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**EXPLORING THE IMPACTS OF NATIONALLY SIGNIFICANT INFRASTRUCTURE
PROJECTS (NSIPS) AMONG ENGINEERING CONTRACTORS AND
SUBCONTRACTORS**

By

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ABSTRACT

This study in organisation and management studies explores the ways in which engineering contractors and subcontractors experience working on Nationally Significant Infrastructure Projects (NSIPs). While NSIPs contribute directly to the UK's 2020 National Infrastructure Strategy and underpin the UK economy by providing a range of networks vital for jobs, business, and economic growth, little is known about how contractors experience working on such projects (UK. GOV., 2020; Pink et al., 2010). By focussing on the everyday lived experiences of engineering contractors working on one large-scale NSIP in the South of England the study reveals how the benefits to the local communities and long-term income security for local contracting firms associated with such projects is juxtaposed with workers in search of security within and beyond the work environment.

The study adopts a qualitative research strategy to focus on the in-depth insights of ten contractors involved with the NSIP and employs Actor Network Theory (ANT) as a theoretical and analytical frame to explore the heterogeneous patterns that emerge and the various impacts of NSIPs. The study employs the novel approach of virtual ethnography to provide depth and insight of the contractors' lived experiences which may be overlooked by traditional ethnographic methods which can be constrained by a range of factors which include time, geography and in this case, the limits imposed by the Covid pandemic. Through employing ANT and virtual ethnography this study provides an important new dimension to research in work and organisation.

The findings of this study highlight three main themes of policy control, felt obligations and (in)security. These themes expose how security becomes laboured into the work of contractors and how work is more precarious in the lower tiers of the contractor hierarchy. In this context contractors labour to secure a sense of security, encompassing both physical financial security and a sense of belonging which remain a central objective for contractors and subcontractors. The research underscores the importance of understanding the activities aimed at achieving worker security and their implications. The study makes important contributions to knowledge in how individuals experience working on NSIPs and the value of virtual ethnography in studying lived experiences of work. The study also provides important insights which have the potential to inform policy by revealing the fluid and ever-changing nature of NSIPs, the complexities and uncertainties inherent in these projects and in navigating the challenges of NSIPs the importance of the informal, subtle connections that emerge.

DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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STATEMENT 1

This thesis is the result of my own investigations, except where otherwise stated. Sources are acknowledged through in-text citations and an appended reference list.

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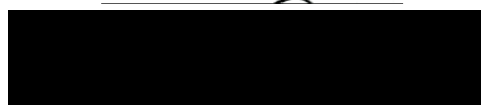
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ABBREVIATIONS

ANT	Actor Network Theory
B&B	Bed and Breakfast
CABs	Conformity Assessment Bodies
CDMs	Construction Design and Management Regulations
COP 27	Conference of the Parties
CRB	Criminal Records Bureau
CV	Curriculum Vitae
DBIS	Department for Business Innovation and Skills (2013)
DCOs	Development Consent Orders
EU	European Union
EDF	Électricité de France (2020)
GDP	Gross Domestic Product
GOV. UK	Government of the United Kingdom (2013-2020)
ICT	Information and Communication Technology
ILO	International Labour Organisation (2015)
ISO	The International Organisation for Standardisation
MNC	Multinational Company
NSIPs	Nationally Significant Infrastructure Projects
RO	Research Objectives
STS	Science and Technology Studies
T1	Tier one
T2	Tier two
T3	Tier Three
UNDP	United Nations Development Programme (1984)
UNFCCC	United Nations Framework Convention on Climate change (2022)
UK	United Kingdom
US	United States

CHAPTER ONE: INTRODUCTION

1.1 Background and Context

The aim of this thesis is to explore the Impacts of Nationally Significant Infrastructure Projects (NSIPs) among Engineering Contractors and Subcontractors. The research emphasises that although NSIPs are a crucial part of UK infrastructure and that critical energy infrastructure projects are being developed with some urgency, little is known about how individuals experience working on such projects (Dainty et al., 2013; Pink et al., 2010). The positive consequences of these projects are attributed to job creation, economic benefits, and sustainable development, although the complexities of infrastructure projects and their tensions are less well documented (Bridge et al., 2018; Flyvbjerg 2014; Flyvbjerg et al., 2003).

NSIPs are frequently characterised as expensive, require lengthy construction periods that generate a range of social consequences, which in turn affect individuals living and working on and around the field site (P. Harvey et al., 2016). In addition, large-scale infrastructure projects are associated with ongoing volatility, resulting from rapid changes in technology and prolonged turnover of capital which is further exacerbated by a construction industry itself challenged by flexible forms of production (D. Harvey, 1989). The construction industry in the UK is highly diverse and complex, with numerous different tiers that all have their own unique roles which play an integral part in ensuring projects are built safely, efficiently and within budget (DBIS, 2013; Dainty et al., 2013). This complexity is captured in **Table 1**:

Table 1 ***Different Tiers in Infrastructure Construction***

Tier Label	Description	Typical Benefits
Tier 1	National and multinational firms with a strong presence across the country. They typically have a turnover of over £1 billion	Large contractors are the most experienced and well-resourced firms in the industry. They typically have an extensive network of subcontractors and suppliers that they work with on a regular basis. This allows them to command lower prices and quicker turnaround times.
Tier 2	Large regional firms with a strong presence in their region. They typically have a turnover of between £100 million and £1 billion.	
Tier 3	Medium-sized firms with a more limited geographic reach. They typically have a turnover of between £10 million and £100 million.	Medium-sized contractors are usually more efficient and have a greater variety of resources than small firms. They can handle larger projects and often get discounts from suppliers due to their higher volume of work.
Tier 4	Small local firms with a very limited geographic reach. They typically have a turnover of less than £10 million.	Small contractors are often family-run businesses that have been passed down through generations. They tend to be more personal and responsive to their clients' needs. They also usually have a good relationship with their suppliers, which can get you better prices on materials.

Through an Actor Network Theory (ANT) perspective, the study explores the lived experience of those involved with a NSIP to highlight the key issues which emerge. The findings reveal a range of tensions, contradictions and precarity distinct from the skill-building and job creation rhetoric. Indeed, the accompanying reliance on contract work which is central to an NSIP can lead to structural fragmentation as each contractor works to a specific remit, rather than focus on the project as a whole and impacts upon the lives of individual contractors (Dainty et al., 2013). This study explores these various challenges and reveals how security is laboured into contractors' work. Insecurity is generated as work and accountability are passed down the various tiers. This in turn forces contractors to labour security into their relationships in other ways such as darts, family, familiarity secured at guest houses.

The above discussion indicates that the UK construction industry is highly diverse and complex, with numerous different tiers that all have their own unique roles. NSIPs tend to be characterised by but limited knowledge exists in relation to (1) a lack of studies about working on NSIPs; (2) a paucity of research about the role of contractors (3) a focus on outcomes such as addressing skills gaps and job creation (4) a lack of in-depth insights which

reflect the lived experiences of those involved with NSIPs (Dainty et al., 2013; Pink et al., 2010).

This study contributes to knowledge by exploring the lived experiences of contractors working in an NSIP environment. This study adopts Actor Network Theory (ANT) (Latour, 2005) to understand the complex relationships and commitments associated with contractor roles, by capturing their lived experiences using ethnographic qualitative methods (Atkinson et al., 2001). These apparent gaps in existing research assisted in informing the aim and objectives of this study.

1.2 Research Question

In alignment with the gaps identified above, this study aims to explore the Impacts of Nationally Significant Infrastructure Projects (NSIPs) among Engineering Contractors and Subcontractors using ANT as a theoretical lens. This study adopts an ethnographic approach to provide an opportunity to attain a level of depth and detail to reveal the lived experiences of contractors working on an NSIP. The following question provides a focus while still allowing for rich exploration:

How do contractors and subcontractors experience working on NSIPs?

In order to fulfil the overarching aim, the following study objectives have been addressed to:

- Develop a critical and comprehensive understanding of working on NSIPs;
- Analyse the significance of Actor Network Theory in relation to working on NSIPs;
- Develop an understanding of worker relations on NSIPs; and
- Outline the impacts and implications of working on NSIPs for Contractors and subcontractors.

1.3 Research Outline and Structure of the Thesis

This study is structured systematically over eight chapters. Following the introduction chapter, these include a literature review comprising context and ANT, research methodology and methods, research findings, discussion of findings, and conclusion.

Chapter two and three reviews the literature related to contract work on NSIPs and ANT. It explains that NSIP environments offer much promise yet are fraught with significant challenge. Developers work with Government and Communities to create the promise of the NSIP yet are solely reliant on contractors to deliver. A critical review of ANT as a theoretical lens is presented as an essential section for the aim of this thesis as this traces the complex relationships that exist in order to deliver the project. The literature on ANT reveals the promise of such a framework for understanding the complex relationships that evolve and diminish during the construction process and shows how issues of contract and subcontract work can be explored to uncover a host of tensions and contradictions. Finally, the underlying argument is raised about the rhetoric and reality of NSIPs from the contractor perspective. Throughout these complementary chapters, critical questions and issues are raised which inform this research. Questions about what is distinctive in NSIPs, contractor roles in such environments, the contradiction of securing a contract and receiving incompatible demands, and how contractors experience such work and its contradictions come to the fore.

Chapter four defends and presents the thesis methodology and methods employed to collect and analyse the data. This study is exploratory and adopts a qualitative approach, using ethnographic methods. Ten in-depth interviews are supported by a number of observations as part of the data collection process. This qualitative approach provided the opportunity to explore the participants lived experience and was complemented by virtual ethnography to study experiences from one NSIP in the UK. The chapter discusses the data collection for the study, followed by clarification of the inductive thematic analysis technique used for data analysis. Inductive thematic analysis was utilised to draw themes from the data by six stages of analysis which enabled the creation of two key vignettes which captured the experiences and stories of two participants. The chapter concludes with the issues of trustworthiness, ethics, and limitations of the research.

Chapter five presents the findings of the research and uses both interview extracts and data-driven vignettes to capture the lived experiences of the participants. The chapter also includes coding snapshots to highlight the evolving themes and data reduction process. The findings show two key themes emerging from the data which centred on different aspects of control. Firstly, policy control, which brings together issues relating to accountability, qualifications, and health and safety policy. This chapter provides further insight into the context of NSIPs, including policy and audit conditions and reveals that NSIPs are characterised by reliance on contractors who are flexible in tasks and hours with an innate ability to know their place within the contractor network.

The second chapter of the findings, *chapter six*, presents the second higher-order theme of felt obligations. It focuses on the various obligations of the construction workers, to their work, their community, and their family which provides insight into the internal and individual controls imposed by workers. These dual modes of control reveal how participants were subject to external regulation and self-regulation. When applying the ANT frame to the analysis of these dual modes of control what emerges is an overarching theme of (in)security. Subsequently in both Chapters five and six, (in)security may be further understood as physical or worker (in)security that look at for example the economic aspects, and ontological (in)security that concentrate on the psychological aspects of (in)security. Moreover, two central vignettes compliment the participant's words to illustrate the complexity of the network in a more holistic sense and to emphasise fundamental aspects of the impact felt by a contractor community.

Chapter seven interprets the data from the finding chapters and discusses them in relation to the literature reviewed in chapters two and three. The chapter provides a deeper understanding of how (in)security may be understood depending on perceptions, experiences, and the hierarchical nature of the industry.

To conclude this thesis, *chapter eight* revisits the earlier aim and objectives to explore the experiences of working on NSIPs. It explores theoretical and practical contributions to knowledge, as well as reflective aspects of the research study. This is followed by the limitations, future research, and concluding remarks.

1.4 Research Contribution

This study offers some research contributions. On a theoretical level, this study is one of the few studies to explore NSIPs and how contractors experience it, using ANT as a theoretical lens. This study explores how ANT can be used to explore complex relations and their impacts (Latour, 2005). Second, this exploration develops an understanding of how contractors deal with precarious working conditions in the construction industry. Finally, this study employs an in-depth qualitative methodology using various data sources at different levels to obtain rich in-depth insights (Pink et al., 2010). Two notable contributions come in the form of virtual ethnography (Hine, 2000; Beaulieu, 2010), and presenting data as vignettes to capture the holistic experience. In addition to theoretical contributions, the study findings provide implications for policy development in the UK in the form of unanticipated consequences of NSIPs.

