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Multi-Stakeholder Ecosystem for Standardization of AI in Industry

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Multi-Stakeholder Ecosystem for Standardization of AI in Industry



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This dissertation is submitted for the degree of
MPhil Industrial Systems, Manufacturing and Management

Abstract

The increasing governmental interest in fostering the Artificial Intelligence sector in Britain has rapidly increased; the United Kingdom has recognised AI's significance and incorporated it into its policy frameworks. The UK's Industrial Strategy framework of 2017 emphasises the need for investment, research, and collaboration in this field, and these efforts raise a significant question: **How do Regional AI SMEs have access to framework, networks and resources?** In line with this research endeavour, the research focuses on how three AI SMEs located in different regions of Britain are influenced by the introduction of those policy frameworks in their business operations. By examining these aspects, this research provides insights into the impact of the domestic AI policy framework on Britain's AI SMEs. It focuses on how policies can shape the development and adoption of such frameworks in SMEs and how these frameworks influences might differ from one SME to another, by utilising two frameworks:

1. The Stakeholder Assessment Criterion, defines three models: **'Statist-model'**, **'Laissez-Faire model'** and **'Academia Model'**.
2. The **Governance Matrix**.

These two frameworks aided this research to in comprehending the current British AI ecosystem policy developments influencing the three AI SMEs. This research was propelled by an inductive reasoning process and qualitative data collection methodology. Three case studies were conducted: one in a company based in London, England's capital; another in Reading, located in Berkshire; and a third in Sheffield, situated in the South Yorkshire County of northern England. These observations took place between June 12 and July 14. Several interviews with stakeholders from these companies were conducted, providing the opportunity to scrutinise and cross-reference the recent AI policy framework developments implemented by the British Parliament. Furthermore, the study engaged regional and domestic policymakers in interviews to comprehend the external factors influencing these companies.

Acknowledgments

First of all, I would like to dedicate this work to my mom, Sofia; I have been privileged have been raised by a single mom; There is no way I would be where I am now without your to life-long lessons, support and encouragement which have helped me to move forward in my professional and personal journey, and during the darkest periods of my life, so I dedicate this work to you.

I equally dedicate this work to my supervisor, Florian Urmetzer and Yongjiang Shi; you both have given me essential life lessons that I will carry with me forever; It's incredible how you both are able to empower others to do better and achieve better in their academic and personal lives, I also dedicate this to my advisor Simon Dietlmeier, without you I would not be able to dive into my inner thoughts and philosophical thinking, thanks for encouraging me in this journey and for empowering me in thinking bigger and greater.

And last but not least, I would like to dedicate this work to all those informants who helped me along the way; this dissertation would not be possible without your dedication and willingness to let me enter your company premises, answer all the questions I had and guided me when I was the most confused, thank you, I really appreciate all the help.

Declaration

I hereby declare that this dissertation titled “**Multi-Stakeholder Ecosystem for Standardization of AI in Industry**” represents my own work. The contents of this dissertation are original except where specific reference is made. No part of this dissertation has been presented or submitted for any other degree or any other University. This dissertation is containing fewer than 15,000 words in length including appendices, bibliography, footnotes, tables, and equations.

George J. Bonilla

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Chapter 1 Introduction

1.1 British AI Ecosystem

The historical progression of AI research has positioned Britain as a substantial player on the global stage, by various metrics, Britain is considered the third-largest AI hub worldwide (Amy Irish, 2019); However, a considerable gap remains between Britain's standing and the positions occupied by the USA and China (Nestor Maslej, 2023). In the European context, Britain outshines others European players with over fifty per cent of AI SMEs being based in Britain, compared to Germany and France, both hold around twenty per cent each. London, serving as the central AI cluster in Britain, has earned the title of “Europe's AI Capital” (Stephen Allott, 2018). In terms of AI leadership, Britain's ranking is significant compared to other European nations; The notable contributions to AI research output from high-level institutions within the Golden Triangle¹ cannot be understated (Government, 2017). Moreover, the private investment sector has also fostered the AI ecosystem, with British AI SMEs being the third-largest private investment recipients worldwide in 2022 (Daniel Zhang, 2022).

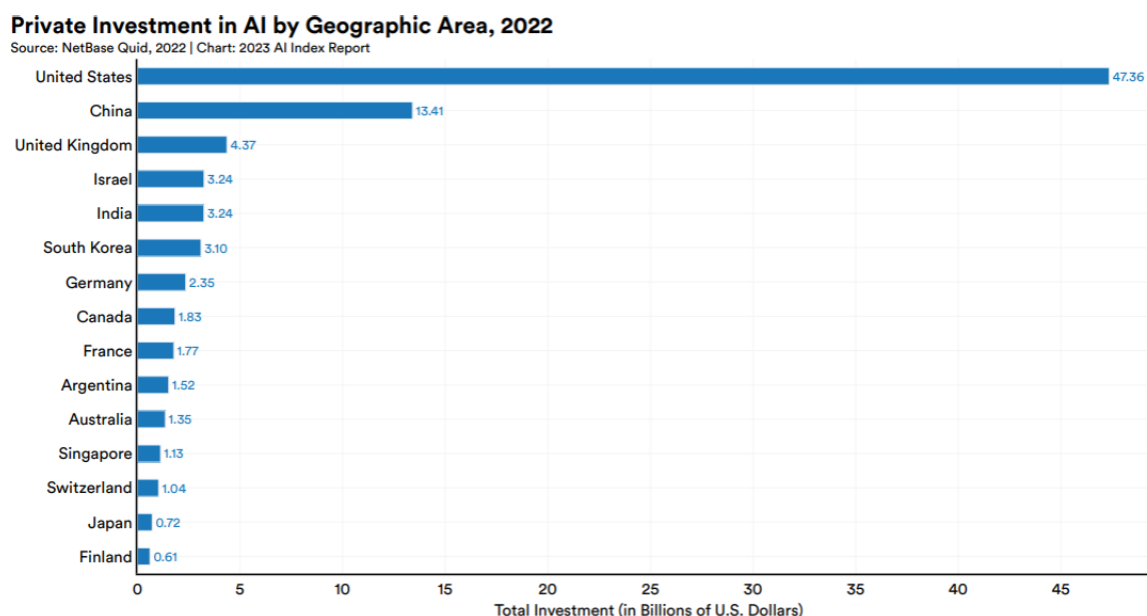


Figure 1 Private Investment in AI by Jurisdiction (Daniel Zhang, 2021).

¹ The "Golden Triangle" refers to the geographic region between the universities of Oxford, Cambridge, and London, where many leading institutions are located (Mullins, 2005).

1.2 British National AI Strategy

Recognising the past and future significance of the AI sector, the country has embarked on its efforts to foster its domestic AI SME ecosystem. The British Parliament in 2017 launched the “Industrial strategy” framework that prioritised AI (Government, 2017); This comprehensive policy framework aims to maintain the nation's industrial competitiveness, and propel further development within the AI ecosystem. It empowers public bodies such as **The Alan Turing Institute** by solidifying its role as the national centre for AI and Data; Furthermore, it reinforces **UKRI's** efforts to stimulate research among British research centres and enables **Innovate UK** to support entrepreneurs to launch AI tech enterprises, these coordinated efforts from the central government and among these three British institutions demonstrate the strategic plan for fostering Britain's AI ecosystem (Government, 2023).

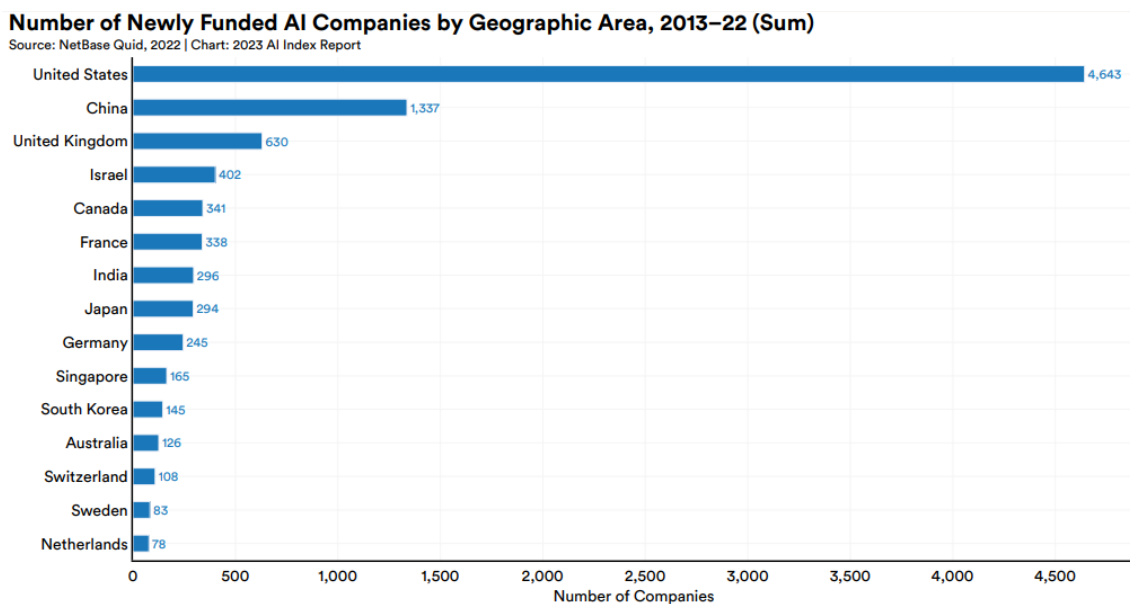


Figure 2 Number of Newly Funded AI Companies by Geography (Daniel Zhang, 2022).

1.3 Research Motivation

As seen in Section 1.1 and 1.2 as key motivators to craft the central research question which is: “**How do regional AI SMEs access policy frameworks, resources or networks?**”. This research explores a bottom-to-top approach, examining how current policy developments impact SMEs across different regions of Britain. It employs qualitative analysis and case study techniques to understand the evolving phenomenon. Current literature addressing the regional AI ecosystem is reviewed (Chapter 2), and the research methodology is detailed (Chapter 3). This research explores three case studies conducted in different AI SMEs across Britain to

comprehend how external AI frameworks and policies influence SMEs' decision-making while using the stakeholder assessment criterion and the ecosystem governance matrix tool (Chapter 5). The insights derived from these case studies are further reinforced and discussed (Chapter 5), and a series of conclusions are synthesised (Chapter 6).

Chapter 2 Literature Review

2.1 Systematic Literature Review

A systematic literature review methodology employed in this research enabled a structured approach to examine the current body of literature addressing AI policies, Stakeholders and Ecosystems theories; this practical framework helped address rapidly evolving AI topics (Toorajipour et al., 2021), Additionally the systematic literature review method aided this research to address recent developments in AI and AI policy in Britain. The review methodology required an analysis of the available literature, followed by the adoption of exclusion and inclusion criteria as filters to select fitting studies; The findings from these studies were then synthesised to provide a comprehensive summary of the outgoing arguments discussed in the literature.

