0.00	The mission has no tool to enforce conditions attached to funding/support.
		0.33	The mission enforces conditions via contractually pre-defined terms.
		0.67	The mission enforces conditions through assessment of KPI.
		1.00	The mission enforces conditions through iterative negotiation.

H3: Innovation commons

The literature framing innovation as a 'collective action dilemma' hypothesized that such dilemma can be overcome under presence of institutional incentives akin to those of 'commons'[cxxxiii]. Below, the eight principles that Ostrom identified as the critical incentives for the creation of commons are presented under four 'rules' – each operationalised as 'intended' and 'realized' strategy[cxxxiv].

i. *Policy directionality* (PDi) regards the design of policy objectives. As intended strategy, it concerns the *target* of the mission as stakeholders and resources to engage with (PDi1); as realized, the congruence of the short- and long-term *benefit* for partaking the mission and the stakeholders' priorities (PDi2)[cxxxv].

ii. *Policy experimentation* (PEx) regards the design of multi-stakeholder collaboration. As intended strategy, it concerns the *format* of the collaboration provided to mission partners (PEx1); as realized, the depth of the *collaboration* achieved through available formats (PEx2)[cxxxvi].

iii. *Policy learning* (PLe) regards the design of a set of mechanisms for knowledge sharing. As intended strategy, it concerns the degree of knowledge *sharing* enabled by a mission between each partner's activities (PLe1); as realized, the breadth of knowledge *seizing* available to partners (PLe2)[cxxxvii].

iv. *Policy revision* (PRe) regards the design of mechanisms for monitoring and evaluation. Given strategic uncertainty, the mechanisms should entail both solution and problem definition. As intended strategy, it concerns the use of a *formative* monitoring approach or similar (PRe1); as realized, the ability of a PSO to *calibrate* policy design based on new evidence from implementation (PRe2)[cxxxviii].

Table A4. Calibration framework – Innovation commons

Indicator	Sub-indicator	Score	Characteristic
Policy	Target (PDi1)	0.00	The mission does not target a clear community of actors and resources.
		0.33	The mission targets a broad community of actors and resources.
		0.67	The mission targets a specific community of actors and resources.
		1.00	The mission targets a specific, yet flexible community of actors and resources.
	Benefit (PDi2)	0.00	The mission does not identify clear benefits for participating stakeholders.
		0.33	The mission provides short-term benefits for participating stakeholders.
		0.67	The mission projects long-term benefits for participating stakeholders.
		1.00	The mission provides short-term and projects long-term benefits.

Policy experiment (PEx)	Format (PEx1)	0.00	The mission funds activities/consortia on pre-determined priorities.
		0.33	The mission funds activities/consortia of stakeholders on self-proposed priorities.
		0.67	The mission is active in shaping activities/consortia on shared negotiated priorities.
		1.00	The mission forges an innovation platform for integration of activities/ consortia
		0.00	The mission has fixed forms of cooperation (e.g., fixed project consortium).
		0.33	The mission has flexible forms of cooperation (e.g., flexible project consortium).
		0.67	The mission has open-ended forms of cooperation (e.g., voluntary networks).
		1.00	The mission has ambitious forms of cooperation (e.g., formal partnerships).
Policy learning (PLe)	Sharing (PLe1)	0.00	The mission does not create visibility among actors on each other's efforts.
		0.33	The mission creates limited visibility among actors on each other's efforts.
		0.67	The mission creates considerable visibility among actors on each other's efforts.
		1.00	The mission creates very strong transparency among actors on each other's efforts.
	Seizing (PLe2)	0.00	The mission provides no specific support for learning.
		0.33	The mission effectively supports learning in each project.
		0.67	The mission effectively supports learning between projects in a same cluster.
		1.00	The mission effectively supports learning between projects and across clusters.
Policy revision (PRe)		0.00	The mission evaluation is focused only on financial reporting and output delivery.
		0.33	The mission evaluation is focused only on a definite set of KPIs (or similar).
		0.67	The mission evaluation is focused on assessment and revision of KPIs (or similar).
		1.00	The mission evaluation is focused on rapid cycles of data gathering & assessment.
		0.00	The mission adopts the same goals, tools, and parameters cycle after cycle.
		0.33	If need be, the mission can adjust goals, tools, and parameters in marginal ways.
		0.67	If need be, the mission can adjust goals, tools, and parameters in relevant ways.
		1.00	If need be, the mission can adjust goals, tools, and parameters in radical ways.

Outcome: Transformative innovation

Socio-technical change is repleted with choices among several socio-technical possibilities that actors with diverse interests have to navigate despite considerable strategic uncertainty[cxxxix]. Nonetheless, the public sector plays an active role in influencing their choices. Its ability to do so can be assessed by operationalising transformative innovation in three macro-processes: niche-building; niche-mainstreaming; regime-unlocking[cxl]. While the literature identifies four main outcomes per macro-process, this paper synthesizes them in two: societal and technical.

i. *Niche-building* (Nb) is the macro-process by which spaces for the gradual development of alternative socio-technical practices are created and protected. In societal terms, it concerns the *engagement* of stakeholders with new socio-technical practices (Nb1) (cf. 'networking' and 'navigating expectations'); in technical, the increase in their Technology *Readiness* Level (Nb2)[cxli].

ii. *Niche-mainstreaming* (Nm) is the macro-process by which new socio-technical practices gain acceptance and credibility outside their original niche. In societal terms, it concerns *integration* of socio-technical practices (Nm1) (cf. 'circulating' and 'institutionalising'); in technical, *diffusion* and commercialisation (Nm2)[cxlii].

iii. *Regime-unlocking* (Ru) is the macro-process by which existing socio-technical practices lose their rigidity and become vulnerable to the expansion of alternative ones. In societal terms, it concerns the *opt-out* of policy or societal support towards existing practices (Ru1); in technical, their gradual *phase out* (Ru2)[cxliii].