1.5 Summary

This introductory chapter has tried to set the scene for the thesis by highlighting the context of NSIPs and their contribution and promise to the UK and their reliance on contract workers. The following chapter will critically evaluate the literature associated with NSIPs.

CHAPTER TWO: SOCIETAL PERSPECTIVES OF NATIONALLY SIGNIFICANT PROJECTS – A LITERATURE REVIEW

2.1 Introduction

This chapter explores the context for the experiences of contractors working on Nationally Significant Infrastructure projects (NSIPs). The political and economic context for NSIPs will be provided which outlines the policy justifications for the contemporary approaches to large scale construction infrastructure projects. These approaches to infrastructure do not simply happen, they are part of a broader strategic move to expedite projects and devolve responsibilities across a range of stakeholders (Harvey, 1990). The aim is to outline how infrastructure projects are not simply technical structures for development but reconfigure the multiple agents that are in contact and effected by these projects.

Drawing especially upon Actor Network Theory, infrastructures will be presented as a particular technological form that shapes how infrastructure can be approached, practiced and understood. Infrastructures are not just entities that control disparate units, but represent a signifier for contemporary culture, particularly with regard a specific approach to management. This section highlights how norms, values and beliefs are always already inscribed in technology (Latour, 1987). These inscriptions represent working assumptions that underly technologies and consequently limit the means through which contractors can engage with large scale projects. The fragmented, hierarchical nature of contemporary infrastructure projects represents contemporary political thinking in terms of managerial approaches. Yet the impact of such approaches upon contractors and host communities are rarely considered in terms of such technology, rather impacts are viewed as a consequence of the construction itself. To better explore the idea of contemporary infrastructure project management as a technology an examination will be made of the history and origins of infrastructure management.

By tracing the origins of infrastructure (2.3), it is possible to view how they both reproduce broader cultural assumptions and feed into how the world can be viewed. This is a more ontological reading of infrastructure as mediating ways of seeing and as a consequence

acting. Ideas associated with modernity and more contemporary ideas and cultural experiences of fragmentation associated with late modernity will be examined. Core ideas from Harvey (1989) and Lyotard (1979) will be examined as they detail links between knowledge, action and belief that that inscribe contemporary infrastructure. Section 2.4 will examine this in more detail, specifically through the operationalisation of infrastructure projects and how this is mediated by local and global concerns. The focus of this research is upon those social actors that engage with an infrastructure project through heterogeneous relationships (2.5). Whilst lived experiences are normally outside of the purview of Actor Network approaches, the experiences of contractors and local residents themselves will be presented in order to underscore the implications of infrastructure on everyday life.

NSIPs are designed to mediate risk through application of contractual controls through audit. These forms of accountability have become more prominent as a means of organising projects over the past 40 years (Strathern, 2000). Whilst broader concerns over contemporary modes of accountability will be examined, the significance of how these impact upon individuals and how their lives are mediated by forms of accountabilities are less apparent and will be considered here. The nature of work on NSIPs requires some degree of movement in order to attract specialist contractors from outside of the locality, yet the espoused *raison d'être* of NSIPs is specifically that they benefit local communities (Planning Act, 2008). As the focus of this research surrounds the idea of who is or is not local, who does or does not belong, who are *us* and who are *them* become vaguely specified terms yet provides an impression of there being a direct localised beneficiary. As such issues of on-site, off-site, of communities surrounding the site, will be examined through the *motifs* of movement, stasis, mobility, belonging and migration. An examination of these issues provides a context for who or what benefits from NSIPs. As such this chapter draws together the political expediencies of subcontracting major projects, the means through which modes of organising infrastructure and how infrastructure may order those in contact with it.

2.1.1 NSIPS and the Local Construction Industry

The current United Kingdom (UK) government has focused on developing sustainable policies leading to the construction of critical infrastructure projects. These Nationally

Significant Infrastructure Projects (NSIPs) have focussed on transport infrastructure such as High Speed 2 and the Northern Hub and energy infrastructure. Energy NSIPs focus on harnessing the potential of renewable energy (such as wind and solar) and low-carbon electricity sources generated from nuclear power stations. They are large-scale developments where, owing to their size and complexity, they are managed under a unique consent process known as a Development Consent Order (DCO). This legislation removes the requirement for various individual planning consents to be obtained, speeding up the development process and reducing application costs (Planning Act, 2008). However, this has also been seen as a means of circumventing systems and process that protect the public, being replaced by *consultation*. Internationally, such circumvention of public scrutiny has been deemed a threat to democracy (Barley, 2007), as the interests of citizens and representation are also by-passed. Within the UK, in respect nuclear power stations, the counter argument is that there will be widespread benefits, notably bolstering the domestic electricity supply (reducing costs to the end consumer) and reduce contributions to climate debates.

Infrastructure projects are not merely technical structures, since they also facilitate “...connections, exchange, networks, flows, mobilities”, thereby reconfiguring “...existing spatial borders and territories” (Barry, 2020, p.2). that in turn, enable the reshaping of transnational, political and economic spaces (Barry, 2020). It is in this reconfiguring and reshaping of national, transnational, economic, and political spaces that the fragilities and vulnerabilities of infrastructure are exposed. The following sections explore these various implications, including an understanding of its ontological aspects and what constitutes an ontological presence. That is, how contemporary approaches to infrastructure both reproduce a particular political economic rationality and transform this into how construction, community and work can be viewed.

David Harvey (1989) makes explicit the social costs that are borne by engineering contractors. Included in his work are Marxist theoretical understandings in which he discusses large-scale infrastructure projects in relation to the fixity of Fordism, see for example (Jessop, 2005). As its name suggests, Fordism was pioneered by the Ford Motor Company, and was the dominant philosophy of mass production that originated in the early twentieth century. It impacted on economic growth and cultural and political change,

notably “deregulation, neoconservatism, decentralization and increased nationalism” - see Blomley, 1991, p. 165). What is significant here is the move from the management of the factory to the governance of society. As such, Fordism is generally associated with the emergence of a range of contemporary impacts: rapid changes in technology, the accompanying processes relating to obsolescence (to maintain consumer demand), increased turnover of capital, as well as extensive and often volatile geographical restructuring. What is more, Harvey also highlights the continuous restructuring of corporate entities, which resulted in previously dependable bureaucratic careers and union-negotiated labour contracts being replaced with more adaptable forms of production. This flexibility of the employment relationship is associated with post-Fordism, which is characterised by industries introducing fluid labour agreements in order to lower their costs and open up new markets, ultimately increasing their profits (Harvey, 1989).

In the construction industry, subcontracted roles have been assigned to people from abroad or to overseas companies, in order to mitigate a lack of local skilled labour (Hannam et al., 2006; Fellini et al., 2007). This has resulted in work that was previously based in the UK becoming more globalised whereby processes such as trade, technology and social changes to be increasingly interdependent on the world stage (Dainty et al., 2013). In this respect, Dainty and colleagues argue that such subcontracting systems have resulted in the construction industry becoming structurally fragmented. This fragmentation makes it difficult to define the scope and boundaries of the construction industry, which has made it difficult to apply established organisational research study models that are frequently deployed in other sectors, such as banking or communications (Dainty et al., 2013). Moreover, fragmentation can raise the costs of production, as a consequence of reduced efficiency, which often results in firms investing less in research and development to maintain profits, and therefore giving less consideration to the impacts of infrastructure projects (Dainty et al., 2013).

The construction sector has been characterised as “...a set of related but relatively heterogeneous sub-industries...” (Dainty et al., 2013, p.2) comprising initial design work, the construction itself and the maintenance services that are necessary to keep things moving. As such, sub-industries form around large-scale infrastructure projects as a result of the need for different types of work with different techniques, such as civil, electrical, and

mechanical engineering. They also point out that firms are required to take certain kinds of policy measures in order to deal with the different kinds of inputs, technologies, and methods that are used, as well as the differing characteristics of their outputs (Dainty et al., 2013). Furthermore, the contracting firms must go through a tender process to win orders in the first place, before using the subcontracting system for specific jobs. As such, the construction industry in the UK is typically characterised by this system of contracting and subcontracting, which involves individual roles. Project initiator, designer, and producer roles being separated in order to take advantage of the *one-off* nature of construction, which often involves self-employed workers and informal employment arrangements. In this way shifting risk and reducing costs may be achieved through the subcontracting system (Bosch and Philips, 2003; Briscoe et al., 2000; Harvey, 2001; Harvey and Behling, 2008; Winch, 1998). As such the construction industry is fragmented geographically across locality and nation states in addition to specificities of role.

In order to better understand these complex and fragmented relationships between contractors, the industry is categorised into tiered groups which are organised in terms of a hierarchy and differentiated by their size and level of responsibility. They are termed “T1” (Tier 1), “T2” (Tier 2) and “T3” (Tier3) (Department for Business Innovation and Skills [DBIS], 2013, pp. 6-8), where *T1* organisations are at the top of the hierarchy. T1 contractors are first-level suppliers, which may include multinational companies involved in projects costing many millions of pounds. They are regarded as the main contractor and have a direct relationship with the Developer who has been contracted by central government to oversee the project through to completion. The *T2* subcontractors and suppliers work directly for T1 firms. The *T3* members, by contrast, are at the bottom of the hierarchy, these suppliers and sub-contractors tend to work on smaller-scale projects that service the T2 companies (DBIS, 2013). In turn what this represents is a series of firms seeking to ensure they fulfil contractual obligations, whilst maximising profit, yet the ability to externalise problematic issues to subcontractors lower down the hierarchy. The implication here for example is how this entails new modes of control are necessary as you cannot determine or police another firm (MacKenzie, 2000).

Given the complex nature of the industry and its many fragmentary aspects including its general volatility, as well as the rapid changes in technology and increased turnover of

capital (Harvey, 1989), forms of audit are installed to mitigate the various risks, both national and transnational. These risks emerge in different forms relating to policy, audit and accountability and globalisation (including migration, mobility, as well as the accompanying sense of belonging), all of which will be examined later in this chapter. As such, predictions about future situations (at various levels of certainty and under different sets of circumstances) can be made, with their potential consequences being carefully scrutinised in the domains of government and policy (Collier et al., 2004). Although it is important to acknowledge the dynamic nature of the construction industry, it is equally important to highlight the fact that it remains an essential sector, employing more than two million people and accounting for 10% of the country's gross domestic product (GDP) (Dainty et al., 2007).

2.2 Infrastructure: Materials

Infrastructure is perceived as constituting materials, physical entities, such as power lines, roads, and databases, which support various forms of work as well as social life. Recently, however, ethnographic research has started to focus more on the central role that infrastructure plays in social life. For example, ethnographic studies of infrastructure can be traced to Evans-Pritchard (1937), who explored how grain storage vessels could be used to develop a rational explanation in the practice of witchcraft among the Azande. As in contemporary times, infrastructures did not feature as playing any role in the organisation of social life or on the relational analysis between material culture and technical artifacts. However, while Evans-Pritchard began to develop forms of rational explanations in the modern sense, he failed to problematise how those same rational explanations within a euro-centric frame were themselves shaped by infrastructure (Niewöhner, 2015). There is evidence of early work that examined how hospital infrastructure created particular patterns of behaviour among patients (Goffman, 1968) and staff (Menzies Lyth, 1960). However, serious consideration of the social aspects of infrastructure appeared in the 1980s particularly in ethnomethodological studies (Bowker et al., 1997), ethnographic studies (Star, 1999; Star and Ruhleder, 1996), feminist studies (Haraway, 1989; Star, 1999), and science and technology studies (Bowker, 1994; Latour, 1996).

What is significant in these more critical readings of infrastructure is the attention to the ways in which infrastructure can shape social practices which best service a community. What is more, the ripple effects of these choices will be felt in the everyday lives of individuals and their communities for many years to come and crucially how they shape these communities. By focusing on the concept of infrastructure, it is possible to consider some of the more productive ways in which it has been problematised in the available literature. This includes a wide range of studies that have focused on energy infrastructure and specifically nuclear development.