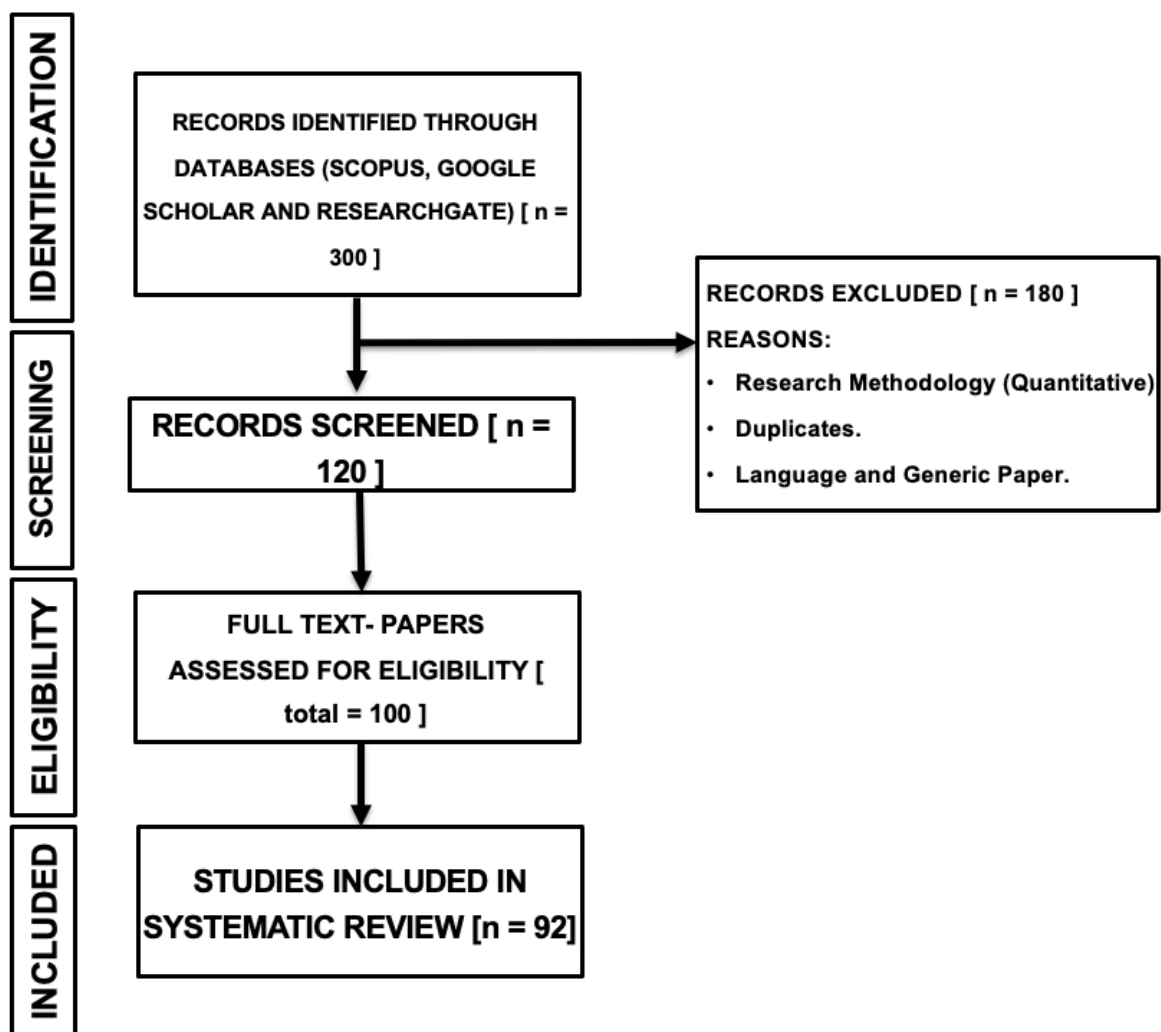


Figure 3 Systematic Literature Review Flowchart (Boland et al., 2017).

2.1 Literature Review Process

The literature review process for this study was divided into two distinct stages to ensure a comprehensive exploration of the research topic:

The first stage reviewed thirty generic AI papers; These papers were instrumental in providing an extensive understanding of AI technology, particularly emphasising the contributions of British researchers and enterprises to the AI sector.

The second stage involved a targeted literature search string technique, this stage involved a detailed review of theoretical frameworks, predominantly focussed on business and entrepreneurial publications addressing Stakeholder and Ecosystem theories, Furthermore, policy research papers were also included to gain insights into the legislative and regulatory AI landscape in Britain.

Table 1 Literature Review Process step by step.

STEP	DESCRIPTION
1	Define literature review methodology, Research question, Keywords and Databases.
2	Search literature by date framework (2017-2020) & (2020-2023), general A.I. topic and do a more specific UK search.
3	Screen titles and Abstract.
4	Screen Full text by applying inclusion and exclusion criteria (Inclusion: U.K. Industrial policy, A.I. etc.).
5	Backwards and Forwards search.
6	Analysis of concepts, find research gaps.
7	Define research questions based on literature gap and current similar work.

Ninety papers were analysed; this number of publications created robust foundations on the research topic and enabled this study to identify research gaps. Moreover, the literature review process aided this research in finding the right theoretical frameworks that were used to address the main research questions.

Table 2 Search String.

Database	Generic Search String
SCOPUS	((“artificial intelligence "AND "industrial* AND “ecosystems” OR “united kingdom*” OR “industrial strategy” AND “ecosystems*” OR “industrial policy” OR “economic*” AND “business*” AND “innovation”) OR (“united kingdom*” “business ecosystems” OR “Parliamentary Hearings*” OR “paper*”)
GOOGLE SCHOLAR	•History of A.I. - UK White Paper - UK Industrial Strategy - APPG A.I •UK Policy Papers - Parliamentary & Council Hearings – Government News releases
RESEARCHGATE	((“artificial intelligence "AND "industrial* AND “ecosystems” OR “united kingdom*” OR “industrial strategy” AND “ecosystems*” OR “industrial policy” OR “economic*” AND “business*” AND “innovation”) OR (“united kingdom*” “business ecosystems” OR “Parliamentary Hearings*” OR “paper*”)

2.2 Literature Exploration

This section explores the current literature developments in theories addressing stakeholders, ecosystems, and the influence of AI policy frameworks from a systematic perspective. This research on "**Multi-stakeholder Ecosystem for Standardization of AI in Industry**" aims to explore, from an SME perspective, how AI policy frameworks influence British AI SME internal decision-making. Consequently, a systematic literature review explored stakeholder theories and innovation ecosystem frameworks used to observe policies’ regional and domestic influence on enterprises. As a result, this chapter explores the following three subjects:

1. Stakeholder Theory
2. Theory of Ecosystem
3. AI Regional Policies

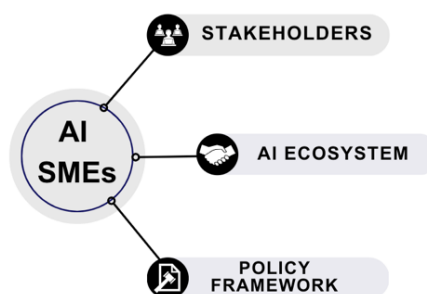


Figure 4 Literature Exploration Outline.

Stakeholder Theory

This section outlines different stakeholders' theories that are currently being discussed in the literature; this section aims to provide a baseline to identify different stakeholders' roles in the AI SME context; stakeholders play a crucial role in the AI SME ecosystem, so it is essential to view them as one component within a larger ecosystem characterised by a chain of interactions, actions, and outcomes (Saunila, 2020).

Theory of Ecosystems

The word 'ecosystem' first widely used in biological sciences and adopted into the business and entrepreneurial venular in the early 2000s. This section outlines and explains the different business ecosystem theories that are currently being addressed in the literature and how those differ from each other, moreover, this section seeks to explain why a particular theory of ecosystem was chosen to assess how AI SMEs in Britain are navigating their regional ecosystems when current AI policies developments are introduced.

AI Regional Policies

The dissertation topic has a major policy component to it, this section aims to outline the current literature addressing the influence of AI policy frameworks across different regions and how those policy frameworks are influencing regional AI SMEs and economic structures changes, this section should be a preamble to the existing industrial strategy framework introduced by Theresa May's government in 2017, the Industrial Strategy framework aims to work on several industrial pillars to foster economic growth, AI being one of those pillars (Kazim et al., 2021).

2.2.1 Stakeholder Theory

Business literature indirectly addresses the role of stakeholders within business ecosystems; Notably, stakeholder elasticity has been emphasised, elasticity indicates how stakeholders' roles can evolve based on the evolution of business ecosystems (Moore, 1993). One key argument that emerges is that stakeholders represent a small but crucial part of a more extensive network of interactions; These interactions, however, do not occur in isolation; ecosystems thrive because of the result of exchanges among stakeholders and actors within the system (Lundvall, 1985). In this context, stakeholders can be considered any entity within the ecosystem network contributing to value creation. Such stakeholders may encompass companies, government agencies, educational institutions, research centres, and other entities (Lundvall, 1999). Certain stakeholder theories underscore the role of these diverse actors in stimulating innovation with an argument that stakeholders interactions and knowledge sharing foster innovation and economic performance (Fransman, 2014). More recent research on the

role of stakeholders within innovation ecosystems has been concentrated on how stakeholders can directly influence ecosystems based on their ability to 'set the rules of the game' (Fransman, 2014). Furthermore, Leydesdorff's Triple-Helix stakeholder model suggest that the role of stakeholders' role has evolved in recent years, the boundaries between these actors are becoming more blurred and stakeholder roles can overlap depending on how the ecosystem is being shaped by external factors. For example, universities might take on a more economic role, industry might engage in knowledge production, and government might act as a network facilitator (Leydesdorff, 1995).

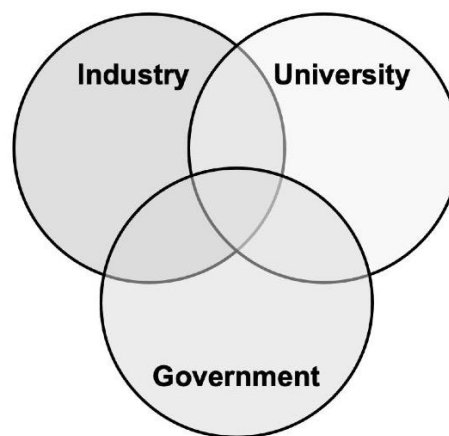


Figure 5 An example of a balanced Triple-helix Stakeholder framework, where all stakeholders have equal influence to the ecosystem (Leydesdorff, 1995).

The Triple-Helix framework established by Leydesdorff analyses increasingly evolving ecosystem, as stakeholders are influenced by the ecosystem transforming.

2.2.2 Theory of Ecosystems

The 'ecosystem' term finds its origins in the botanical and biological sciences; Arthur George Tansley introduced the term in the mid-1930s (Blew, 1996), However, it was not until the early 1990s that the term 'ecosystem' was formally defined by the United Nations at the Convention on Biological Diversity as "A complex dynamic among plants, animals, and micro-organisms communities and their non-living environment interacting as a functional unit" (Sands, 1992). Nowadays, when addressing business context the 'ecosystem' term was adopted and adjusted from its original form into a business and innovation context in the early 2000s (Cohen, 2006), the new term was introduced and began gaining traction in academic circles when (Bloom & Dees, 2008) studies on 'entrepreneurial ecosystem' were published; Bloom and Dees introduced the 'entrepreneurial ecosystem'; a theory defined as "the social and economic environment affecting local or regional entrepreneurship". Moreover, several scholars have

revisited theories of business ecosystems that were initially proposed in the early 1990s. One of the most influential theories is Moore's definition of a business ecosystem, Moore emphasises that companies are not part of a single sector or industry but rather a chain where companies fulfil customer needs (Moore, 1996), this understanding of ecosystems underscores the competitive dynamics that exist within them, bearing a resemblance to a predator-prey relationship in nature, and it is through the predator-prey competitive process that ecosystems co-evolve (Moore, 1993); Further explorations of the predator-prey ecosystem concept have been undertaken by (Snehota & Hakansson, 1995), whose study about interconnections within business networks shape the actions and perceptions of involved stakeholders in the ecosystem. Other theories analyse closely stakeholder's interactions among different players when centred around a common interest, with these interactions helping to establish "The rules of the game" (Muldoon et al., 2022), Among the various 'business ecosystem' theories that exists, the model proposed by Jacobides provides a fitting angle for analysing ecosystems that are subject to governance changes, Jacobides' ecosystem is defined as a network of actors with the primary objective of creating value (Jacobides et al., 2018), Jacobides' ecosystem model includes four key elements:

- **Governance:** Ecosystems are held together by a central policy or framework that guides interactions within the system.
- **Dynamism:** Ecosystems constantly evolve, with value creation processes changing.
- **Modularity:** Actors within the ecosystem are continuously adapting and evolving.
- **Fungibility:** The value created within ecosystems can be interchangeable.