Table A5. Calibration framework – Transformative innovation

Indicator	Sub-indicator	Score	Characteristic
Niche building (Nb)	Engagement (Nb1)	0.00	No niche emerges that can help to solve the mission.
		0.33	A niche emerges albeit at a very small scale.
		0.67	A niche emerges including a good variety of actors.
		1.00	A niche emerges including a wide variety of stakeholders.
	Readiness (Nb2)	0.00	No progress in TRL for new solutions is achieved.
		0.33	Little progress in TRL for new solutions is achieved.
		0.67	Limited progress in TRL for new solutions is achieved.
		1.00	Radical progress in TRL for new solutions is achieved.
Niche mainstreaming (Nm)	Integration (Nm1)	0.00	No integration among niche actors takes place.
		0.33	Limited integration among niche actors takes place.
		0.67	Some integration among niche actors takes place.
		1.00	Radical integration among niche actors takes place.
	Diffusion (Nm2)	0.00	No progress towards diffusion is achieved.
		0.33	Little progress towards diffusion is achieved.
		0.67	Limited progress towards diffusion is achieved.
		1.00	Radical progress towards diffusion is achieved.

Regime unlocking (Ru)	Phase-out (Ru1)	0.00	Stakeholders' support for existing regime is untouched.
		0.33	Stakeholders' support for existing regime is marginally weakened.
		0.67	Stakeholders' support for existing regime is weakened.
		1.00	Stakeholders' support for existing regime is collapsed.
	Opt-out (Ru2)	0.00	Policy support for existing regime is untouched.
		0.33	Policy support for existing regime is marginally weakened.
		0.67	Policy support for existing regime is weakened.
		1.00	Policy support for existing regime is collapsed.

Appendix B: Robustness check

Table B1. Sensitivity analysis

	Lower bound	Threshold	Upper bound
Raw consistency threshold	0.932	0.977	0.999
Frequency cut threshold	1	1	2

Table B2. Fit-oriented robustness

	Coverage	Consistency	SC_minTS	SC_maxTS
Fit-oriented robustness	0.756	0.892	0.646	0.812

Table B3. Case-oriented robustness

	Robust typical	Robust deviant	Shaky typical	Shaky deviant	Possible typical	Possible deviant
Number/Total	6/35 (17.14%)	0/35 (0%)	9/35 (25.71%)	4/35 (11.43%)	0/35 (0%)	4/35 (11.43%)
Number/Total (Y>/<0.5)	6/15 (40%)	0/20 (0%)	9/15 (60%)	4/20 (20%)	0/15 (0%)	4/20 (20%)

Table B4. Analysis of necessary conditions for the absence of transformative innovation

	Consistency	Coverage	Relevance
Strategic uncertainty	0.961	0.609	0.415
Strategic learning	0.688	0.560	0.593
Dynamic accountability	0.669	0.645	0.727
Innovation commons	0.620	0.631	0.735
~ Strategic uncertainty	0.362	0.826	0.954
~ Strategic learning	0.768	0.976	0.985
~ Dynamic accountability	0.825	0.843	0.871
~ Innovation commons	0.884	0.868	0.881

Table B5. Truth table for the absence of transformative innovation

Innovation commons	Dynamic account-ability	Strategic learning	Strategic uncer-tainty	Trans-formative innovation	Number of cases	Raw consist-ency	PRI	Cases
0	0	0	1	1	11	0.972		C,E,F,G,Q, T,V,W,X,Z,II
0	0	1	1	1	2	0.967		A,K
0	1	0	1	1	2	0.962		H,N
0	1	1	1	0	3	0.841	0	R,Y,HH
1	0	1	1	0	3	0.810	0	B,U,EE
1	1	1	1	0	13	0.708		D,I,J,L,M, O,P,S,BB, CC,DD,FF,GG
0	0	0	0	?	1	0.938		AA
0	0	1	0	?	0			
0	1	0	0	?	0			
0	1	1	0	?	0			
1	0	0	0	?	0			
1	0	0	1	?	0			
1	0	1	0	?	0			
1	1	0	0	?	0			
1	1	0	1	?	0			
1	1	1	0	?	0			

Table B6. Analysis of sufficient conditions for the absence of transformative innovation

	Consistency	PRI	Raw coverage	Unique coverage	Cases
(SU AND) ~DA AND ~IC	0.976	0.935	0.787	0.134	C,E,F,G,Q,T,V,W,X,Z,II; A,K
(SU AND) ~SL AND ~DA	0.975	0.935	0.730	0.077	C,E,F,G,Q,T,V,W,X,Z,II; H,N
Solution	0.978	0.943	0.864		

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