Project management of complex large-scale projects has resulted in the energy infrastructure industry facing huge challenges. In several works, Flyvbjerg has highlighted the foundational importance of the decision-making that occurs at the planning stages of such megaprojects. Value is generally assessed in relation to the various inputs – that is, the technical and economic factors – but little attention has so far been paid to more qualitative understandings of value, such as the accompanying environmental and social impacts (Flyvbjerg, 2008, 2009, 2014; Flyvbjerg et al., 2003).

In terms of nuclear infrastructure projects more specifically, the research works of Goodfellow et al. (2011), Van de Graaff (2016), and Richter (2017) have focused on perceptions of risk, questions of social impact, and concepts of ethics and fairness, exploring how these various aspects have been managed, as well as the roles that they play in nuclear power developments. Van de Graaff, for instance, highlights the argument that the growth of nuclear generation capacity has been constrained as a result of nuclear advocates failing to adequately engage with a worldview that acknowledges climate change. To date, comparable studies have combined qualitative methods with quantitative approaches that focus on specific areas of research. For example, comparative studies on nuclear power generation have been conducted in Finland, France, and the UK, focusing on questions of policy and discourse (Teräsväinen et al., 2011), energy security and nuclear insecurity (Peoples, 2014), and energy justice (Jenkins et al., 2017). These works have mainly focused on the entities that are responsible for meeting national low-carbon energy transition targets and the implications of their decisions. Fabók's (2016) ethnography focuses on nuclear energy in Wales and presents an empirical study of the proposed Wylfa Newydd nuclear power station in Anglesey, concentrating on aspects of governance and public

engagement. As such, Fabók's project examines the geographies of energy transitions, their political aspects and the changes that occur in participation in large-scale infrastructure projects.

Infrastructures can be viewed as technical structures that are so embedded as to become invisible, allowing the delivery of energy, water, and information technology services for example. It has also been conceptualised as the final manifestation of a series of economic, political, social, technical, and ethical choices that have been made by a range of different actors over an often-extensive period of time. Yet, Niewöhner (2015) argues that the temporal nature of infrastructure, as well as its ability to form layers points to infrastructures as relational. As such, infrastructures consist of a process of continuously coordinated networks that include social organization that are interwoven with layers of technical integration. However, what is key, is *unfolding* (Niewöhner, 2015, p.3) those political, ethical, and social choices that are involved with infrastructures and hence analysing the "inscriptions that lie within a logic of infrastructure". This may be compared to Harvey and company (2016, p. 8) who refers to heterogeneous entities in infrastructural networks that *fold together* in interconnected relationships, but at the same time, they are never quite aligned as "...they may also run in parallel or even work against each other". Nevertheless, the implication is that infrastructures are not "passive", but rather generate effects on society, organisations and people, thus "re-shaping them in turn" (Harvey et al., 2016, p. 12). The inscriptions of infrastructure work to reorganise social practices, shaping the possibilities of visibility and human conduct.

2.3 Ontological Concepts of Infrastructures

'savoir pour prévoir, prévoir pour pouvoir': To know in order to predict, to predict in order to control'.

(Comte, 1988[1830])

Mattelart (2000) has described infrastructure as having its roots in the *enlightenment*. The enlightenment was an intellectual and philosophical movement that reflected changing beliefs from political or religious doctrine to a mode of rationality borne from knowledge. Enlightenment thought, bound with ideas of scientific rationality gave rise to what Comte

(1988[1830]) termed a positive philosophy, characterised by the maxim ‘to know in order to predict, to predict in order to control’, whereby a direct link between knowledge and prediction for social control was seen as essential to positive understandings (now referred to as positivism). Infrastructures gave rise to increased mobility and increasing levels of control over populations, enabling the free circulation of goods, people, within the confines of a given infrastructure. Such understandings were intertwined with the shaping of modernity and the belief in a future of prosperity. Foucault (2008) describes infrastructure as being integral to organisations that are involved in market economies, which are central to the understanding of liberalism. By considering these *Enlightenment* ideas and their various continuations, it becomes clear why it is sometimes difficult in contemporary society to separate the analysis of infrastructure from evolutionary histories of thought, such as that noted earlier through Evans-Pritchard. Ultimately, it is difficult to disentangle infrastructure from modern ways of thinking because infrastructure forms a core part of one’s existence in the contemporary world (Larkin, 2013).

The conditions of postmodernity as David Harvey terms them, followed, as an adverse reaction to the Age of Enlightenment, which was perceived as “positivistic, technocentric and rationalistic” (Harvey, 1989, p.9). By the middle of the twentieth century, postmodernity, associated with an approach to philosophical thought that challenged the worldviews of the Enlightenment period, was gradually starting to emerge. For instance, this was brought about by capitalism, as well as the growing alienation that was fostered by the violence and the lasting effects of two world wars.

Harvey, therefore, argues that the *conditions of postmodernity* has resulted in contemporary expressions of social justice and relativism. This is because they work together in a way that “privileges heterogeneity and difference as liberative forces in the redefinition of cultural discourse” (Harvey, 1989, p. 9). Postmodern society’s response to the ongoing economic and political processes – and the accompanying issues relating to power – constitutes an ontological presence that amounts to a “state of being” (Mora et al., 2012, p. 50). What is more, such *conditions of postmodernity* not only point to a state of “being”, but more importantly to a “process of becoming” (Harvey, 1989, pp. 205). Even though the concept of infrastructure is bound up with transformational intentions and promises of improvement, it is also important to remember that, in reality, it is capable of introducing fundamental

impacts on society that often prompt visceral responses to social justice issues (Larkin, 2013). In many respects, the associations of infrastructure with rapid changes in technology and increased turnover in capital, as well as obsolescence and volatility, are themselves symptoms of modernity. The emergence of a postmodern society, however, and the correlative rise of ontological questioning allow the subject of infrastructure to be broached from a range of different perspectives. Further showing how infrastructure acts as a vehicle through which principles of modernity become inscribed as everyday mundane practice. Infrastructure is how modern ideology becomes embedded socially.

Rottenburg (2009) and Kockelman (2010), describe infrastructural systems as complicated arrangements, which result in every new connection only creating further gaps. Rather than infrastructure simply enabling goods and services to flow freely between people, instead the processes are somewhat fractal, with gaps that multiply simultaneously, resulting in new connections as well as new disconnections (Jensen, 2007; Strathern, 2005). The logic of an all-encompassing infrastructure or unification becomes one where new gaps, inconsistencies and tensions emerge. Such a phenomenon has been seen “...infrastructures as precarious achievements,” (Graham, 2009, pp.9-10), rather than a technology of stability.

While infrastructures represent veneers of permanence, reliability, and stability, they are in truth structures that constantly need to be worked on, to be laboured into existence. This means that infrastructures are in fact fragile and vulnerable. Indeed, it is common for people to assume that energy networks, for instance, mature with time, becoming more deeply embedded within their surrounding environments and less socially intrusive, when it is actually more accurate to say that, over time, they become more vulnerable and therefore less predictable, such as the Chernobyl disaster in 1986. Indeed, the evidence suggests that such gaps in large-scale infrastructure projects require constant maintenance and support (Graham, 2009).

This assumption that infrastructure only improves with time is often accompanied by the correlative understanding that lessons are learnt from past mistakes. Once again developments in infrastructure capacity require more actors to come on board for its maintenance. In doing so however, the range of technical complexities relating to such projects only increases. Akin to Niewöhner (2015), Law and Mol (2002) have viewed

infrastructures as having the ability to form layers and have interpreted such technical complexities in terms of the networks of social, political, and technical factors that are intricately woven between the heterogeneous realms of law, economics, policy, technology, and the environment. Indeed, according to McGucken and Winner (1988) and Hughes (1993), the technical aspects of infrastructure become impenetrable to the majority of people, with only managers and other experts being able to grasp their true dimensions. This is by no means to assert that individuals become completely powerless in the face of such complexity. Rather, Von Schnitzler (2008) and Jensen and Winthereik (2013) have suggested some ways in which users may be able to navigate and manipulate their way through these various gaps and inconsistencies between layers (the gaps being important for shaping meaning), with only a basic understanding of the features of infrastructure. This may imply that knowledge of scale and complexity are less important in terms of determining gaps and inconsistencies.

With new gaps and new forms of relational complication constantly being introduced, new actors are generated, which may extend beyond consumers and other end users to include designers and experts. What is crucial in the study of infrastructure, however, is the accessibility of the information that it holds. This gives rise to important questions regarding the “scale” of infrastructure, since the various activities of “configuring, extending, maintaining, and disrupting” infrastructure have the capacity to produce various scales (P. Harvey et al., 2016, pp. 16-17). For example, infrastructure creates multiple situations, with the potential for transformation as well as reversal. Rather than understanding infrastructure as something that is developed from the centre to the periphery, one should instead view infrastructure as playing an active part in “making these geographies” (P. Harvey et al., 2016, p. 17; see also Callon and Latour, 1981; Harvey, 2012; Jensen, 2007; Tsing, 2005). One notable example in this respect is the global oil industry, as the various elements of infrastructure that make this industry possible have been responsible for shaping individual livelihoods, political democracies, and global environments (Harvey et al., 2016).

2.4 Operationalising Infrastructure

Following a review of processes that are bound up with the development of infrastructure, the focus now concerns NSIPs and how they may be affected by a logic of infrastructure. Security building activities, both contractual and physical, are introduced in order to mitigate the risks that accompany the complexity of infrastructure projects, especially with their fragmentation and their volatility. Even so, the new gaps that result from the new connections may become evident only when an infrastructure project is operationalised. Consequently, a range of challenges emerge in the fields of policy, risk, audit (and accountability), migration/mobility, kinship, globalisation and questions of belonging. These challenges are most likely to affect construction workers, so the following sections will therefore focus on these workers, exploring each field in turn.

2.4.1 Policy: Operationalised

NSIPs are primarily classified by project size (since they are mainly large-scale developments), which contribute to the public interest at a national level. In the UK, NSIPs are automatically given Development Consent Orders (DCOs), removing the need for individual consents to be obtained as noted previously. As such, the accompanying legislation and policy requirements can be completed much more quickly and smoothly (Planning Act, 2008). Indeed, by classifying NSIPs in this way, both authorities and developers can expedite economic and political agendas (or internal bureaucratic processes) by means of policies alone (Bridge et al., 2018). However, these policies that aim to minimise uncertainty in terms of consent (for example) bring to light new issues of risk and security.

This presupposes the Comtean enlightenment logic whereby knowledge of the present, predicts likely futures which in turn render futures amenable to control as part of an iterative process. Over time these models improve as more data is aggregated (or in Comtean terms, more knowledge is available) that leads to more precise information, greater predictive power rendering futures more controllable. Future risk then comes to be regarded as something that can be controlled or managed. This allows one to plan different actions, in the form of different policies, that can bring about the desired outcomes. The

argument, however, focuses on the transformation of the “abstract” future into risks that have the potential to affect the “present” future (Maguire and Westbrook, 2021, p. 4). As such, “the future” becomes a way of arguing about what to do in the present, with the result that discussions about the future constitute a type of politics that involves the practices of policy going beyond the basic need for protection (Maguire and Westbrook, 2021). The future is therefore diminished into manageable risks which enable one to project a future that aligns with those risks in order to justify policy. Perhaps more problematically such a perspective assumes that the knowledge upon which a prediction is made will remain valid in the future and remains valid so long as there are no changes to any variable or parameter between the present and future. In essence, the future remains stable and predictable so long as nothing changes. The nuclear power industry has been beset with failures to account for behaviours outside of the predictive model, such as human error, failure of materials, adverse weather (such as in Fukushima). It is in precisely these incidents that the gaps, tensions, ambiguities and ambivalence of a predicted future emerges.

‘...a policy finds expression through sequences of events; it creates new social and semantic spaces; new sets of relations, new political subjects and new webs of meaning...’