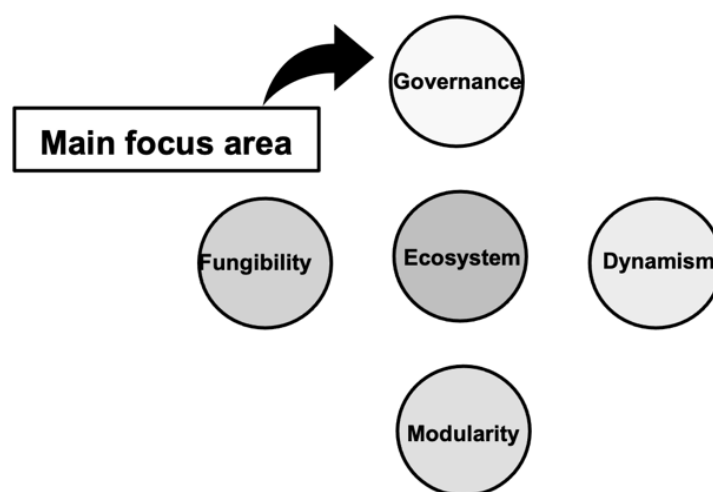


Figure 6 Jacobides Ecosystem theory focuses on a central governance influencing the value creation chain (Jacobides et al., 2018).

Jacobides' theory of ecosystem gives emphasis on the role of governance; This is particularly relevant in understanding how AI policy frameworks influencing value creation ecosystems.

2.2.3 AI Policy Frameworks

The influence of AI policy frameworks on regional business ecosystems is increasingly being studied in the academic world (Arenal et al., 2020); These explorations leverage novel methodologies to evaluate AI's adoption in terms of level, reach, and extent within various regions. One significant method to assess the level of AI policies influencing the regional ecosystem is by counting AI-related patents across different European legal jurisdictions to visualise regional AI penetration levels and the role of domestic AI policies in encouraging this phenomena (Buarque et al., 2020); this technique enables scholars to quantify the extent of AI's penetration into regional economies. Similar regional studies have been deployed in China, focusing on exploring the regional penetration of AI technology across various industrial sectors, These studies propose that the impact of AI can be quantitatively evaluated by analysing the evolving complexity of regional economies, Moreover, It has been found that regional clustering of AI enhances economic complexity, this has created an argument in which scholars are pushing for implementing targeted, micro-level policies in regional AI business ecosystems instead of broad, macro-level AI policy framework or strategies (Shoufu et al., 2023). (Korinek & Stiglitz, 2018) put forward the argument that dedicated policy initiatives are required to stimulate equal innovation across all societal sectors; such initiatives should aim to develop AI-centric policy frameworks and supporting tools that can reduce disparities created by AI technology and lessen potential losses, particularly in resource-scarce regions. Economists emphasise the importance of domestic AI frameworks as tools to foster innovation across a broad range of regional ecosystems. These AI policies should assist in the equitable distribution of wealth produced by AI technology and compensate for any losses it might incur, especially in sectors heavily reliant on unskilled labour (Korinek & Stiglitz, 2018), The current British AI policy recognises central governments' crucial role in coordinating and fostering the AI field across different ecosystems throughout the UK. According to the British government: “employing AI and technology is seen as an equalising medium that can profoundly change the British industrial sector”; this understanding is addressed in the existing industrial strategy framework launched by Theresa May's government; the framework stimulates economic growth by concentrating on several vital industrial pillars, including AI as one pillar (HM Government, 2017).

2.3 Research Gap

Various governments worldwide have significantly altered the AI sector's landscape by introducing AI policy frameworks. These frameworks are primarily aimed at fostering AI ecosystems via diverse methods such as resource allocation, network building, and research advancements; however, these frameworks, are designed with the idea that by defining the AI sector's regulations, the ecosystem and AI businesses can flourish, benefiting the entire industrial sector. Nevertheless, these frameworks adopt an institutional or centralised government perspective, a viewpoint that potentially restricts the evaluation of local AI SMEs' perspective. Academic research has encouraged centralised governments to implement such AI frameworks to foster the AI ecosystem and address regional disparities (Korinek & Stiglitz, 2018). There has been a lack of research exploring the impact of policy shifts on the AI ecosystem from a bottom-up perspective, specifically, examining the influence on enterprises of varying sizes (Arenal et al., 2020). Therefore, this research aims to address the identified literature gap by focusing on the current developments within the British AI ecosystem from a bottom-up perspective, this viewpoint enables an analysis of how SMEs - constituting the "bottom" - are navigating the current AI policy developments at a regional level – British AI policy framework represented by the "top". -, The bottom-to-top point of view provides insights into the operational responses of AI SMEs to policies intended to influence the AI ecosystem throughout Britain (Riemer et al., 2015). This analysis is achieved by adopting a methodology that facilitates research tools such as qualitative data collection and case study frameworks, enabling the observation and understanding of the ongoing phenomena (Eisenhardt, 1989). This analysis is achieved by adopting a methodology that facilitates research tools such as qualitative data collection and case study frameworks, which enable the observation and understanding of the ongoing phenomena (Eisenhardt, 1989).

Chapter 3 Research Methodology

3.1 Introduction

This research aims to fill an existing gap in the academic literature surrounding British AI ecosystems. This will be achieved by exploring how AI SMEs navigate and respond to the current AI Policy frameworks enacted by the British government, as referenced in Chapter 1; The Industrial Strategy framework of 2017 and the National AI Strategy of 2021 serve as two starting points for understanding contemporary AI policy developments (Horowitz et al., 2018). An evaluation of the roles played by the public sector in fostering these frameworks' efforts provide further context. Furthermore, the local councils where the SMEs are based have also been scrutinised; This research has been seen with an interpretivism research philosophical angle and an inductive research methodological framework; these frameworks are reinforced by three distinct case studies of AI SMEs located in various regions of Britain. These case studies intend to explore how external AI policy factors, such as the Industrial Strategy and the National AI strategy, make an impact to SMEs and influence internal interactions.

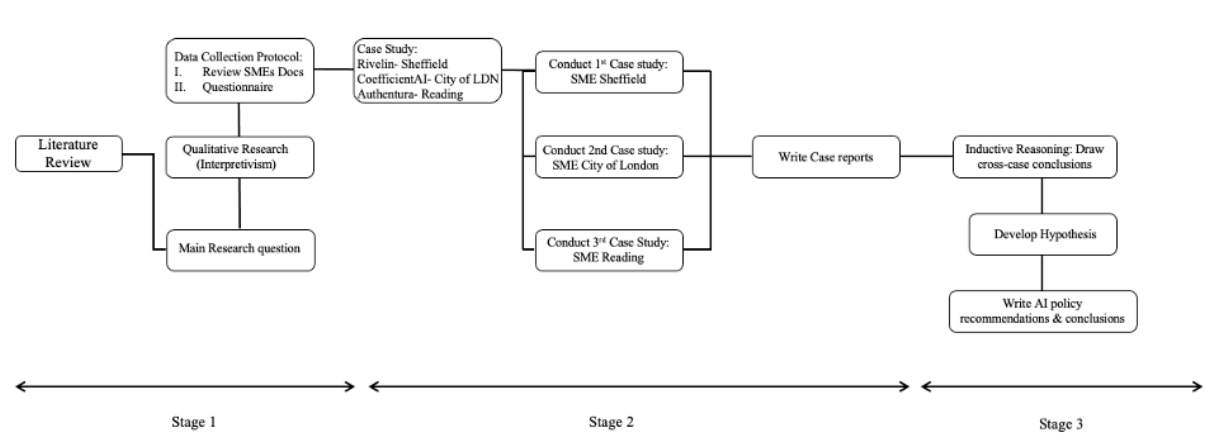


Figure 7 Research Design (Bendassolli, 2013) and (Yin, 2009).

Taking (Yin, 2009) methodological design approach allowed for an in-depth examination of the SMEs' internal and external factors and policy influences at a micro level. Consequently, the inductive and qualitative methodology protocol facilitated an understanding of how AI policy frameworks impact AI SMEs' decision-making processes (Hill & Tiu Wright, 2001). It also addressed the responses of policymakers to the reactions of AI SMEs, as evidenced by reviewing existing frameworks, policies, or initiatives. This led to the formulation of the central research question:

"How do regional AI SMEs have access to policy frameworks, resources or networks?"

The anticipated outcome of this research is:

“An analysis of how AI industrial policies influence local AI SMEs in Britain.”

To assess the internal, external, and policy influences, three separate sets of sub-questions were developed to explore perspectives from the SMEs, the public body or council, and finally, the Government. The construction of these sub-questions will be analysed on the following sections on this chapter.

3.2 Research Philosophy

Interpretivism served as a philosophical tool for this research; Interpretivism emphasises the comprehension of unique social experiences, perceptions, and motivations (Alharahsheh & Pius, 2019); Interpretivism enabled this research to comprehend the unique context of AI SMEs'. Moreover, interpretivism is was a philosophical tool and an effective vehicle that facilitated a deeper understanding of the current evolving landscape faced by the AI SMEs within the British policy context (Paul, 2022), it opened a window into the SME internal context, enabling a first-hand observation of the SME experiences and interpretations.

3.3 Qualitative Approach

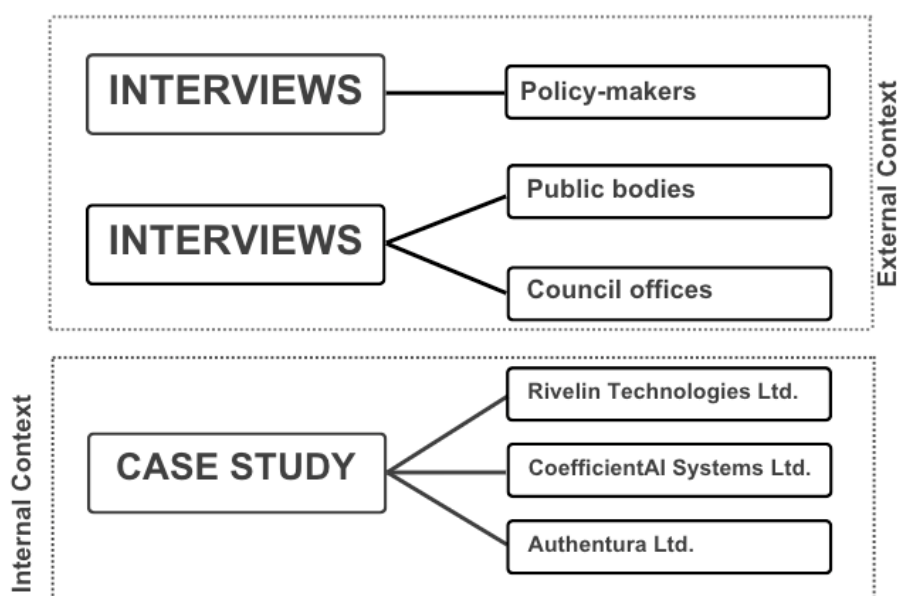


Figure 8 Research Design (Eisenhardt, 1989).