(Shore and Wright, 2011, p. 1)

Policies affect people in various ways by categorising what can be discussed, discussed when and by whom (Maguire et al., 2014), such an approach is normalised and accepted as standard practice by for example government, and management. Policies affect people’s lives more fundamentally, by shaping (forcing or limiting) the political choices individuals can make, even though policies are deemed to be more successful the more they appear to be apolitical. Such an understanding is particularly applicable to the construction industry and NSIPs, where in Latour’s (1984) terms, the policy creates the reality that the policy describes, rather than simply being a description. In this way a policy can be deemed performative in the sense that social actors in turn fill in the gaps and interpret the policy as reality and ensures that the policy *holds*. In this sense new sets of relations and meaning are reconfigured in order to view policy in a way that gives it life. This is especially true in an industry that faces a number of challenges, including notably high levels of risk in terms of

accidents and other incidents, especially in the nuclear energy sector (International Labour Organization [ILO], 2015).

Construction workers and subcontractors who work on NSIPs encounter many policies and regulations that attempt to mitigate risks. Contractors may be caught up in a series of never-ending controls, creating what in Organisation Studies has been referred to as a *moral maze* (Jackall, 2017), where with conflicting, ambivalent and ambiguous rules determine that there is some satisficing of which rule to follow, whilst leaving a plethora of justifications for not following one particular rule. For the developers of major construction projects, introducing such policies has the effect of enforcing a number of common goals: to aspire to best practices, by avoiding risk, with a view to achieving economic efficiency (DBIS, 2013; Fellini et al., 2007). But when we consider that many employees are paid by the hour, there may be implications in terms of the number of hours worked and the amount of income received by those contracted by small, private companies. For other workers and firms, such an environment may cause anxiety (and may also modulate into a form of politics), especially if the environment is known to be highly competitive, fragmented, and volatile (Barry, 2020; Dainty et al., 2013). In short, infrastructure projects have the potential to create an “ontological politics of both uncertain and future possibility” (Barry, 2020, p. 9). For developers, policy processes present a blueprint for continuous progress while simultaneously creating precarity for subcontracting firms and their workers.

While drawing on ideas about how future risk could be operationalised in order to analyse present day infrastructure projects, Maguire and Westbrook (2021) question the epistemological foundations of policy and security discourses. In contrast to other kinds of anticipatory projects, policy outcomes do not always end up being as predictable as initially hoped. Policies and other requirements may in fact be operationalised only up to a certain point, but as noted previously, there is a high scope for interpretive variability (Star, 1999) in order to make sense of gaps, discontinuities, ambivalence (Jensen, 2007; Shore and Wright, 2011). Some recent examples of incidents that have occurred at a NSIP where safety measures were already established included a fatal traffic incident in late 2022, at the same site as a worker’s legs were crushed by a falling steel-framed box only a few months earlier and a scaffolding accident occurred three months prior to that (Jenkins, 2022; Thomas-Alexander, 2022). Following the traffic incident, operations on the construction site were

completely shut down for almost a week, while the other incidents resulted in new safety measures being introduced. As such, it is important to consider local events in the broader context of policy outcomes and how those elements not previously considered become a supplement to existing policy. This not only reproduces a Comtean enlightenment logic whereby with greater information policy becomes more fit for purpose but highlights the difficulties of predicting futures in any project, let alone complex projects involving multiple stakeholders with different emphases at different stages.

2.4.1.1 Global Sustainability

The need for a new or reworked infrastructure policy for energy has become a priority in a number of different socioeconomic, political, and environmental contexts. This has been influenced by the European Union's Infrastructure Package of 2011, which targeted the development of new energy infrastructure projects, in order to meet various decarbonisation, energy security, and market liberalisation needs. The Lisbon Treaty of 2009 also attempted to align new energy infrastructure projects between the EU (European Union) member states and the European Commission. The main goals of such policies include the improvement of transport services, the modernising of housing, and the transformation of society to move towards more sustainable forms of living, as well as the promotion of economic growth and the enhancement of national security (Bridge et al., 2018).

'Subsequent to international frameworks and legislation for addressing climate change, an economic and political priority has been given to support such sustainable policies, especially those that focus on reducing carbon emissions. Such examples include the Kyoto Protocol of 1998, the Renewable Directives of 2009, the Paris Agreement of 2016, and, most recently, the 27th Conference of the Parties (COP27). In many respects, COP27 represented the best chance for the nations of the world to come together and action the commitments of the Paris Agreement by limiting global warming to 1.5 °C.'

(United Nations Climate Change, 2022)

These policy agreements have emphasised large-scale infrastructure projects that have the potential to deliver the low-carbon and low-cost energy systems necessary to secure energy

supplies over the long term. Therefore, the classification of new energy infrastructure projects (or NSIPs) as being of *national importance* also reflects the related concerns of economic growth and prosperity on the one hand, and a growing dependency on energy imports and international integration on the other. Niewöhner (2015) has argued that the transition to renewable energy sources will require more scrutiny over the infrastructure that shapes economic, social as well as political processes:

‘...Major industrial actors; a technological field that has not settled on key technologies yet and that is still witnessing a multitude of decentralized, often very local initiatives and innovations; and a civil society particularly in the affluent North that so far show little inclination to reduce energy use or develop other ways of accounting for its externalities...’

(p. 8)

Niewöhner argues that when contemporary infrastructure is being researched, it is imperative that the social and ethical implications of the accompanying choices are fully considered. These choices often appear to be technical choices yet are ethical and social choices as they have global consequences (Niewöhner, 2015). It remains the case that investing in alternative national energy infrastructure projects has the potential to offer solutions to some of the contemporary challenges we face, notably surrounding decarbonisation and energy security (Bridge et al., 2018).

2.4.1.2 Lived Experiences

Policies can connect different actors, discourses, and institutions through processes of association. Connections between contractors and subcontractors impact each in different ways depending on where one is situated in the construction hierarchy. The impact of these connections is bound up with broader economic, political, and social processes (Maguire et al., 2014). Drawing from previous examples on NSIPs, policies are also able to impose narrow rules with the potential to affect the workers on the construction sites. The implications can be explored by means of control processes. On nuclear power projects, for example, major construction and manufacturing work is required in areas such as civil works, marine works, and the instrumentation of nuclear turbines. While this demonstrates the fragmentation of

such projects, and the heterogeneous sub-industries that are involved (Dainty et al., 2013), it also serves to expose the fragility of such projects (Harvey et al., 2016). Especially for example, as they are regarded as being of high risk, involving materials that can be extremely hazardous and potentially dangerous, both for workers as well as the environment. Each speciality sector has pre-existing rules and regulations, particularly around health and safety that need to be brought into the broader project management.

Following the Chernobyl and Fukushima disasters, local governments have had to rethink their energy strategies. New nuclear power stations are now being built in accordance with a range of new regulatory measures and other reforms (Infrastructure and Projects Authority, 2016; GOV.UK, 2016; 2018; Soni, 2018). Moreover, the need for readily accessible nuclear energy sources has recently become even more urgent, following the onset of the war in Ukraine as it made explicit the insecurity of UK energy supplies. This example, once again, exposes the vulnerabilities of nuclear energy sources, while also highlighting their pivotal importance to energy security through uninterrupted availability of energy sources at an affordable price. In order to mitigate any future disasters, it is necessary for developers to introduce robust policy strategies, with detailed quality control and verification requirements, during the construction and manufacturing stages.

Even though compliance with policy requirements is a necessity for the construction industry, it is not without its difficulties. Given the competitive nature of the industry and the skill shortages it periodically faces (Wall, 2014; DBIS, 2013), compliance can be costly. The International Organization for Standardisation (ISO) comprises a number of member representatives and countries. It offers various forms of international standardisation in technical as well as non-technical fields. In effect, preparedness through training and other practices might not meet the required ISO standards for the country in which the construction is taking place, adding further pressure to an already highly fragmented and mobile supply chain (Fellini et al., 2007; ILO, 2015; Pink et al., 2010). This is exacerbated by high levels of informal employment, where employees may be UK or foreign based nationals.

Brexit has introduced further challenges to the construction industry, notably increased material and labour costs. This has had a knock-on effect on employers who have had to increase wages due to competition amongst construction companies. Before Brexit, about

40% of construction workers came from other European countries. For example, it has been recorded that since the referendum, EU workers working in the UK has dropped from 165,000 in September 2016 to 90,000 in September 2017. This has dramatically fallen from an all-time high of 189,000 recorded in June 2016 (BuildSafe News and Articles, 2022; Balfour Beatty, 2018). Given the specialist nature of NSIP concentration work, the necessity to recruit EU workers has resulted in additional costs.

Tutt and Pink (2019, p. 479) have similarly pointed out further challenges such as a rise in populism or “hard borders” over recent years, which has resulted in clashes over identities as well as policies. In turn, leading to the reconfiguring of the relationships between local and global networks as well as revised trade agreements. Political tensions may exist on national as well as international levels in terms of the freedoms and constraints as a consequence of the ISO standards (which have been developed in order to provide a universal platform) not necessarily meeting the cultural standards of a particular international workforce.

Bigo (2002) has argued that even though a lot of attention has been placed on risk, less attention has focused on the bureaucratic and organisational aspects of everyday policy practices. Recent events provide a pertinent example here, as the contractors participated in industrial action in order to demonstrate their *concerns* about their working arrangements (BBC News, 2022). Most importantly, like Maguire and Westbrook (2021), and Niewöhner (2015), Bigo stresses the need to call particular attention to the policy processes themselves. In effect, policy strategies for the minimisation or eradication of risk are dependent upon the ways in which they are interpreted by those who such policies aim to regulate.

2.4.2 Risk

In order to develop a nuanced understanding of policy, it is also important to pay equally close attention to the accompanying questions of risk. This is because policies themselves are means of controlling for risk. Modern societies are obsessed with eliminating ambiguity when it comes to uncertainty (Bauman, 1999), as seen earlier through the Comtean philosophy. Radioactive emissions, the hole in the ozone layer, global warming, financial

crises (Jacobs, 2004) are all examples of uncertainty where policies are put in place to ameliorate risk. However, too great an emphasis on uncertainty heralds the arrival of a *risk society* (Sørensen and Christiansen, 2013). Drawing on the work of Beck (1992) on risk societies, Jacobs (2004) pinpoints the fundamental contradictory problem that emerges from the project of modernity: in the attempt to impose order and control, such as, through various policy measures, new sources of ambiguity and ambivalence continue to become apparent. As such, modern societies organise themselves as *risk societies* in response to such threats. In this respect, a risk society is a systematic way of dealing with hazards and insecurities “induced and introduced by modernisation itself” (Beck, 1992, p. 21). Beck also draws on the work of François Ewald, who categorised the prototypical modern society as an “insurance society” (Ewald, 1991, p.197). According to Ewald, insurance is fundamental to modern society, being founded on the principles of transparency and calculability. This ultimately allows for uncertainty to be categorised as a rational phenomenon, by means of calculation. Furthermore, transparency is also key to an insurance society, because a “transparent world [...] will no longer be able to surprise us” (see Sørensen and Christiansen, 2013, p. 16). In effect, for Beck (1992), the social world is organised around ideas of risk, where strategies to minimise risk become the guiding feature of social life.

As insurance is characterised by the fact that transparency cannot be guaranteed (Maguire and Westbrook, 2021), so a risk society produces new risks as a consequence of the eradication of others. In this respect, the very same uncertainties that modern society attempted to eradicate during the Age of Enlightenment, by means of rationality, science, calculability, and other technological advances, have arguably returned as the contemporary consequences of unpredictability, resulting in the creation of a risk society. For example, the technological advances that were achieved in terms of nuclear power were counterpointed by the noted disastrous and unpredictable Chernobyl and Fukushima events, and new instances of ambiguity have arisen as a result of the ongoing war in Ukraine and its global consequences. Much as Merton (1936) argued, there are unintended effects of purposeful social action, so too there are unintended risks as a consequence of managing risks.

Risks of NSIPs cannot be simply confined within borders or to specific spaces or specific times. Much as Multi-National Corporate activity transcends national borders and as such is impossible to regulate beyond national borders (or supranational borders in the case of the

EU), so policies are limited to national context. Beck examines the borderlessness of the risk society, and this concept has prompted correlative analyses of globalisation and its many implications (Beck, 2016, pp.260-262), where risk stands beyond national borders, yet can only be policed within them. It may be suggested that the increase in potentially risky consequences, and their antecedent uncertainties, have affected and transformed the institutions of contemporary society, as well as the living conditions and perceptions of those who inhabit the world more broadly (Sørensen and Christiansen, 2013).