Interviews are significant resources and tools for validating field observations and documents (Eisenhardt, 1989). The interviewing process, designed in distinct stages, focused first on the leadership teams within the SMEs. Regardless of size, co-founders and leadership teams are pivotal decision-makers within any enterprise. These interviews facilitated cross-referencing of internal documentation procedures and operational decision-making (Yin, 2009). The second group of interviewees comprised council members from Sheffield, the City of London, and Reading, where the three companies are based. The goal of this stage was to triangulate the internal perspectives of the SMEs and link them to the external context of their respective locales. Moreover, interviewing council members helped assess the level of AI policy implementation, such as the industrial strategy. Public bodies like the Turing Institute and Innovate UK were also interviewed in the third stage, these interviews offered insights into the coordination between public bodies and local councils. Finally, the last stage of the interviewing process involved interactions with Parliamentary members. These discussions helped gauge policymakers' stances regarding the existing policy frameworks. This multi-tiered interview approach gave depth and breadth to the understanding of the dynamics within and around AI SMEs.

3.3.1 SME Context

To better comprehend the internal dynamics of SMEs as they navigate the introduction of AI policy frameworks set forth by The British government, a series of questions were formulated. These questions are explicitly directed at the leadership team within the SMEs, comprising roles such as the Chief Operational Officer, Chief Product Officer, and Chief Technical Officer. The intent of these queries is to evaluate how external forces are shaping the decision-making process of these crucial figures and, reciprocally, how their decisions are influencing the company's internal operations (Parida et al., 2012). It is critical to bear in mind that not all SMEs follow a traditional leadership board structure. For instance, in some SMEs, a single individual may hold the dual roles of Chief Executive Officer and Chief Technical Officer. Consequently, the following sub-questions have been tailored to reflect the reality of each SME's board structure, aiming to illuminate the impact of external influences on internal operations and decision-making processes.

3.3.2 External Context

To comprehend the SMEs' external context and evaluate the extent of integration of the Industrial Strategy framework within local councils, several sub-questions were developed and posed to council members spearheading digitalisation, Innovation, and Technology efforts. The

formation of these questions was guided by the primary research question and the responses from the SMEs to the questionnaire detailed in Section 3.5.2 Interviews; This methodological design facilitated the creation of a feedback loop between the AI SMEs and the local council. This feedback mechanism served a dual purpose. Firstly, it helped to illuminate the extent of influence Council decisions exert on SMEs' decision-making processes (Rolfo & Calabrese, 2003). Secondly, it aided in establishing how AI policy frameworks have been operationalised within the councils under examination and whether these frameworks engender synergy among SMEs, regional actors, and public bodies, The central government context of British policymaking, such as the House of Lords and House of Commons, play significant roles in this study. Notably, the House of Lords, through the APPG AI² has taken the helm in analysing and debating current AI Policies and Frameworks (Kathrani, 2015). A series of questions were constructed to analyse the degree of coordination between government entities and public bodies. These questions aim not only to scrutinise the dynamics of their interactions when handling current AI frameworks but also to assess the level of synergy and communication between councils, public bodies and government representatives. The formulated questions aim to explore the interaction among these various stakeholders within this context. The objective is to evaluate how this synergy influences decision-making within AI SMEs (Weber et al., 2022).

3.4 Case Study

As pointed out by (Eisenhardt, 1989), case studies serve as a great tool allowing researchers to analyse complex phenomena. The procedure of a case study involves meticulous observations and data collection, thereby offering a comprehensive perspective of social phenomena. This process enables researchers to decode the meanings and understandings prevalent in the studied context. Complementing this, (Yin, 2009) argues that a systematic and thoughtful case study design aids researchers in logically connecting the data to the research goal, facilitated by established criteria that help interpret the findings. Therefore, incorporating case studies as a research tool. It incorporates an additional angle through which the evolution of phenomena can be examined and offers context for comprehending how various actors respond to external and internal influences. As part of this research, three case studies were conducted on three AI SMEs. The first case study was Rivelin Technologies Ltd., legally registered within the boundaries of Sheffield Council, part of South Yorkshire County. The second case study

² APPG AI is indeed an All-Party Parliamentary Group on Artificial Intelligence, it would suggest that it is a group of parliamentarians who come together to discuss and address issues related to artificial intelligence in a cross-party manner.

involved CoefficientAI Technologies Ltd., which is legally registered within the boundaries of the City of London, a borough that forms part of the London metropolitan area. Lastly, the third case study was carried out at Authentura Ltd., legally registered within the boundaries of the City of Reading, part of the Royal County of Berkshire. The objective behind conducting these three case studies was to gain an internal understanding of how governmental AI frameworks influence AI SMEs across different regions and to ascertain if the internal decisions of these SMEs are moulded by external factors originating from the decisions of councils and public bodies. Further insights into how these external and internal factors impact SMEs will be addressed in the subsequent chapters.

3.5 Data Collection Methods

3.5.1 Documentation Review

The review of documentation played an instrumental role in discerning the decision-making processes and responses of SMEs, Public Bodies, Councils, and Parliamentary bodies with the implementation of AI policy frameworks. Consequently, the process of document review was partitioned into three distinct categories, as seen in Figure 9.

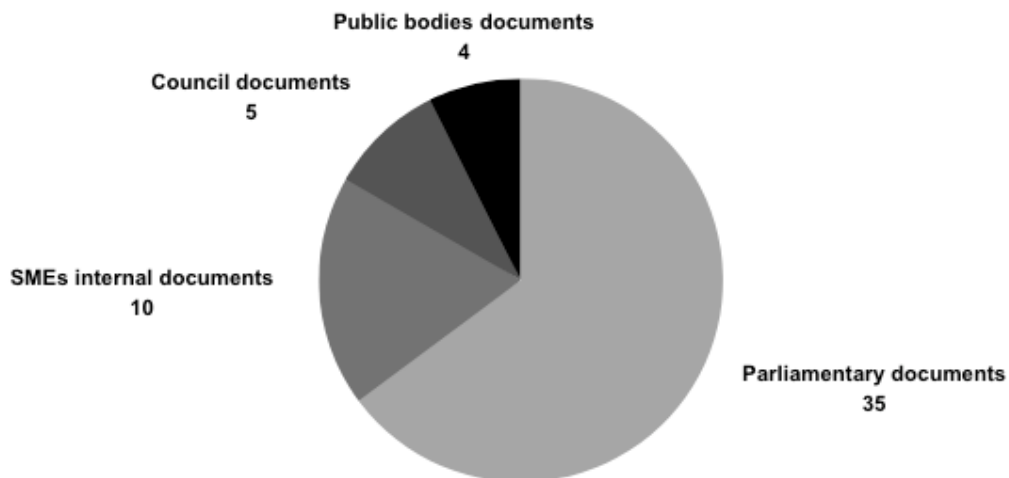


Figure 9 Pie chart with a breakdown of documents reviewed.

This method facilitated an understanding of the evolving operations of SMEs over a specific period, namely from 2018 to 2023 (Hancock et al., 2021). The second category assisted in evaluating how public bodies are navigating discussions surrounding AI-level policymaking. Lastly, the third category contributed to an understanding of how the instruments of public bodies are fostering an environment conducive for AI SMEs to flourish.

Table 3 Documents Reviewed List.

Institution	Document type
CoefficientAI	Historical Financial Document
Rivelin Technology Ltd.	Product document
Sheffield Council	Entrepreneurial policy frameworks
Innovate UK	Grant scheme forms
Authentura Ltd	Operational documents
British Parliament	APPG AI hearings
British Parliament	AI Policy reports

3.5.2 Interviews

Exploratory interviews are valuable resources and tools for validating field observations and documents (Palinkas et al., 2015); The interviewing process, designed in three distinct stages as outlined in Figure 8, focused first on the leadership teams within the SMEs as seen in Table 4; Regardless of size, co-founders and leadership teams are pivotal decision-makers within any enterprise, these interviews facilitated cross-referencing internal documentation procedures and operational decision-making (Farquhar et al., 2020); The second group of interviewees comprised council members from Sheffield, the City of London, and Reading, where the three companies are based. The goal of this stage was to triangulate the internal perspectives of the SMEs and link them to the external context of their respective locales. Moreover, interviewing council members helped assess the level of AI policy implementation, such as the industrial strategy. Furthermore, Public body members like the Turing Institute and Innovate UK in the third stage were also interviewed. These interviews offered insights into the coordination between public bodies and local councils. Additionally, the last stage of the interviewing process involved interactions with Parliamentary members. These discussions helped to gauge policymakers' stance regarding the existing policy frameworks. This multi-tiered interview approach lent depth and breadth to our understanding of the dynamics within and around AI SMEs, shedding light on the interconnected layers of policy, enterprise decision-making, and regional ecosystems.

Table 4 Interviews details, with an average duration of 42 minutes.

#	Institution	Role	Level	Region	Interview Style	Total Duration	Interview Type
1	Stanford HAI	Researcher	University	California	Exploratory	30 Minutes	Pilot Interview
2	Fulcrum	CTO	SME & Industry	Greater London Area	Exploratory	20 Minutes	Pilot Interview
3	Vyntelligence	Researcher	SME & Industry	Portsmouth	Exploratory	20 Minutes	Pilot Interview
4	Rivelin Technology Ltd.	CEO	SME & Industry	Sheffield	Exploratory	60 Minutes	SME Internal Context
5	Rivelin Technology Ltd.	CTO	SME & Industry	Sheffield	Exploratory	60 Minutes	SME Internal Context
6	Rivelin Technology Ltd.	CPO	SME & Industry	Sheffield	Exploratory	60 Minutes	SME Internal Context
7	Sheffield Council	Technologist	Public & Council	Sheffield	Exploratory	30 Minutes	External Context
8	Sheffield Council	Economic Development	Public & Council	Sheffield	Exploratory	15 Minutes	External Context
9	CoefficientAI Systems Ltd.	CEO	SME & Industry	City of London	Exploratory	50 Minutes	SME Internal Context
10	City of London	Technologist	Public & Council	City of London	Exploratory	30 Minutes	External Context
11	Authentura Ltd.	CTO	SME & Industry	Reading / Cambridge	Exploratory	50 Minutes	SME Internal Context
12	Authentura Ltd.	CPO	SME & Industry	Reading / Cambridge	Exploratory	60 Minutes	SME Internal Context
13	Reading Council	Technologist	Public & Council	Reading Council	Exploratory	15 Minutes	External Context
14	Innovate UK	Portfolio Investor	Public Body	Greater London Area	Exploratory	15 Minutes	External Context
15	The Alan Turing Institute	Researcher	Public Body	Greater London Area	Exploratory	45 Minutes	External Context
16	Newspeak House	Technologist	Non-profit.	Greater London Area	Exploratory	30 Minutes	External Context
17	House of Lords	Policy Maker	Public & Government Area	Greater London	Exploratory	45 Minutes	External Context

The interview questions were crafted to explore central practical implications, by initiating the interviews with general and broad inquiries, the process was designed to foster open

discussions, even in areas that might not be readily apparent at first glance, to avoid any biases in the interviewing process and to enable dialogue among the interviewees (Sedgwick, 2013).