Schillmeier (2011), referred to global disasters, such as Fukushima, as cosmopolitical events. Here, the unfolding consequences have disrupted, questioned, and fundamentally altered the “common and taken for granted modes of ordering social life’ (p. 514) including the institutionalised machinations of societal relations. Debates surrounding risk and calculations of likelihoods of particular events drawing on objective data, political debate and political interest can be situated as local discussions, yet an event such as in Fukushima brings into stark relief how a risk calculation becomes meaningless when the risk becomes reality.

Within the context of such contemporary risks, an increasing emphasis has been placed on workplace accidents and incidents, as societies “have their agendas dictated through different types and kinds of risks and hazards” (Sørensen and Christiansen, 2013, p. 18). Tutt and Pink (2019) and Dainty and colleagues (2013) show the dangers of treating global risks as localised issues, as discussed previously in relation to the rise of populism and *hard borders*. National policies surrounding migration and the risk of foreign nationals disconnect with the needs and demands of specialist labour, particularly within NSIPs.

2.4.3 Audit and Accountability

According to Beck (1992, p. 19), modernization is becoming more “reflexive in risk societies”. The ways in which new security technologies are being developed and administered has seen greater emphasis has been placed on the economic, social, and political management of risk. Despite this acknowledgement of reflexivity and its increasing development, it has nonetheless remained the case that the systematic managing of realism in interactions

between experts and other actors has remained dominant, as Habermas (1971) argues. Contemporary society is a risk society, which means society is organised in response to risks. Systematic attempts have been made to prevent, minimise, or successfully channel the insecurities and hazards that are bound up with modernisation itself (in Beck's terms). This has been accomplished through the creation of what Power (2000) terms an *audit culture*, a specific system of accountability.

We may recall the work of Ewald (1991), who described modern society as an *insurance society* based on the principles of transparency and calculability. Strathern (2000) has similarly pointed to the ubiquitous term *management*, which stands as an exemplar for understandings of organisation and regulation. Nonetheless, it is also the case that the various processes of measurement, evaluation, and assessment that are commonly grouped together under the term *audit* can have social consequences, which constrain personnel, resources and time, prompting management awareness of moral questions. Audit practices often appear to be especially mundane elements of bureaucratic processes. Strathern, however, argues that when the bigger picture is further probed, the various circumstances of such practices emerge as "a distinct cultural artefact" (2000, p. 2). In this understanding, an audit culture is:

'Informed by practices confined to no single set of institutions and to no one part of the world. Recognizable in the most diverse places, these practices also drive very local concerns. They determine the allocation of resources and can seem crucial to the credibility of enterprises; people become devoted to their implementation; they evoke a common language of aspiration. They also evoke anxiety and small resistances, are held to be deleterious to certain goals, and are overdemanding if not outright damaging.'

(Strathern, 2000, p. 1)

We have previously approached processes of accountability via government decision-makers and structures, linking them to the highly varied compliance controls and requirements that frequently govern NSIPs. We may compare the recognition of such compliance requirements with the understanding of Strathern (2000), who argues that the workplace is increasingly managed and moulded in accordance with an ever-present (if not ever-changing) consensus regarding its procedures and objectives. Compliance becomes a moral terrain couched in

terms of “good practice and economic efficiency” (p2). Indeed, in the language of management and its accompanying accountability, terms such “transparency”, “quality”, “effectiveness”, and “value for money” have increasingly dominated institutions (Shore and Wright, 2015, p. 422). In this respect, it has been argued that audits (as well as the suggestions within the language used) have ultimately introduced a new form of ethics: “they are where the financial and the moral meet” (Shore and Wright, 2015, p. 422).

Power (2000) highlighted how auditing practices, including evaluation and monitoring are frequently employed to enhance organisational change, suggesting the possibility of such audits also bring dysfunctional effects, as well as benefits, that are not extensively considered. For an organisation to be accountable, and to have its accounts audited, is not the same as that organisation being more transparent. It has been argued that the performance of auditing is conducted in order to display a kind of accountability that is specifically designed to avoid transparency. Strathern for example, emphasised the need for thorough anthropological enquiry into the impacts of the “new ways of practicing, or performing, accountability” (2000, p.2). This, however, has the potential to open up a wide range of social situations, which are not confined to a particular community or state apparatus, but are instead premised upon institutionalised instruments and expectations.

Audits become so enmeshed in contemporary thought that they become impossible to criticise, since they invariably emphasise contemporary preoccupations with responsibility and value. Nonetheless, anthropological enquiry has the capacity to draw upon the understanding of new accountabilities, which Strathern (2000) has also described as *rituals of verification*. This term refers to new management practices that are increasingly focused on auditing, using a range of monitoring techniques to ensure that internal control systems are successfully in place. In addition to introducing new mechanisms and systems that facilitate this approach to auditing, these practices are also accompanied by rhetoric that emphasises this new “culture” of “helping (monitoring) people to help (monitor) themselves” (Strathern, 2000, p. 3). Thus, it remains the case that these new control measures, or *rituals of verification*, only enhance the underlying levels of mistrust, since professional judgements and trust are ultimately replaced by the formal and impersonal systems of auditing and accountability (O’Neill, 2002). As Porter (2008) makes explicit, when

issues of trust are at stake, we rely on and trust numbers, the quantification of real and potential is where we place our trust and audit performs this function well.

2.4.4 A Sense of Belonging

The understanding of a *contemporary society* is inescapably linked to notions of globalisation, as we live in world that is increasingly mobile, fast-moving, and interconnected, that is being driven by developments in technology. In this respect, individuals feel what Giddens refers to as “ontological insecurity,” which describes an “obsessive exaggeration of risks to one’s personal existence, extreme introspection and moral vacuity” (Possamai-Innesedy, 2002, p. 27). This deep and ongoing uncertainty may result in the identities of individuals becoming increasingly unstable. What is more, if an individual should feel ontologically unstable, it is unlikely that they will be able to establish basic understandings of trust with others and, as a consequence, be able to experience “dignity”, a sense of “freedom”, or even a sense of “self” (Shani 2017, p. 277). Arguably this gives rise to a greater trust in numbers and control mechanisms rather than those things being controlled (Porter, 2008). To counteract this, however, routines can be established, with a view to bringing about greater degrees of cognitive and behavioural certainty (Mitzen, 2006).

The temporal natures of NSIPs have previously been explored, in terms of the economic, social, political, and cultural realities that engineering contractors and subcontractors face (Barry, 2020; Dainty et al., 2013). It was noted that fragmentation greatly depends upon a mobile labour force, with the work being either regular or irregular and either authorised or unauthorised (Fellini et al., 2007; Dainty et al., 2013). Moreover, the contracting firms that work on NSIPs hold hierarchical positions, depending on the size and complexity of the contract. In essence, then, the social relationships that are developed during construction projects, as a result of the establishment of routines and subsequent trust, can have huge impacts on major large-scale projects (Fellini et al., 2007, pp. 279–80).

This juxtaposition emphasises the opposing realities that construction and other workers experience: on the one hand, they are attempting to establish a sense of self through

“biographical continuity” and “cognitive consistency” in their everyday experiences, but on the other hand, they are continually being exposed to a system that is characterised by rapid change in both cultural and socioeconomic terms (Kinnvall and Mitzen, 2020, p.240). As Mitzen (2006, p. 341) has argued, “ontological security is achieved by routinizing relationships with significant others,” with the result that identities are formed and sustained through relationships, with trust being key. Therefore, by forming attachments we develop a *sense of belonging*.

An individual’s personal experience will, therefore, be bound up with the different communities to which they belong. These could include characteristics such as national identity, gender, class, political persuasion, personal values and the situations in which they find themselves. As Yuval-Davis (2006) argues, identities are narratives, stories that are told not only about oneself and others, but also about who one is and who one is not. Not only do these narratives relate to an individual belonging to a particular group, but they can also be about one’s mental beliefs, physical appearance, or vocational aspirations, for example. Nonetheless, such stories often touch upon, either directly or indirectly, what it means to be a member of a particular group. More specifically, identity narratives often function as a means of explaining one’s present circumstances or one’s hopes for future trajectories, thereby reflecting one’s current and future emotional investments and desired attachments. It is in such a context that Yuval-Davis suggests that *belonging* is a dynamic ongoing process that consists of shifting identity narratives that can often be multiple and, therefore, contested:

People can *belong* in many different ways and to many different objects of attachments. These can vary from a particular person to the whole of humanity, in a concrete or abstract way; belonging can be an act of self-identification or identification of others, in stable, contested, or transient way.

(Yuval-Davis, 2006, p. 199)

To simplify our understanding of belonging, Yuval-Davis (2006) groups an individual’s different relations into three different categories. At the first level are the relations to *location*, which involves safety and the maintenance of a sense of home, enabling freedom from fear; at the second level are relations to others, whether these are emotional

attachments or broader connections with encompassing communities; and at the third level are the *ethical* and *political* relations by which the various *belongings* of oneself and others are judged. At this third level, it is important to acknowledge that once a sense of belonging has been achieved, it can also become politicised, in the event that it should be threatened. For instance, studies in social psychology and sociology (Giddens, 1991; Lewin and Lewin, 1948; Tajfel, 1982) have considered how interpersonal relationships can be affected by memberships of groups, or the lack thereof, as well as by an individual's position within a group as in kinship relations. (Yuval-Davis, 2006). As Giddens (1991) has argued, the developments of modernity have caused people to become more reflexive about their sense of belonging, with the result that ethical values are often highlighted above all.

Mass communication, mass migration, and global capitalism have been described as bringing about a *transnational social space* (Pries, 2002), a "multi-local life world" (Vertovec, 2001, p. 578). For migrants, the social world involves a duality of physical places on the one hand, and communities on the other, since membership is claimed in more than one place. This means that a migrant relies less on an individual sense of belonging than multiple narratives of belonging (Vertovec, 2001). Nonetheless, it has also been argued that the choices of migrants may be limited and/or regulated and/or informed through the various processes comprising the act of migration, such as the reasons for migrating, the companions along the way, the final destination and any conditions of employment.

Eriksen and colleagues (2010) pose the question "how do transnational relations influence notions of belonging" (p.93)? One way of answering this involves looking at *culture*, not in the sense of the relations that result from living in a particular place, but in the sense of the relations that arise from the interactions between people, their everyday conversations, and experiences (Eriksen et al., 2010). In this respect, locality can be understood as comprising a range of multifaceted and multi-layered processes that mobilise loyalties to different communities at the same time (Lovell, 1998). What is more, the sense of belonging is particularly selective when it comes to "memory," as only certain elements are picked out, to highlight certain social relations or promote certain aspects of an individual's identity (Lovell, 1998, p. 150). In this way, it is possible for notions of belonging as well as notions of not belonging to be felt.

The construction labour force is classified as migrant. Even *local* contractors are relative as they arrive from other parts of the UK, with a large proportion being Welsh. As a consequence, demand-driven labour migration is shaped by a range of transnational social spaces, which in turn influence the perceptions and experiences of the construction workers, especially those who are migrants (Barry, 2020; Fellini et al., 2007).

2.4.5 Mobility and Migration

While early capitalism witnessed movement from rural to urban areas, contemporary capitalism has resulted in global mobility, coming into contact with others and taking on new tasks (Erikson et al., 2010). This increased mobility may be perceived as a platform for institutions to be reorganised, generating migration patterns, producing new risks, and ultimately contributing to climate change. This increased mobility is also responsible for transforming the natures, scales, and temporalities of individuals, families, and communities as they exist in public as well as private spaces, bringing about different levels of commitment to the understanding of a nation state (Hannam et al., 2006).