Table 5 SMEs Questionnaire

#	Role	Question
1	CEO	Why is (The company) based in (Location)?
2	CEO	How would you assess the technological ecosystem in (Location) compared with other England cities?
3	CEO	Who are the key stakeholders, and their roles within the AI/tech ecosystem in (Location)?
4	CEO	Have you heard (or applied) of UKRI, Innovate UK, Turing Institute or any other similar public bodies?
5	CEO	Has there been a council-level regulation or policy that has enabled or limited (COMPANY) growth?
6	CEO	Are there any challenges and barriers and challenges (COMPANY) face in training or finding qualified professionals to work for the company?
7	CEO	How does the (Location) ecosystem foster collaboration and knowledge sharing among different researchers and organizations based on your experience as CEO?
8	CEO	Is the company aware of Parliament's White paper and Industrial strategy initiatives?
9	CEO	Is the company optimistic about (Location) role in fostering AI technology?
10	CPO	How is (COMPANY) leveraging AI technologies to drive innovation and gain a competitive advantage in the industry the company is in?
11	CPO	What are your key challenges and opportunities in implementing AI solutions within (COMPANY) operations and processes?
12	CPO	What are the emerging trends and advancements in AI research and development that your team is closely monitoring or actively exploring?
13	CPO	How do you approach integrating AI technologies within (COMPANY) existing systems and infrastructure, and, what considerations do you consider?
14	CTO	Has there been a council-level regulation or policy that has enabled or limited (COMPANY) growth?
15	CTO	What considerations do you take into account when selecting and integrating AI technologies or platforms into your product?
16	CTO	Can you share examples of successful AI-driven products or features that have had a significant impact on customer experience or business outcomes?
17	CTO	Is the company aware of Parliament's White paper and Industrial strategy initiatives?

Table 6 Council Members Questionnaire.

#	Role	Question
1	Council Member	How would you assess the AI ecosystem in (Council) compared with other Northern/Southern England cities?
2	Council Member	Who are the key stakeholders, and their roles within the ecosystem in (Council)?
3	Council Member	How is the (Council) supporting local AI SMEs and companies in light of the economic potential of the AI sector?
4	Council Member	What initiatives does the council have in place to promote entrepreneurship in AI?
5	Council Member	How does the council aim to promote collaboration between AI start-ups and academic institutions for research and development?
6	Council Member	How does the (Council) ecosystem foster collaboration and knowledge sharing among different researchers and organizations?
7	Council Member	How does the (Council) plan to assist AI start-ups in securing their intellectual property rights?
8	Council Member	Are there any specific resources or support systems available for AI SMEs during their initial stages of development?
9	Council Member	Are there plans to establish any AI-specific business incubators or accelerators in (Council)?
10	Council Member	Is the (Council) aware of the AI White Paper and Industrial Strategy?
11	Council Member	How does the (Council) aim to promote collaboration between AI start-ups and academic institutions for research and development?

Table 7 Government and Public Bodies Questionnaire.

#	Role	Question
1	Government Public Bodies	With AI ecosystems likely to influence future economic competitiveness, how is our government fostering AI SMEs development in different regions of Britain?
2	Government Public Bodies	How does the government intend to balance the need for innovation in the AI ecosystem outside of the capital?
3	Government Public Bodies	Are there any plans to work closely with councils when it comes to AI frameworks like the Industrial Strategy?
4	Government Public Bodies	How do you make sure AI SMEs are involved in AI policy decision-making?
5	Government Public Bodies	How would you assess UKRI and Innovate UK structures?

6	Government Public Bodies	How does the (Council) ecosystem foster collaboration and knowledge sharing among different researchers and organizations?
7	Government Public Bodies	How does the (Council) plan to assist AI start-ups in securing their intellectual property rights?
8	Government Public Bodies	Are there any specific resources or support systems available for AI SMEs during their initial stages of development?
9	Government Public Bodies	Are there plans to establish any AI-specific business incubators or accelerators in (Council)?
10	Government Public Bodies	Is the (Council) aware of the AI White Paper and Industrial Strategy?
11	Government Public Bodies	How does the (Council) aim to promote collaboration between AI start-ups and academic institutions for research and development?

3.5.3 Field Observations

Visits were conducted to two of the three companies under this research; the third company operates remotely, making a field visit unfeasible; (Eisenhardt, 1989) Suggests that field visits are valuable tools to gain a first-hand perspective on the phenomenon under study and build confidence in the gathered observations (Tellis, 1997). Field observations included visits to the premises of the SMEs to witness first-hand how key decision-making actors interacted with each other and formed company-related strategies. These visits provided direct insight into these organisations' operational dynamics and decision-making processes.

Table 8 Field Observations List

Institution	Date of Observations	Days	Type of Observation	Outcome
CoefficientAI Systems Ltd.	June 14th & July 6th, 2023	2	Participant	Internal SME Operations
Authentura Ltd	June 25 th , 2023	1	Participant	Internal SME Operations
London Tech Week	June 22 nd , 2023	4	Participant	Pilot AI & Tech Ecosystem assessment

3.6 Thematic Data Analysis Method

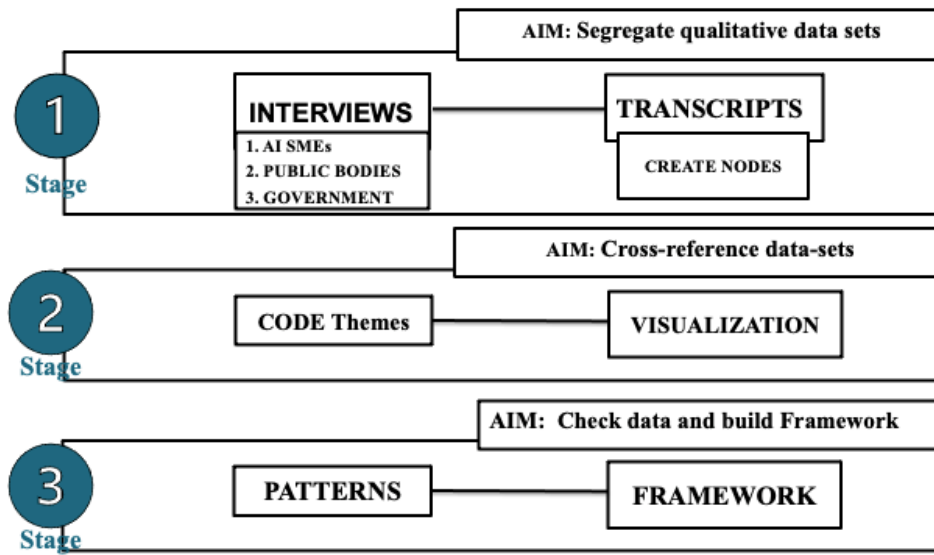


Figure 10 Data Analysis Protocol.

The Data Analysis method applied to this research was thematic; this data analysis methodology, commonly used in qualitative research method aids the researcher in spotting patterns within data; as required by this research, the main goal was to see if there are any common or differential patterns among the three interviewees, Thematic analysis is known for its flexibility and its adaptability when applied to different of theories (Castleberry & Nolen, 2018).

The Data analysis method was divided into three stages, as seen in Figure 10.

Stage 1: This stage was enabled by creating interview transcripts; those transcripts were separated or segregated into three different groups; Group 1: AI SMEs, Group 2: Council and Group 3: Public Bodies and Government; this stage aimed to find common and differential themes among these different groups (Braun & Clarke, 2006), Themes were created in each of those themes as seen Appendix A.

Stage 2: This stage involved triangulation of data collected; the coded themes helped this research to visualise if there were any patterns worth looking at, and NVivo software was used.

Stage 3: The final stage enabled this research to find common and differential patterns among the different code themes, enabling cross-checking patterns

Chapter 4 Findings

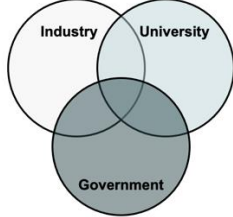
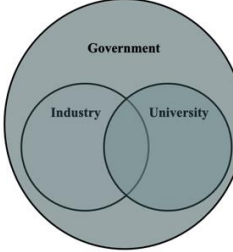
4.1 SME Stakeholder and Ecosystem assessment frameworks

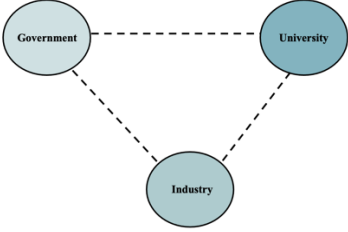
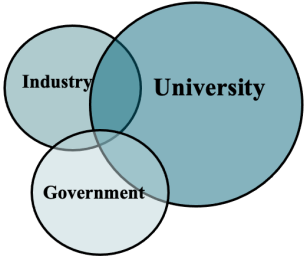
The data collection analysis and the main research question required two frameworks to pinpoint where the three analysed SMEs stand within both stakeholder (Leydesdorff, 1995) and ecosystems governance (Jacobides et al., 2018). These two frameworks are further explored in the following sections of this chapter, alongside the findings.

4.1.1 Stakeholder Analysis

Based on the inductive data collection process made across Rivelin, CoefficientAI, and Authentura, alongside interviews done with council members developing policy to foster AI SMEs in their jurisdictions, this research has adopted an updated version of (Leydesdorff, 1995) triple-helix stakeholder model made by (Ranga & Etzkowitz, 2013), t In evaluating the decision-making processes within three AI SMEs, this study by adopting a bottom-up methodology to analyse the distinct strategies across the three SMEs and subsequently integrating these findings into the model delineated in Table 9, these findings offers a nuanced and adaptive examination of the subject matter.

Table 9 Stakeholder Assessment Criterion.

Variation Model	Type
 <p data-bbox="328 1460 504 1487">Balanced Model</p>	<p data-bbox="619 1227 1362 1348">As the “ideal” model, all involved stakeholders: Industry, University and Government, are equal forces of influence within an organisation decision making process.</p>
 <p data-bbox="344 1796 488 1823">Statist Model</p>	<p data-bbox="619 1527 1362 1738">In the “statist” model, in this model government plays a significant role in influencing an organisation; this influence could be in the shape of policies aiming to influence decision-making or public resources aimed at specific sectors; in this model, the government has an essential role of setting the rules of the game.</p>

 <p style="text-align: center;">Laissez-Faire Model</p>	<p>The Laissez-Faire model is, in essence, the opposite of the Statist model; It could suggest a system where the collaboration between universities, industry, and government occurs with minimal governmental influences; Laissez-faire model could take the shape of organisations relying heavily on private equity to raise capital to keep running operations.</p>
 <p style="text-align: center;">Academia Model</p>	<p>The Academia model; universities take a significant role in fostering innovation and entrepreneurship; these could be in the shape of university SME spinouts, incubators or programs to foster value creation through entrepreneurship.</p>

4.1.2 Ecosystem Governance Matrix

	RISKS	OPPORTUNITIES
GOVERNANCE	Implementation of complex regulatory AI SMEs frameworks	Efforts coordination with councils and universities
	Not implementing public resources that enable SME growth	Bring AI SMEs founders into policy making conversations
	Not decentralised public bodies*	Create hybrid private-public initiatives to foster AI SMEs.

Figure 11 SMEs Ecosystem Governance Analysis Matrix.

Through the inductive data analysis protocol taken in this research, several themes and codes were analysed; Risk and Opportunities patterns were identified through the analytical process. For example, SMEs identified certain risks in which their operations could be affected if specific AI policy frameworks were to be introduced in Britain. Moreover, several opportunities identified by the interviewees, are seen in Figure 11. This framework enables this

research to analyse AI SMEs' stand when it comes to AI policy frameworks being introduced in Britain.

4.2 Case Study I: Rivelin Technology Ltd.



Figure 12 Rivelin team in a conference early this year.

This chapter provides an in-depth examination of the first case study in this research project, focusing on Rivelin; this section analyses the SMEs' internal interactions. Observations and interviews were conducted with Rivelin Technologies Ltd., the enterprise legally incorporated and registered in Sheffield, Yorkshire, England. The company's internal structure is distinctly divided, as illustrated in Figure 13.