What is significant in contemporary capitalism is the constant change and mobility occurring in global economics, identities, and relationships, what Bauman (2001) terms *liquid modernity*. Indeed, it is presently the case that the terms *liquid modernity/mobility* and their cognates are frequently used to describe the conditions of late capitalism, which are associated with advances in technology, increased access to financial capital, and post-Fordism, resulting in a rise in income inequality (Brenner and Theodore, 2002). In this respect, the concept of mobility is exemplary as a means of defining the contemporary human condition, as it is expressed in terms of the specific tangible materialities of particular times and places, as well as the narratives of globalisation (Dalakoglou and Harvey 2012). Equally, however, liquid mobility has also come to represent forms of detachment or what Brenner (2004) has termed “deterritorializations,” which are always accompanied by “rhizomic attachments” (i.e., nonlinear networks of multiplicities) as well as “reterritorializations” of other processes of connection, detachment, and reconnection (Hannam et al., 2006, p. 3; Sheller, 2004; Shurmer-Smith and Hannam, 1994).

Power relations have impacts in everyday life (Massey, 2012), including the different hierarchies and structures of mobility empowerments, which range from the local to the global (Hannam et al., 2006). In this context, the different tiered groups within the construction industry (T1s to T3s) provide a compelling example. The various contracting firms within the construction industry are divided into tiers according to their size (i.e., their position and power), their overall profitability, and their political influence, all of which contribute to an individual firm's capacity to effectively (or profitably) mobilise both materials as well as people. Different sets of challenges are experienced by different firms however, depending on their ranking in the hierarchy. It is also important to acknowledge that the different firms working on a project will be local as well as global, which raises a further set of challenges in relation to the processes that both facilitate and constrain other groups or institutions (Fellini et al., 2007). By using the lens of mobility to consider the impacts of infrastructure projects on contracting firms and construction workers then, the requirement for movement within the construction industry impinges upon and perhaps also defines the everyday lives of people who come from different backgrounds and have different social standings. Indeed, it is essential to acknowledge the consequences of mobility when exploring questions of belonging and kinship.

2.4.6 Kinship in the Context of Mobility and Migration

The notion of kinship is helpful when it comes to exploring and understanding questions of mobility and migration. In fact, this notion goes hand in hand with research into the transnational processes of migration. Anikopoulos and Duyvendak (2020) have argued that any attempts to conceptualise kinship must fully consider its dynamic and flexible nature, in a range of changing settings, as well as the various ways in which it is connected to state politics. In the case of NSIPs, it may be considered in terms of internal politics or bureaucratic processes, as previously noted. As such, the negative implications of kinship relations should also be acknowledged. For instance, while kinship is often associated with positive attachments and understandings of solidarity, it can also be bound up with hierarchies and inequalities. Wedel and colleagues (2005, p.34) suggested that people can be classified as particular "policy problems", a suggestion that resonates with the previous

discussion of the development of policies in the construction industry. On the one hand, there will be some people who comply with a system of policy controls, on the other there will be others who may falter in adhering to these practices or standards, and who will subsequently be put through further auditing processes.

It is important to acknowledge that mobility and migration are to be differentiated. According to Urry (2007), mobility is to be understood in a more general sense, as referring to any kind of movement. Setting the fundamental understanding of physical movement aside, other kinds of movement may be differentially accessed and experienced, especially when questions of power and status are involved. By contrast, Anikopoulos and Duyvendak (2020) have described migration as something that is more specific: this is a kind of mobility that enables transnational processes that are ultimately subject to the logic, and hence the control, of nation states – or in the case of NSIPs, it includes for example, policy controls by government and developers.

2.5 Infrastructure: Shaped by Heterogeneous Entities

‘...infrastructures turn out only to be good for some people, some of the time.’

(Harvey et al., 2016, p.8)

Infrastructure developments are often complex and can meet with further complications. Stories of crises are plentiful, whether they are analysed in the scholarly literature or presented via news stories or blogs. New forms of insecurity, surveillance, and terror are continuously presented in ways that had not previously been imagined. Many infrastructure crises are associated with notions of splintering and collapse, which result from neoliberal policies. As previously noted though, transformations of infrastructure are not entirely in the hands of those in power (Latour, 1996). What is more, the intentions of politicians often bring about unexpected outcomes with new sets of complications that had not previously been anticipated (Merton, 1936). A logical approach would be to view a continuous linearity of progress that has been defined by government and industry, so that in the event of a crisis these actors would be considered responsible. However, the complexities of infrastructure are shaped by heterogeneous entities with competing interests and

capacities, even though they interact at the same time, these heterogeneous entities are not necessarily aligned. The partial and provisional nature of these alignments are exposed during periods of crisis (Schillmeier, 2011). These complexities and crises can emerge in unexpected and uncontrollable ways, making it very difficult for government and industry managers, or other comparable experts, to enforce linearity in development projects.

Jensen and Morita (2015) have emphasised this aspect of infrastructure as being particularly important because it highlights the fundamentally experimental nature of infrastructure development. One way of thoroughly exploring the dynamic character of infrastructure development is through Actor Network Theory (ANT), which is both a theoretical as well as a methodological approach and will be presented in the following chapter. Briefly, though, ANT enables the intricacies of large-scale infrastructure projects (shaped by heterogeneous entities that are interconnected in one way or another, but not always necessarily aligned) to be fully explored, in order to reveal connections and disconnections between human and non-human actors. Non-human elements (such as technologies and economic goods, including policy documents and texts, material structures, and objects) are active in these heterogeneous relationships, prompting a range of human actions. They are, therefore, acknowledged as being symmetrically connected. Larkin (2013) similarly defined heterogeneous networks or infrastructures “as built networks that facilitate the flow of goods, people, ideas, and allow for the exchange over space.” (Larkin, 2013, p. 328)

Over the past decade, the world’s superpowers have invested in infrastructure developments to modernise the systems that allow the circulation of energy, goods, and money. This has inspired a number of researchers to employ qualitative methodologies (such as ANT) to gain greater understanding of the social systems that are affected by these infrastructure investments. As a consequence, a number of studies have concentrated on the roles that materials and objects have played in the shaping of social worlds, by analysing a range of practices, including those relating to scientific investigations, engineering, resource allocation, contractual negotiation, connectivity, and gridding (Harvey et al., 2016). Such investigations have proved to be extremely insightful, since they demonstrate a range of approaches to understanding the complexities of infrastructure developments, where those developments have impacts in economic, political, social, and cultural contexts.

Michel Foucault, Donna Haraway, and Bruno Latour for example, make use of material-ontological or post-humanist approaches in order to realise the symmetry between human and non-human elements. Such theories are premised upon the understanding that a range of intra-actions occur between the human, the animal, and the technological, which cannot but undermine anthropocentric notions of Cartesian duality. These ideas underpin the following chapter, as they align with an ANT framework. The case is made that such an approach has the potential to bring fresh understandings of policy, risk, accountability, auditability, mobility, migration, kinship, and belonging. These different elements are inextricably linked to NSIPs and the people who work and live on and around the infrastructure. Latour (1999, p.23) refers to the term “blackboxing”, which is used to suggest the ways in which scientific and technical developments can be rendered invisible as a consequence of their efficiency, taken-for-grantedness and common sense. In this way, inputs and outputs are emphasised, while internal complexities go unnoticed. This notion of visibility is crucial when it comes to the benefits and drawbacks of working on NSIPs, and the conditions under which such benefits and drawbacks are experienced. On the one hand, for instance, government authorities and developers talk up the extensive socioeconomic benefits that will result from such projects; on the other hand, the specificities of the how, the what, and the why often remain unknown, especially in terms of the limitations (or invisibilities) of the infrastructure development itself. With the use of an ANT framework, however, the full extents of such benefits and drawbacks can be explored. This helps us to understand the various kinds of impacts that are registered by the local workforce, while always bearing in mind that their visibility or invisibility may have different meanings in different geographical spaces and contexts.

2.6 Chapter Summary

Harvey et al. (2016) have described how, as a result of the increased attention that infrastructure has received in the social sciences, an elaborate ensemble of the various actors involved in the development of infrastructure projects has been introduced into evolving conversations, providing an expanding range of resources for thinking and acting. Consequently, a social science research has been able to emphasise the multiple dimensions

of the cultural, economic, political, and ethical transformations and complications that both unite and divide communities. Over time, engineered infrastructure systems have been associated with understandings of development and progress, and a popular belief has emerged regarding their linearity and singularity, in terms of both political and technical change. While this may be true up to a point, such a straightforward belief in progressive development has necessarily had to become more complex as time has passed. In the present day, various forms of political and technological change are more diverse than ever before, and in some cases are also more uneven.

Comparable narratives are increasingly being applied to the complexities of infrastructure systems, especially in the era of climate change. Indeed, we now find ourselves facing a climate crisis – and, as a consequence, the government is urgently attempting to mitigate its affects by means of the construction of NSIPs, among other things. Given that infrastructure systems can be characterised by their volatility, while the construction industry that builds such systems can be characterised by its fragmentation, the vulnerabilities of such an approach become fully exposed on the route to operationalisation. This research aims to focus on the impacts felt in the everyday lives of the construction workers who are commissioned to build such projects, in the economic, political, as well as cultural arenas. In many respects, the success of our sustainable future depends on them and their efforts.

CHAPTER THREE: THEORETICAL FRAMEWORK – ACTOR NETWORK THEORY (ANT)

3.1 Introduction

The aim of this research is to explore the Impacts of Nationally Significant Infrastructure Projects (NSIPs) among Engineering Contractors and Subcontractors. The previous chapter emphasised that critical infrastructure projects need to be developed urgently owing to the rapidly escalating effects of the climate crisis. These projects purport to create new jobs, provide economic benefits, and aid sustainable development, the literature review also called attention to the complexities of infrastructure projects. Most notably, NSIPs are not only frequently characterised as expensive, but they also require lengthy construction periods that have a range of social consequences, which in turn affect individuals living and working on and around the field site (Harvey et al., 2016). Large-scale infrastructure projects are also frequently associated with volatility, resulting from rapid changes in technology and prolonged turnover of capital. Furthermore, the construction industry's flexible forms of production and accompanying reliance on contract work has instantiated a structural fragmentation, which further affects members of the workforce. By acknowledging these various challenges and examining them in some depth, the previous chapter emphasised a range of social impacts including issues relating to policy, audit, globalisation, mobility, migration, and questions of belonging – many of which are not always fully considered.

The following chapter continues to explore some of these concepts, using Actor Network Theory (ANT) as a theoretical and analytical framework for better understanding the social impacts that are experienced by contracting engineers in their everyday lives. ANT allows lines of connection to be drawn between a range of heterogeneous networks such as the economic, material, political, social and the technological. This approach allows for a deeper understanding of the dynamics between the various relations especially the ways in which they are negotiated, forged, and maintained by highlighting alignments, attachments and interests (Rydin, 2012).

3.2 Actor Network Theory Frame

Latour (2005, p. 5) considers sociology as being more than a “science of the social,” he instead characterises the discipline as involving the “tracing of connections.” This resonates with the suggestion by Law (1992, p. 1) of a “sociology of translations.” ANT can be considered as a sociological approach to uncovering associations between heterogeneous entities, including human as well as non-human and material elements. ANT is a theoretical and analytical framework that allows everything in the material, social and technical worlds to be linked together and considered as a web of associations that is referred to as an *actor network*. The ANT framework offers much more than passive descriptions of interactions between people and material objects as these heterogeneous networks, which include agents, machines, organisations, and society as a whole, “are all effects generated in patterned networks of diverse materials” (Law, 1992, p. 1). Ultimately, an ANT approach aids a better understanding of how seemingly inert objects that surround us can influence our actions and shape our subjectivities (Baiocchi et al., 2013).

Law (1992) also explains that the various patterned networks surrounding us not only participate in the social, but also contribute to it too, with the result that knowledge is produced in the process. Attributes that are commonly associated with human beings, such as acting, earning, loving, thinking and writing are revealed as always being generated in networks, which means that they cannot but extend beyond an individual’s body. It is such an understanding that gives rise to the term “actor network,” in which “an actor is also, always, a network” (Law, 1992, p. 4). The *actor* (or *actant*) in an actor network is always someone or something that acts on something else, or that is prompted to act by something else. In this respect, Latour (1999) introduces the term *actantiality* emphasising its importance by stating that it does not merely describe “what an actor does,” but rather calls attention to what “provides actants with their actions, with their subjectivity, with their intentionality, with their morality.” (p. 18).

These various patterning processes are also explored in what Law (1991) refers to as *material semiotics*, a term that emphasises how social practices are woven together as a social web. That is, woven out of threads that are simultaneously semiotic (meaning that they are relational and carry meaning) and material (meaning that they are involved in, as

well as shaped by, those very relational processes). These approaches are used in order to determine *how* such processes of weaving have either been realised or have failed; *where* such threads come from, their natures, agendas, and processes of *domination*, and how they perform different realities (Law, 2019). The related terms *network*, *weave*, and *web* are used interchangeably and point to the ways in which we are always already moved by a multitude of interests and agendas. Nonetheless, the main objective is always to trace how such heterogeneous patterns or webs are being networked or woven, and then to explore their various consequences. As such, the ANT framework ultimately represents the understanding that entities only become significant in relation to other entities, with new hybrid formations being created in the process. It is in this way that the social can only really be understood as relational as we understand ourselves in relation to others, human or non-human. As Latour (1996, p. 7) states: “What really matters is that [material semiotics] is an elevation instead of a reduction and that the new hybrid status [is] given to all entities.”

The networks of interacting heterogeneous actors that constitute institutions are often perceived as precarious networks that by no means function homogeneously. Some network patterns are performed more than others. Law (1992) refers to this as *punctualisation*. Accordingly, punctualisation may be volatile and it may also be met with resistance. Similarly, punctualised resources can also be rapidly adaptable when they draw on the networks of the social, without becoming too involved in the surrounding complexity. Resources can be so enmeshed within networks that they become reproduced in, performed in, and extended to other networks of the social (Law, 1992). What is more, the process of exploring the generation of ordering effects (such as agents, devices, institutions, and organisations) is called “translation” (Law, 1992, p. 386). Translation implies the related understandings of equivalence and transformation, through which an actor may represent a network. In sum, the core concept of the ANT approach is concerned with the following:

‘How actors and organisations mobilise, juxtapose and hold together the bits and pieces out of which they are composed; how they are sometimes able to prevent those bits and pieces from following their own inclinations and making off; and how they manage, as a result, to conceal for a time the processes of translation itself and so turn a network from a heterogeneous set of bits and pieces each with its own inclinations, into something that passes as a punctualised actor’

An ANT approach connects with issues of performance and performativity. From an actor network perspective, descriptions do more than simply describe something. Indeed, they can create the very things they describe (Callon, 1984). This is a position seen in other areas of social science and philosophy (e.g., Foucault, 1981; Bourdieu, 1991; Butler, 1993). Knowledge is produced by means of the forming of associations and the enacting of worlds, giving rise to the suggestion that knowledge itself constitutes an actor network. According to Law (2004), social science research methods are themselves performative, where only one type of reality is represented – the one that the researcher wishes you to see. The recognition of this condition, however, has subsequently developed into the understanding of *ontological politics*, which Mol (1999) has described as a framework for exploring the ways in which the world is continuously being shaped and reshaped by everyday practices. Haraway (1988, 1991, 1997), who developed feminist material semiotics in order to explore political tensions as they are rooted in practice (e.g., science and technology studies), similarly argues that all practices are performative and semiotically reflected and therefore political. As these various understandings imply, and as the ANT framework emphasises, in ethnographic work (or the use of any research methods) it is impossible for the researcher to be completely inseparable from the political. The distinguishing quality of ANT, however, is that it enables researchers to engage with more subtle political associations, by reflecting upon social science practices more generally, as well as the kinds of knowledge that are produced (Baiochi et al., 2013).

No heterogeneous networks or social orders will ever be truly complete and final. Thus, the point is highlighted, that no heterogeneous engineering can ever be fully predictable. However, even though punctualisation may always be precarious, punctualised networks can also be extremely resourceful by drawing on other social networks (Law 1992). As a consequence, “the social order” (societal components that work together to move forward) does not have a centre or stable relations. As such, these orders, as well as their resistances, have the potential to be infinite (Law, 1992, p.386). The ANT framework, therefore, plays a key role in analysing these ordering difficulties and exploring what may be central to a particular concept. As Law (1992) understands it, the objective is “to explore and describe local processes of patterning, social orchestration, ordering and resistance” (Law, 1992, p.

386). The first chapter, for instance, discussed the complexities of NSIPs in detail and explored how the material, the social, the political, and the technological are bound up with everyday human experiences and the various impacts that may be felt. The following chapter, too, will explore how the ANT framework aligns with qualitative methods and it is there that I shall discuss my own rationale for using it.

3.3 Origins of ANT

The principles of Actor Network Theory were sketched out in two key texts; Latour's 'The Pasteurization of France' (1988 [first published in 1984]), which was translated by Alan Sheridan and John Law and Latour and Woolgar's (1979) 'Laboratory Life'. The Pasteurization of France represents an ethnographic study that showed the multiple means through which scientists engaged with enrolling interests of multiple social actors. In this case how Pasteurization was transformed into the only viable future for milk. In turn translating the interests of Pasteur into the interests of multiple agents, from the humble milk bottle, to consumers, policy makers, businesses, infrastructure, logistics, storage, wholesalers, retailers for example. Whereas Laboratory Life represents an ethnomethodologically inspired approach to ethnographies of scientific laboratory work, where an understanding of how scientists made sense of laboratory life was at odds with how they presented and accounted for their work. Ethnomethodology does not see the world as already formed, but constantly in the making, any social order is of itself an accomplishment (Garfinkel, 1984). Both Pasteurization (1988) and Lab Life (1979) make explicit how the acceptance of Pasteurized milk or mundane lab life is not a given but something that is performed by social actors. The departure from ethnomethodology concerns how an ANT approach privileges nothing, humans, materials, paperwork, animals, objects all hold a role in world making and this world making is constituted within a network of human and non-human actors. Social life in whatever manifestation is an accomplishment in ethnomethodological terms and ANT aims to show the work of a multitude of actants (human and non-human) in maintaining or challenging a given social network.

The ANT approach gives equal credence to human and non-human elements rather than separating material or technical elements into two separate categories. Moreover, they also

argue that the human drives the non-human. Thus, as Law (1992) has emphasised, the ANT framework refuses to accept reductionism (to a singular unit of the social) and in addition, it opposes any *a priori* suggestions that people or objects determine the character of social stability or change. Rather, the patterned heterogeneous networks in which social relations occur continually shape actors within a given network.

ANT was not initially intended to be a theory for explaining the social (Latour, 1999). Rather, it emerged in response to the need for ethnomethodological understandings to align themselves with the elements that constitute the social world: “actors know what they do, and we have to learn from them not only what they do, but how and why they do it” (Latour, 1999, p. 19). Like ethnomethodology itself, the ANT framework offers a means (or a method) for social scientists to access sites, and then to *travel* from one site to another. In this respect, the term *associations* (Latour, 1984) were subsequently replaced with a preferred term, *agencement* (Callon, 2007), which refers to the effects of an agent’s association, thereby allowing agency to be attributed to both human and non-human entities. As a consequence, power is granted to such heterogeneous entities, making them tractable and by focusing on “powers” of association, it is also possible for researchers to focus on “changes to the action” (Munro, 2013, p. 128).

The term *intermediaries* is also important as it gives prominence to a range of heterogeneous elements, that is they bring to attention a particular means of apprehending something. Whenever these intermediaries associate with one another, they produce assemblages and in turn as a corpus determine the conditions by which a phenomenon can be viewed and consequently acted upon. Such assemblages are fundamentally temporary, enabling attachments to as well as detachments from, whatever it may be displaying as a point of reference. Whilst intermediaries work to highlight an assemblage of understandings, much as shining a light on an advertising hoarding, mediators go further and change, interpret or reinterpret meanings. Mediators then determine how phenomenon can be understood. In terms of NSIPs an intermediary could be the rising cost of fuel experienced by households, or issues of energy insecurity as seen in news reports on the War in Ukraine, something has been brought into prominence. On the other hand, mediators determine meanings, such as the necessity for nuclear power as the most economic, viable and sustainable alternative to fossil fuels. In effect, intermediaries work to bring an issue to

prominence, whilst mediators fashion new understandings of phenomenon. In this way both work to determine attitudes and as a consequence behaviour within a given network of associations.

The concepts of attachments and detachments will be examined in greater detail later. By treating assemblages as concepts that incorporate both human as well as non-human elements, the ANT framework is able to maintain its fundamental principle that there is symmetry between them (Munro, 2013). Latour (1993) highlighted this concept of symmetry in relation to Science and Technology Studies (STS), exposing the complex relations that people have with various items of technology, and critically emphasising the ways in which such people may be *emplaced* within the frame of technology. It is here that the term *translation*, which has previously been introduced, becomes particularly important, since it refers to the ways in which diverse relations are able to translate themselves into different actions. As such, this understanding means that assemblages are ultimately constituted of long chains of translations. Indeed, even though assemblages appear to be singular, they do in fact comprise numerous actor networks, with each network being complex and dynamic in its own right.

The main objective of “translation” is “to see how and when any drawing together of relations takes place” (Munro, 2013, p. 131). Indeed, since the initial ethnographic study of laboratory practice by Latour and Woolgar (1979), the ANT framework has continued to emphasise the concept of symmetry and, in doing so, to refuse to discriminate in any way to a particular event taking place. Rather, the ANT framework favours the following or tracing of the *actors* in order to explore the various translations that unfold, with the understanding that *any* translation may be possible. In the case of French post-structuralism (Deleuze and Guattari, 1987) for example, this symmetry is sometimes referred to as a *flat ontology*, whereby no essential distinctions are drawn between the different elements constituting a specific scenario. Thus, given that the resulting interpretations are entirely dependent upon the initial actions, the study by Callon (1984, pp. 214-219) has become useful in understanding how self-appointed “spokespersons” are able to “enrol” others, particularly those who appear to be inert and passive. In turn, these seemingly inert and passive entities (here Callon draws on the scallop of St Brieuc) not only *represent* the views of the spokespersons, but they also enrol technologies with which the spokespersons can

subsequently align themselves. As such, the fundamental notion of *power* can be seen not as the cause of an individual's behaviour, but rather as "a consequence of enrolling, convincing and enlisting" (Latour, 1984, p. 273). These terms shall be better understood in the following section as I draw on the work of Callon and others (e.g., Callon, 1984; Latour, 1984) to demonstrate how action can become operationalised.

An early examination of human and non-human interactions was in Callon's (1984) analysis of the scallops of St Brieuc bay. Following the depletion of the scallops (a local delicacy and the basis for St Brieuc bay as a tourist hotspot) and the fishermen's loss of profitable income, the scientists proposed a plan to increase production of the scallops by controlling their cultivation. In this instance, whether or not the researchers are successful depends upon the alliances they form with the scallops and the dependence of such alliances upon a multitude of other entities, such as the behaviours of the scallop larvae, the ocean currents, parasitic visitors, and even the contradictory opinions of the researchers themselves. Indeed, through the processes of *interessement* (part of a process that deepens associations) and *enrolment*, these scientists can also become *spokespersons* (mediators) for some of the other actors and interests involved. By tracing the steps taken by the biologists, the fishermen, and the scallops, Callon demonstrated the extensive network that includes tourists, restaurateurs, the local mayor, government, hoteliers all of whom are connected through association to the scallop. Additionally, in the subsequent unfolding of the various alignments, non-alignments, and re-alignments between the different actors, knowledge is produced. As Callon states, "the simultaneous production of knowledge and construction of a network of relationships in which social and natural entities [exist] mutually control who they are and what they want" (Callon, 1984, p. 203).

The related acts of tracing networks and determining the resulting knowledge must be repeatedly conducted because each new scene will necessarily produce "new actors, new webs, and new scenes" (Law, 2019, p.4). For some, such an approach may be problematic, because it very clearly demonstrates that "webs never end" and that "every actor is its own web" (Law, 2019, p. 4). In the example from Callon, for instance, the filters, hatcheries, and people all represent separate networks. What is most important here, however, is for no *a priori* assumptions to be introduced, only the various actors themselves are responsible for the enrolment of other such actors, and no fixed definitions are imposed on them.