4.2.1 Background

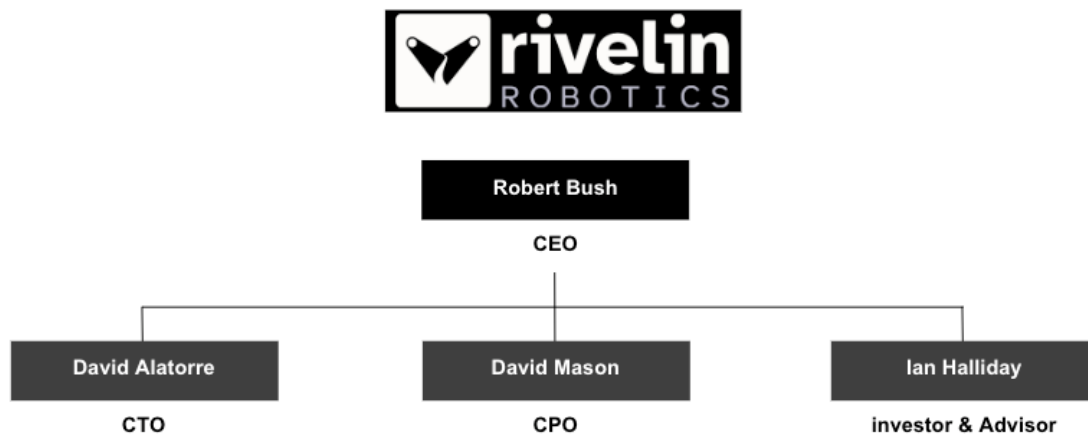


Figure 13 Rivelin Internal Structure.

Rivelin's value proposition is to support the manufacturing production journey for its partners, particularly in the field of metal additive manufacturing sector, the SME aims to maximise value by providing comprehensive support throughout various stages; Rivelin Robotics takes

care of the software, hardware, service, and preventative maintenance, indicating that they offer a holistic approach to ensuring smooth operations for their partners.; AI is a fundamental component of Rivelin's product development roadmap; Rivelin is applying AI to autonomously programme robots for metal manufacturing post-processing applications. Moreover, AI technologies have been integrated into the product to scan and align the physical parts to the digital data file. This has dramatically improved accuracy, repeatability, and quality for customers. Rivelin Technologies Ltd. offers a unique value proposition by providing end-to-end support for its partners in the metal AM sector. Their services extend across software, hardware, customer service, and preventive maintenance, embodying a comprehensive and holistic approach that ensures seamless operations for their partners. Rivelin closely collaborates with its clients to create a smooth transition from their factory floor to the client's facility; AI is pivotal to Rivelin's product development strategy, the SME is harnessing AI to programme robots autonomously for post-processing applications in metal manufacturing; Rivelin has integrated AI technologies into its products to enable the scanning and alignment of physical components with their digital counterparts. This integration has resulted in substantial improvements in accuracy, repeatability, and quality for their customers, reinforcing their value proposition.

4.4.2 Rivelin Stakeholder analysis

Rivelin has effectively harnessed public funds to boost its research and development initiatives; One of the co-founders mentioned that the company has successfully applied for grant schemes from Innovate UK and has procured substantial resources through this source; The funds secured from Innovate UK have driven the company's internal Research and Development initiatives, significantly impacting its operations.

“ Rivelin has engaged with Innovate UK and we've applied for funds from Innovate UK. It is a patient source of funding, suited to R&D, not to growth. [P2]”

The SME access to Innovate UK resources has been pivotal in the company's rapid growth; The exploration of Rivelin's trajectory pinpoint instances where public funding has significantly influenced the success of SMEs that are in early stages; Moreover, these financing methods have not necessarily fostered the company's long-term growth strategies.

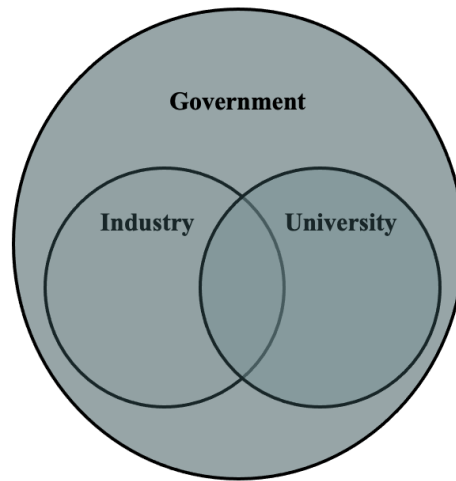


Figure 14 Rivelin has used public funds to operate, as seen in the Statist Model.

In the context of the Rivelin case study, the stakeholder analysis has been applied in the following ways:

1. **University:** The University of Sheffield was critical in fostering partnerships with Rivelin for testing projects in the SME early stages.
2. **Industry:** Rivelin's offerings are primarily designed for industrial and manufacturing contexts; its customer base in Germany has seen considerable growth over the past few years. This international outreach has been primarily facilitated through the company's consistent participation in various industrial and manufacturing fairs across Germany and partnerships with European private partners.
3. **Government:** Innovate UK initiatives to incentivise Rivelin to engage in entrepreneurial activities by public funds for early research and development has played a significant role.

In the assessment criterion, the significant role to fund Rivelin r&d efforts has created great influence in the SME, thus government has been a facilitator and it falls into '**statist model**', fostering collaboration between Rivelin and the government; in a practical sense, the analysis as seen in Figure 14, where it is clear to see an increasing government role as a leading player in fostering the AI ecosystem by providing these incentives to SMEs like Rivelin, however, one of the SME co-founders emphasised that, heavy regulation on cybersecurity could be harmful for the SME.

“Cybersecurity. Protection of data, who owns the data and where it is stored needs to be addressed...[P2].”

4.2.3 Rivelin Ecosystem Governance analysis

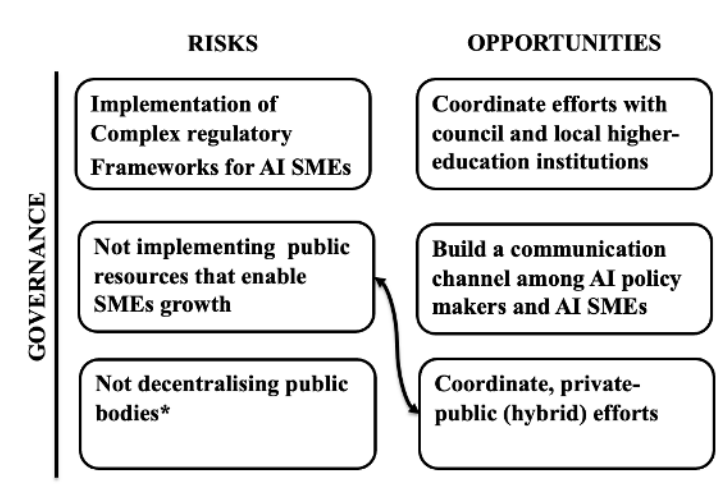


Figure 15 Rivelin Main governance concerns are towards complex AI regulatory frameworks.

The data analysed revealed Rivelin's response to the current AI policy frameworks introduced at both the council and country levels; in the voice of the SME's chief product officer:

"There hasn't been council-level regulation or policy from the council. Potential regulation or policy could limit Rivelin's ability to innovate and could favour large multinational incumbents with the legal teams to navigate large complex frameworks. [P4]"

As seen in Figure 15, Rivelin sees AI policy governance concerns, the introduction of complex frameworks that would pose a threat to SMEs and benefit big corporations; moreover, Sheffield Council member's response to those concerns:

"The council has been able to work alongside different stakeholders in higher education and private sector, through the 'Sheffield Digital', in this platform all those stakeholders engage into debates on current AI policies implemented at the council and county level....[P6]"

4.3 Case Study II: CoefficientAI Systems Ltd.



Figure 16 CoefficientAI's attending a PyData³ networking meeting in London.

This chapter navigates a comprehensive examination of the second case study conducted as part of this research project, exploring on CoefficientAI; This chapter provides an in-depth examination of the second case study carried out in this research project, focusing on Rivelin, in this section the SMEs internal decision-making is analysed, Observations and interviews were undertaken at CoefficientAI Technologies Ltd, which is legally registered in the boroughs of the City of London and the City of Westminster, part of the Greater London Metropolitan area, The internal structure of the company is distinctly divided, As illustrated in Figure 17.

4.3.1 Background

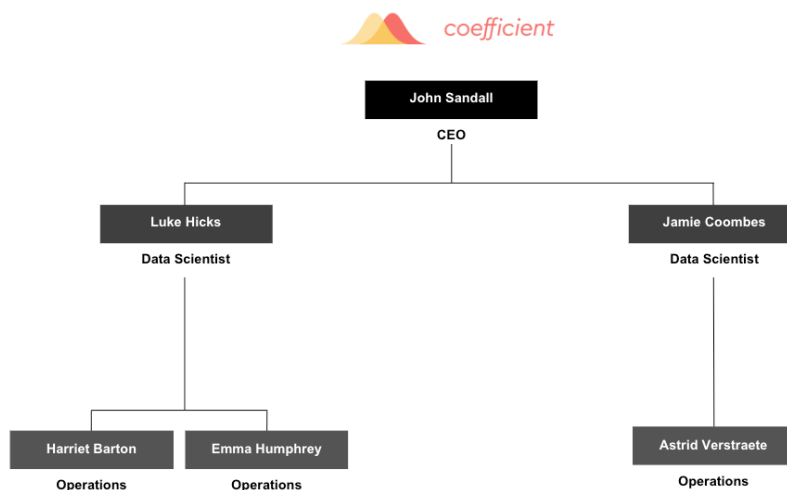


Figure 17 CoefficientAI internal structure.

³ PyData refers to a community of python enthusiasts that gather in London once a month.

CoefficientAI Technologies Ltd.'s value proposition lies in its broad range of data science and AI services, offering comprehensive solutions covering every data science life cycle stage. Their offerings span the breadth of data analysis, predictive modelling, software development, and AI implementation. The company differentiates itself through its multidisciplinary team, able to handle complex, interdisciplinary projects. By assembling a group of data scientists, software engineers, statisticians, and machine learning PhDs, they can deliver robust, holistic solutions that address the technical aspects and the business and practical implications of the problems they are solving.

4.3.2 CoefficientAI Stakeholder analysis

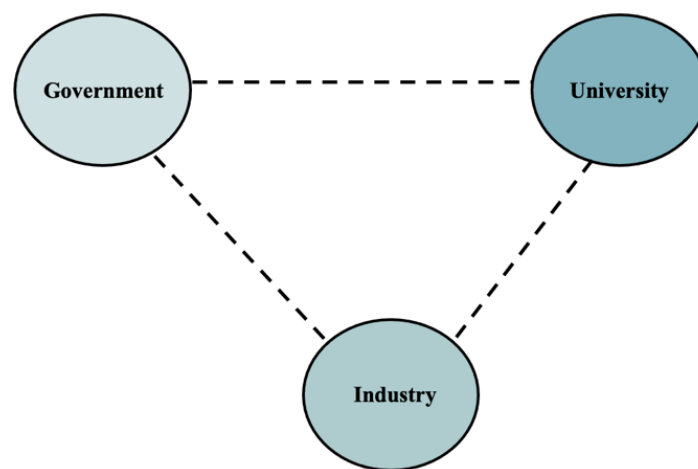


Figure 18 CoefficientAI leverage private resources to foster its operations.

Originally based in the Bristol AI tech scene, CoefficientAI strategically relocated its operations to London, a city known for its vibrant tech ecosystem; This move was primarily motivated by the need for more incentives and support for the tech industry in Bristol at the time, which made it challenging for the SME to grow and thrive there, Moreover, CoefficientAI highlighted a critical challenge that the SME faced when navigating the public funding landscape - the complexity and resource-intensive nature of specific public funding schemes, especially when requiring advanced financial planning and projections, which cause troubled to the SME while applying for the fund scheme.

“The Innovate UK grant scheme process is way too complex, at the time of filling the fund request proposal, my co-founder and I did not have the expertise to fill the financial plan section, we submitted our application regardless, and we got rejected from the scheme [E3]”

Given these challenges, CoefficientAI ultimately decided to look for private equity funding. While this course comes with its challenges and considerations; it highlights the flexibility that the SME needed to exhibit to secure the necessary funding for growth and expansion. In the Context of the Coefficient case study, given the significant role the private sector have had in enabling Coefficient to grow, this is seen in the stakeholder model analysis as **the ‘Laissez-faire’**, this analysis has been applied in the following ways:

1. **University:** The SME has not partnered up with any high-level education in any shape or form.
2. **Industry:** According to the co-founder, the SME managed to secure money, through private equity channels, this alongside building partnerships across different private enterprises in London, has aided CoefficientAI in keeping growth.
3. **Government:** The experiences of CoefficientAI raise considerations for policymakers regarding how to design funding schemes and support mechanisms that are more accessible early-stage ventures.

“The government should provide co-founders more accessible public funding options, and not predatory public funding contracts... [P2]”

The SME references the complex public fund scheme, according to the cofounders, needs to change; in changing that, the government will manage to foster a better AI SME ecosystem.

4.3.3 CoefficientAI Ecosystem Governance analysis

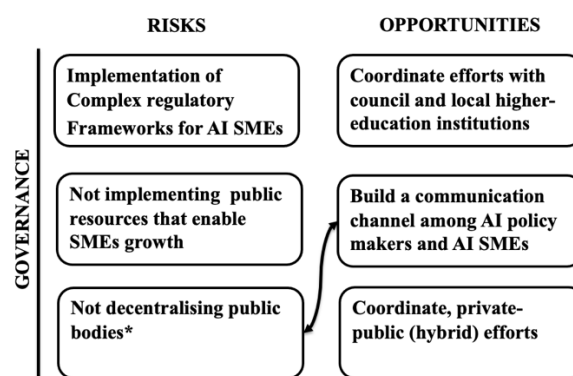


Figure 19 CoefficientAI sees as an opportunity to build a communication channel between co-founders and policy makers.

Assessing the SME experience while navigating London and Bristol ecosystems in the last few years, The co-founder emphasised the need for public bodies and SME founders to build a communication channel and invite AI SME founders to sit at the table when policymakers are making decisions about AI, as seen in Figure 19.

“The true is, when I moved to Bristol a couple years back to found my start-up, the tech community was non-existent, this became a huge challenge, so after a few years I decided to pack my bags and move back to London. [P2]”

The company's experience in Bristol highlighted the importance of being part of a supportive tech community for its growth and success and the role of AI policy framework to achieve that.

“Ecosystems are all about building communities, to network, share knowledge and ideas, and I believe the government should help co-founders to build a better community, especially in regions away from London. [P2]”

CoefficientAI made the strategic decision to engage with the PyData community with the end goal to leverage the strengths of London's tech ecosystem to its advantage; The SME active participation in the PyData community serves as an example of how SMEs can thrive in a supportive and collaborative environment; It also underscores the importance of policy frameworks that encourage the growth and development of the ecosystems, said the co-founder.

4.4 Case Study III: Authentura Ltd.



Figure 20 Authentura co-founders at a pitch competition early this year.

This chapter navigates a comprehensive examination of the third case study conducted as part of this research project, exploring on Authentura; This chapter provides an in-depth examination of the third case study carried out in this research project, focusing on Authentura, in this section the SMEs internal decision-making is analysed, Observations and interviews were undertaken at Authentura Ltd, which is legally registered in Reading, Borough of Berkshire, The internal structure of the company is distinctly divided, As illustrated in Figure 21.

4.4.1 Background

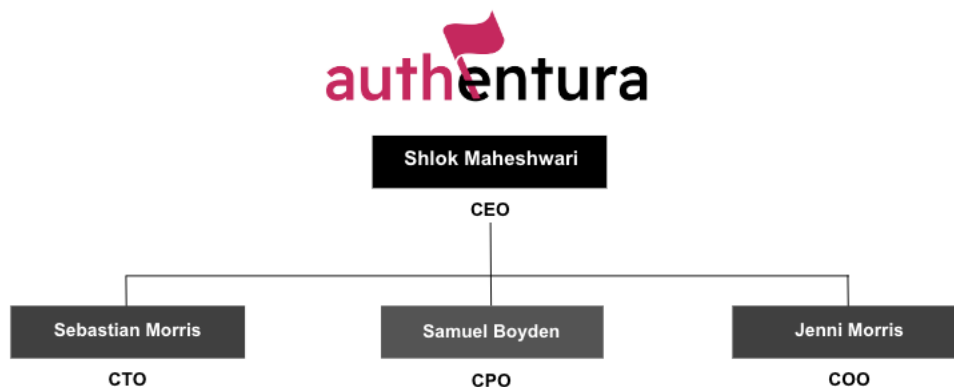


Figure 21 Authentura internal structure.

Authentura's value proposition involves empowering programmers to avoid potential quality assurance issues during the coding process; Authentura's development has been primarily influenced by the entrepreneurial ecosystem at The University of Reading, with three board

members being students at the university. As per the accounts of the CEO and CTO, the university has provided initial resources since late 2021, contributing to the slow but steady growth of the SME and further advancement of their idea, The SME is still in its early stages, However, the Henley Business School ecosystem, particularly its expansive network of angel investors and venture capitalists, has played a crucial role in Authentura's journey. Authentura is currently developing an early version of its software, the product has a machine learning-driven plug-in interface tool designed to alert users when they omit crucial features in their code. The CEO underscores the fact that many I.T. security breaches resulting from hacker activities originate from programmers' inability to detect errors while writing code; Authentura's mission is to streamline the programming quality assurance process, enabling programmers to conserve time and effort while saving companies money. Although the SME is still developing the beta version of its software, they have rolled out a Minimum Viable Product to several partner companies for testing and proof of concept validation. These trial runs have proven beneficial, as Authentura has been able to gather valuable client-specific data, which has been utilised to improve the ongoing development of the beta version of the software.

4.4.2 Authentura Stakeholder Analysis

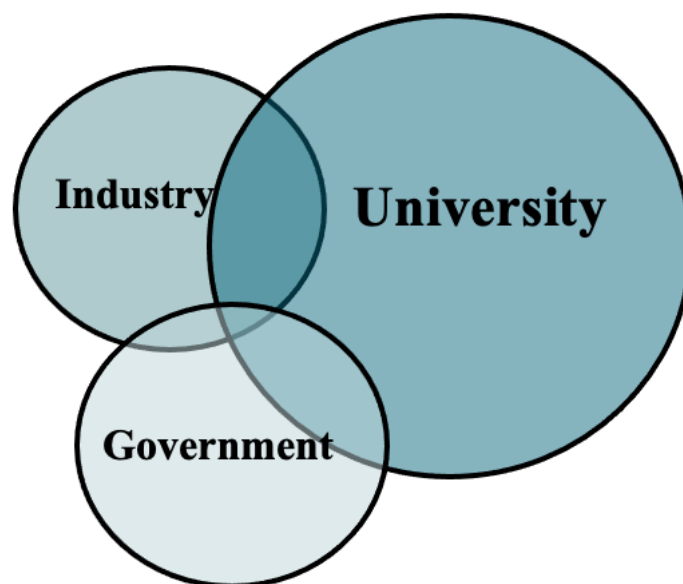


Figure 22 Authentura close ties with Henley Business School is shown in the 'Academia Model'

Authentura was conceived in 2020, originating as a modest university project. Its co-founders, possessing several years of professional experience in the programming quality assurance

industry, identified a significant need for developers and companies to streamline their coding quality assurance processes. Leveraging the vibrant tech ecosystem in Reading, which boasts one of the region's best business schools, the co-founders swiftly developed prototypes. The co-founders started pitching their ideas to potential partners and investors.

“We managed to take advantage of Henley Business School VC network, in which we won seed capital that helped us to keep developing the MVP [E7].”

Given Reading's proximity to London, the SME has managed to gain access into the capital's vibrant AI ecosystem resources; However, in terms of raising type A capital, Authentura has been seeking for private funding, they quote the complex nature of public funding schemes and unfriendly co-founder agreements with certain public bodies as the reasons for their decision to not apply for any current public funding schemes.

“We haven't heard of public funding schemes as much as we have heard from angels, or VCs, we don't want the hassle of dealing with the government, honestly [E8].”

In the Context of the Authentura case study analysis, given the SME close ties with the academic world, the stakeholder analysis falls **into the Academia model as seen** in Figure 22, and can be summarised as:

1. **University:** The SME has built a strong partnership with Reading University; this synergy has enabled the SME to develop a product prototype further. Moreover, the University has facilitated key external partners where Authentura conduct software deployment trials.
2. **Industry:** The SME has engaged with potential private partners on deploying potential software trials to achieve the SMEs' flagship product proof of concept.
3. **Government:** Although they are aware of Innovate UK grants and the Industrial Strategy's initiatives to bolster the British AI ecosystem, Authentura has shown limited interest in applying for any public funding, viewing public schemes as overly complex compared to the straightforward and predictable resource schemes offered by the private sector.

4.4.3 Authentura Ecosystem Governance analysis

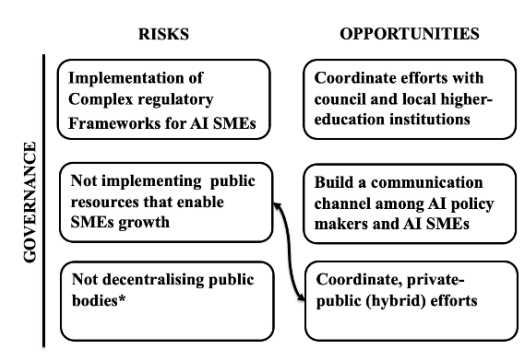


Figure 23 Pushing for a private-public system is the right answer, to foster ecosystems.

One compelling trend when measuring Authentura’s data, and Reading’s council interviews, is that the SME co-founders are interested in exploring hybrid SME resources model that could offer options to co-founders.

“As co-founders, I ’m not looking to think about one option, but options, it’s amazing to have the flexibility to check all the options that are out-there....[P8]”

Reading’s council technologist and economic development officers, however, seem to be slowly implementing AI policy frameworks, as the refer it as:

“The fact that we’re now part of the Elizabeth line, it makes Reading closer to London, but there’s still a long way to go for the council to implement any Industrial strategy or National AI Strategy framework at the council level...[P8]”

However, the slow implementation of public funds aimed to foster AI SMEs might be influencing Authentura to gradually shift its operations away from the Reading ecosystem towards Cambridge and London as it continues to grow.

Chapter 5 Discussions

5.1 Introduction

This chapter will analyse the key findings of this research. Moreover, answers to the two main research questions will be addressed, and contributions to the research and practise will be further explored.

5.2 Key Findings

(Moore, 1993). seminal work on business ecosystems introduces the concept of predator and prey. **Enterprises could collaborate and simultaneously be competitors**, this research finds that (Moore, 1993). arguments fall short; In order to address the “predator and prey” dynamics in an AI SME ecosystem, it is essential to understand the enterprise context first; How do we assess “predator and prey” dynamic in a hypothetical scenario like (Moore, 1993). said? in the case of *Rivelin* and *CoefficientAI*: Both SMEs have had different contexts; *Rivelin* doubled-down public funding to kick off research and development efforts, whereas *CoefficientAI* had to pivot to the private equity sector to raise capital. Does it mean that *Rivelin* and *Coefficient* could play ‘predator and prey’ in the future? How do we assess that?

Additionally (Lundvall, 1985), argues that ecosystems thrive when there is **interaction among stakeholders**; this could be seen in *CoefficientAI* case study, where enterprises can thrive when creating communities that co-create value; *CoefficientAI* involvement with the *PyData* community in London exemplifies these interactions. (Etzkowitz & Leydesdorff, 1995), argues that stakeholders’ roles overlap over time, depending on the circumstances of the ecosystem. However, (Etzkowitz & Leydesdorff, 1995) approach comes from a top-to-bottom angle, this research took (Etzkowitz & Leydesdorff, 1995) approach to assess how SMEs’ stakeholders’ involvement is shaping SMEs internal context.

In a centralised point of view (Muldoon et al., 2022) “**A common central interest enables to set the rules in an ecosystem**” approach could be seen when analysing the current AI ecosystem in Britain; the central government has taken a leading role to lead policy frameworks that aim to “set the rules of the game” in AI. Additionally, (Jacobides et al., 2018) provide a clear framework **when central governance influences** the value creation within an ecosystem; this could be seen in *Rivelin*, *CoefficientAI* and *Authentura* navigation of the respective AI ecosystem in which those SMEs are based, and Finally, (Arenal et al., 2020) studies **the Chinese AI ecosystem perspective** by adopting a inductive and qualitative technique; This

research reinforces the notion that AI SME ecosystems can be studied from a bottom-to-top perspective by adopting qualitative methodology and interpretivism philosophy.

5.3 Answer for Research Questions

5.3.1 1st Main Research Question

"How do regional AI SMEs have access to policy frameworks, resources or networks?"

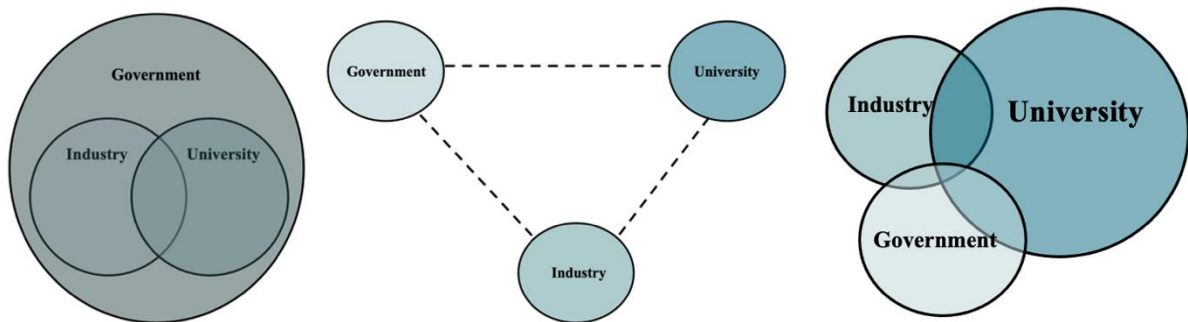


Figure 24 Stakeholder ‘Statist Model’, ‘Laissez-Faire Model’ and ‘Academia Model’.

The SMEs agreed that the current process to obtain public funds from the government is excessively complex; This complexity is exacerbated by the lack of skills required when requesting resources; The three Early-stage SMEs saw government resources as a starting point to build thriving enterprises; This however, creates a significant factor as seen in figure 24, **Rivelin** has gained access to public resources; therefore its closeness to the Government-led model or ‘**Statist Model**’ is apparent, **CoefficientAI** looks for a private-sector only resources as seen in the ‘**Laissez-Faire model**’ (Leydesdorff & Meyer, 2003). Furthermore, **Authentura's** close relationship with Henley Business School has enabled the SME to snatch resources from them, and the ‘**Academia-Model**’ is apparent. as public resources remain the starting point when accessing resources, as seen in the **CoefficientAI** case study; these factors play a substantial role when SMEs are considering their resources; Therefore, a central AI policy to foster SME ecosystem (Muldoon et al., 2023).

5.3.2 2nd Main Research Question

“How are AI SMEs being influenced by the introduction of AI policy frameworks?”

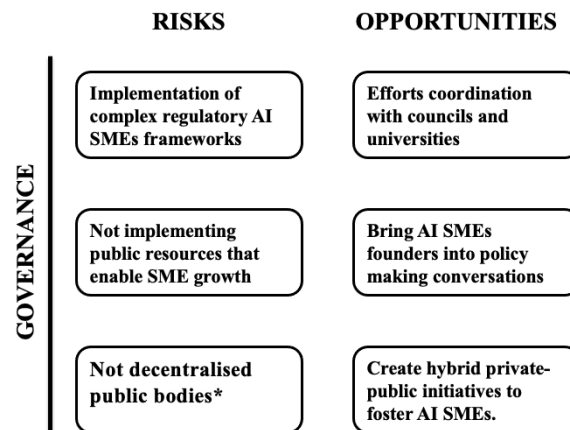


Figure 25 SME Governance Matrix.

The Industrial Strategy's AI framework seeks to nurture a vibrant ecosystem nationwide by fostering the AI SME ecosystem. This goal is attainable; however, achieving it requires a certain level of coordination among these public bodies and local councils. SMEs and Council alike raised risks and opportunities when implementing a central policy of governance within the AI ecosystem in Britain (Jacobides et al., 2018), Seen in Figure 25, address the following points to analyse:

1. Too much AI regulation could be harmful.
2. Current public funds are designed for research and development efforts, not growth.
3. Decentralise AI bodies across Britain.

5.4 Contribution to the Research and Practice

5.4.1 Bottom-to-Top analysis

Numerous studies have examined AI regional ecosystems from a macro perspective, typically from the lens of large tech companies or government policy. However, this study micro-perspective focus on the decision-making process of small and medium-sized enterprises (SMEs) while they navigate AI policy developments in Britain. This research refocuses the discourse at the micro level by analysing the AI SME context, Moreover, qualitative analysis of ecosystems is a viable approach (Arenal et al., 2020); this research further underscores the idea that qualitative and case study approaches are highly suited for analysing complex social phenomena these methodologies offer invaluable insights into the complex realities that shape AI SMEs' decision-making processes (Eisenhardt, 1989).

5.4.1 Regional Approach

This research has adopted a micro-level perspective to understand the decision-making processes within AI SMEs, which are significantly influenced by macro and regional policies. It is evident from the study that clusters vary considerably across several dimensions, such as access to resources and networks. Examining these external contexts is crucial for understanding the internal dynamics of small enterprises. Furthermore, this micro-level approach could facilitate developing and mapping existing policies on regional, national, and international scales. It can also shed light on how SMEs proactively navigate these policy landscapes. Understanding these nuances is essential in designing effective policies and interventions that foster growth and innovation in the AI sector across different regions. This research contributes to a more nuanced and contextually grounded understanding of the AI SME landscape by providing detailed ground-level insights.

Chapter 6 Conclusions

6.1 Introduction

This chapter will explore and synthesise this research's findings and results. Moreover, limitations of the research and further research will be explored.

6.2 Research Conclusions

By adopting theories from business and innovation ecosystem studies, this research proposes two frameworks to analyse three British AI SMEs navigate the current developing implementation of AI Policy frameworks by the central government; the first framework, **“Stakeholder model criterion”**, analyses the AI SME decision-making process, when accessing their local ecosystems frameworks, resources and networks. **“The Governance Matrix”** analyses the AI SME ecosystem governance factors from a bottom-to-top point of view. The findings suggest that the approach taken in this study reinforces the qualitative and case study techniques that were applied while conducting this research; the methodological framework provided an internal and external context to study the phenomena. The bottom line of the existing AI policy frameworks deployed by the British government and their influence on AI SMEs analysed in this study indicate that while some SMEs utilise public resources to fund early-stage research and development efforts, others avoid public resources due to the highly complex process. Moreover, SMEs emphasised the need for further cooperation between the government and co-founders; this will seek to mitigate any possible risks. Additionally, this research extends (Leydesdorff & Meyer, 2003) stakeholder framework by adopting it to a micro-level perspective (SME). It explores (Jacobides et al., 2018) ecosystem governance importance as a central piece of an ecosystem. Furthermore, (Arenal et al., 2020) analysis of the AI ecosystem has been applied and extended in this research. Britain has been at the forefront of AI development since its early days. Recognising the global advancements in AI, the government has formulated an AI Policy framework to foster Britain’s AI sector; Central to achieving this objective is fostering an AI SME ecosystem with the provision of resources, networks, and support; these efforts.

6.2 Limitations of the Research

6.2.1 Data Collection

The data collection process in this research was notably intricate and challenging. Conducting case studies at specific locations required a comprehensive consideration of external influences and the collection of insights from council members overseeing regional AI policy frameworks required others. Additionally, engaging with parliamentary stakeholders and public bodies was vital. These different stages of data collection allowed for a comprehensive understanding of the interplay between internal and external factors and how they influence the decision-making within AI SMEs. However, due to time constraints, the scope of the study was limited to only three companies. If the sample size were more significant, it could have facilitated a deeper understanding and better insights into the phenomena studied. Despite these limitations, the research has provided valuable insights into the dynamics of internal and external factors that shape AI SMEs' operations and decision-making processes.

6.2.2 Policy developments

The current AI framework was approved during Conservative Theresa May's tenure as Prime Minister; the Conservatives have been in the government for over ten years, as how politics stand in 2023, there is a possibility White Hall will change running parties next year; The ruling party change could profoundly affect AI policy frameworks moving forward. Hence, this research addresses a topic that is still developing and a policy that might change, the current AI policy is been heavily influenced by the current ruling party in Britain.

6.3 Recommendations for Further Research

Data analysis and field observations in this research raised several questions that might be worth focusing on; AI SMEs emphasised the need for policies that foster communities; implementing policies that empower entrepreneurial communities could influence stakeholders and ecosystem value-creation, hence analysing how external factors are shaping SMEs communities across Britain could be a good and different angle on AI ecosystem studies.

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Appendix A – Coding Themes

Research Question: "How do regional AI SMEs have access to policy frameworks, resources or networks?"

Data Source: Case studies and interviews with stakeholders from various SMEs.

Theme 1: Resources

Code: RS1

Description: Early stages SME funding options

Argument: "Securing venture capital has been critical for scaling our AI operations."

Argument: "Cash flow is a constant concern, especially when we're investing heavily in R&D."

Argument: "Raising our initial capital was a struggle, and we faced multiple rejections from potential investors."

Argument: "We attended startup pitch events and leveraged our personal networks to connect with angel investors."

Code: ESM1

Description: Private Stakeholders

Argument: "We benefited from a startup grant that helped us initiate product development."

Argument: "Applying for government grants was time-consuming, but the financial support was worth the effort."

Theme 2: Academia stakeholders

Code: PS1

Description: Resources

Argument: "Ecosystem members collectively influence policy to support innovation-friendly regulations."

Argument: "Informal meetups and workshops facilitate the exchange of best practices among ecosystem members."

Code: ASR1

Description: Ecosystem

Example: "Collaborative partnerships between startups and established companies drive mutual growth."

Example: "

Theme 3: AI Industrial Strategy

Description: Policy to foster funding

Argument: "Government initiatives allocate substantial funding to support AI innovation in academia and industry."

Argument: "Policies include incentives for businesses to invest in AI technologies and startups."

Argument: "Policies support collaborations with other countries to foster global AI advancements."

Argument: "Government strategies position AI as a driver of economic growth and international competitiveness."

Code: PF1