‘...objects are an effect of stable arrays or networks of relations...’

(Law 2002, p.91).

Individual objects are only perceived as wholes if their relations continue to hold together, with their shape remaining unchanged. For example, the 15th century maritime technologies that were used in the imperialist expansion of the Portuguese required new vessels, new navigational techniques and a crew who were drilled to perform actions in the absence of direct control in order to perform colonial domination. These emissaries as Law (1984) terms them, documents (maps and policies), devices (new shaped hull and sails that enabled longer distance travel in harsh weather conditions) and drilled people (all crew members were specifically drilled in terms of roles and responsibilities) ensured remote control of the vessel at all times. These developments resulted in the boats being able to travel longer distances for longer periods, by using astrological and astronomical techniques that were transferred from land to sea. An object (such as a vessel) may remain an object only if all of its relations are able to hold together, including its relations with other neighbouring objects or networks. In this way, the vessel is able to reach its destination without encountering a wide range of difficulties along the way, such as hunger, disease, pirates, or becoming lost at sea. The most important point here is that the ANT framework allows a researcher to explore the strategies through which humans and non-humans are generated and then subsequently held in place (Law, 2002). Documents, devices and drilled people were emissaries of Portuguese control, they sustained each other within a given network and enabled Portuguese sailors to push the envelope of lands that could be safely explored.

Latour (2011) presents a different interpretation, however, which alludes to *immutable mobiles*. These exist when a logic from one domain (or a specific network) can shape understandings in another domain (or network) without itself being changed. For example, the ways in which a logic is associated with economy, which then becomes the guiding principle for other areas of social life such as management, governance, relationships. Latour applies a double meaning to the word *network* here to acknowledge the two different kinds of scales that exist. On the one hand, the *immutable mobiles* constitute a network/object whilst simultaneously these *immutable mobiles* move through a network that is held together by means of stable surroundings. To reaffirm the point, for a network to continue

to be maintained, the constituent entities, such as documents, devices and drilled people must remain enrolled.

Latour (2011, p. 67) turns his attention to a further example in the development of the printing press, which enables the possibility of “translation without corruption.” The new device of the printing press allows for the simultaneous possibilities of mobilisation as well as immutability: inscriptions such as books, maps, and newspapers may be printed and mobilised (that is, distributed to any destination) in an immutable (that is, identically reproducible) state. Moreover, in this particular example, images accompany the text as intermediaries on the same page, with the result that inscriptions play crucial roles in shaping thinking (that is they are mediators).

Using the ANT framework, de Laet and Mol (2000) focussed their research on a Zimbabwean bush pump. It can be described as a hydraulic device that produces specific quantities of water from a specific source. It is a village pump or a sanitation device consisting of a concrete slab, mould, casing, and gravel, which ensures clean water. The boundaries of the bush pump could also be described as being connected to the Zimbabwean nation as it “helps to make Zimbabwe as much as Zimbabwe makes it.” (de Laet and Mol, 2000, p237). The authors repeatedly call attention to the fluidity of the bush pump, from the various connections of its boundaries to the individual components that make it work. For example, the bolts linking the pump to its mounting could be replaced by something else or be removed altogether, without inhibiting the flow of water. As a result, those mechanisms or elements that are perceived to be essential may in fact not be so essential after all. Depending on who uses the pump, its fluidity can be variable and adaptable to the requirements of particular circumstances. As such, this structure cannot be said to be fixed, since it changes aspects of its shape according to the particular needs of the community. In this respect, de Laet and Mol (2000) proceed to raise a particularly important point:

'...although the bush pump is fluid and variable, meaning that it's able to change its shape, it can also be broken down and deformed. On the other hand, it has also been suggested that, rather than being broken down, the bush pump can instead be seen as homoeomorphic in some other space, meaning that it holds its shape in a fluid form.'

(p. 237)

This resonates with the concept of *immutable mobiles* that has previously been discussed. In essence, the bush pump “is part of – it helps to enact – a fluid form of space” (Law, 2002, p. 99). In this respect the example of the bush pump is a metaphor for the ANT framework, in which the social, material, and technical worlds are linked together in webs of unfolding associations with all effects being generated in patterned networks. However, as also previously noted, fluid spaces, objects, and patterned networks can only hold their shapes if they follow a set of rules. It is only then that these networks come to be durable and denote stability (Munro, 2013). As Law (2002) suggests:

‘No particular structure of relations is privileged; relations need to change bit by bit rather than all at once; no particular boundary around an object is privileged; mobile boundaries are needed for objects to exist in fluid space.’

(p99)

Bearing in mind the concept of *objects* as suggested by Law (2002) and the understanding of *fluid technology* as set out by de Laet and Mol (2000), it is possible to point to some examples of infrastructure projects that are particularly receptive to the ANT framework. Harvey and colleagues (2016) explored the forms that political and technological transformations assume, illustrating how the various complexities accompanying infrastructure projects are fast becoming the norm because of climate change in particular. Examination of tourism in the European Alps (Harvey et al. 2016) highlights the various entanglements resulting from human and technical interactions. Extensive ski resorts and their accompanying infrastructure can be viable only if they have snow cover. But it is now also the case that such ski resorts have become increasingly dependent upon the management of technical snow, owing to the receding of the glaciers and other effects of climate change. The reliability of snowfall becomes a further constituent in the networks of hotels, reservoirs, roads, and ski lifts that already exist. This demonstrates that, even though heterogeneous entities are connected by different networks, they are nonetheless never quite aligned. As such, the various formations of infrastructure are always somewhat out of sync, with the result that they may run parallel to one another or even work against one another. In this sense, different networks (of technical as well as human interactions) will have different ideas of progress and will produce different answers to specific questions, such as which services to provide, the means of providing them, and the reason for doing so.

As people continue to make greater demands on the environment, it is increasingly the case that the environment must be supported in meeting those needs, with the result that engineered and non-engineered systems become increasingly entangled. Individual patterns of complicated systems eventually start to merge, with the lines between the natural and the engineered becoming blurred.

Another effect of climate change can be witnessed in Block's (2016) fieldwork on the introduction of wind turbines in Copenhagen, where civic attachments, material politics, and urban infrastructure developments become intertwined in planning for a low-carbon transition. Block (2016) uses the ANT framework as a means of exploring not only the material politics of urban infrastructure developments, but also the various forms of interplay between local communities, planners, and politicians in Copenhagen. This interplay includes the places of civic attachments and public contestations within the broader context of the global challenges that the world continues to face. The analysis explores the urban situation in terms of material objects of infrastructure being "folded into the city's democratic politics" (Harvey et al., 2016, pp. 102–113). As such, connections can be drawn regarding how heterogeneous elements can be *folded together*, making visible their cultural, economic, ethical, political, social, and technical dimensions. Indeed, Harvey and colleagues (2016, p. 51) argued that "critical infrastructures" are "routinely identified by governments as the assets, systems and networks that underpin economic stability." The development of new infrastructure projects has the potential to spark a "moral charge" in the promise of an improved future.

In a study of two major roads in Peru, Harvey and Knox (2012), show how despite the surrounding everyday circumstances of abandonment and socio-material degradation a promised improved future of emancipation may be delivered. The road infrastructure is viewed as representing broader transformations in terms of speed, economic activity and political integration, despite the project itself having been politically disruptive (regarding corruption). In keeping with the understanding that heterogeneous elements, such as in this case, engineers, locals, regional governments, road building programmes, and the World Bank are often not fully aligned, this study emphasises the various entanglements that are produced and the precariousness of the various elements involved. Indeed, despite

ultimately being marred by failure, investment in the project continued, fuelled by the promise of emancipation such an infrastructure would produce.

The ANT framework emphasises the fragility of infrastructure projects. This in turn will bring about an increased awareness that the patterned networks held together through translation may collapse and become corrupted at any moment. On the other hand, these studies also demonstrate that such projects can be quite adaptable and therefore resilient, as other networks may form other spaces and times. Ultimately, through an ANT perspective it is possible to witness that far from being a given, infrastructure is an ongoing accomplishment. Such an accomplishment is worked into being through a host of intermediaries that highlight meanings, interests and the various interconnections between social and material worlds. As such, it can similarly provide an analytical and theoretical framework for exploring and understanding the experiences of engineering contractors working on NSIPs.

3.4 Applications of ANT Research

Over recent decades, the ANT framework has been extended across a range of disciplines, including development and policymaking (Greenhalgh, 2008; Mosse, 2005; Tsing, 2005), urban infrastructure, infrastructure development, and architecture (Fallan, 2011; Farias and Bender, 2010; Harvey et al., 2016); geography and spatial politics (Mueller, 2012; Murdoch, 1998; Thrift, 2007), economics, markets, and organisation studies (Ban, 2011; Bockman and Eyal, 2002; Czarniawska and Hernes, 2020; Hawkins, 2011; Mitchell, 2005), renewable energy development and policy (Iskandarova, 2017) and animal studies and inter-species relations (Nimmo, 2012; Whatmore and Thorne, 2000).

Originating in social studies of science and technology, the ANT framework has been extended into economic and finance studies (Callon, 1998, 2007), democracy (Callon et al., 2009; Latour, 2005), and the methods and politics of research (Law, 2004). Moreover, the concepts of the social as well as modes of existence have been explored by Latour; in relation to the topics of law (2005) and religion (2009). The ANT framework has also been extremely useful for qualitative studies in fields such as ethnography (see, e.g., Latour and

Woolgar, 1979; Law, 1994; Mol, 2002). Drawing upon the work of Law (2009a, 2009b), then, we may approach the ANT framework as constituting an ensemble of sensibilities. Mol (2010) shows how ANT provides researchers with new “ways of asking questions and techniques for turning issues inside out or upside down.” (p. 261). As a set of sensibilities ANT offers a unique methodology for exploring and understanding social and material worlds, and the ongoing interrelations between them. Thus, by using the ANT framework, it will be possible to gain more nuanced appreciations of some of the issues that have already been considered, such as questions of accountability, ideas of belonging, mobility, migration, infrastructure development, and organisation studies more generally, in terms of the ways in which they are operationalised in NSIPs and have various impacts on contracting engineers.

3.4.1 ANT in Organisation Studies

The process of exploring the generation of ordering effects (the alignments of heterogeneous networks) has been termed translation (Law, 1992). Some elements are more capable than others of maintaining relational networks over longer periods of time. Translation is “contingent, local and variable” (Law, 1992, p.387). Translation networks often include materials and processes of communication, including accounting, banking systems, electronic communications, methods of representation, and writing, and these are often considered to be “immutable mobiles” (Law, 1992, p.387) whereby the organising principles remain similar across network domains. However, systems of representation (mediators) that include immutable mobiles can also be precarious (Law, 1992), orderings (and reorderings (through intermediaries) are potentially infinite and, as a consequence, a series of strategies may be created in which such orderings not only coexist, but also interact. For example, in the domain of management and organisation studies, Law (1992) has recognised a number of strategies including those of administration, the enterprise, vision and vocation which collectively have the capacity to generate “multi-strategic agents, organisational arrangements and inter-organisational transactions” (Law, 1992, p.388). In this respect organisations can be viewed as constituting a set of strategies that operate in order “to generate complex configurations of network durability, spatial mobility, systems of representation and calculability.” (p.389). Any organisation or mode of organising can also

be viewed as precarious, given that the resulting effects may be asymmetrical between the centre and the periphery, as well as hierarchical in nature. Accordingly, it is therefore possible to view an organisation as:

‘An achievement, a process, a consequence, a set of resistances overcome, a precarious effect. Its components – the hierarchies, organisational arrangements, power relations, and flows and information – are the uncertain consequences of the ordering of heterogeneous materials.’

(Law, 1992, p. 390)

When the characteristics of organisations are being explored, the ANT framework considers the effects – and consequences – that are generated by the interactions between materials and the strategies of the organisations in question (Law, 1992). It is here, as Czarniawska (2016, p. 4) has suggested, that “the roles of standardization, formalization, and classification” of different kinds become explicit. Moreover, the earlier terms from the ANT framework that have been used to analyse networks, as introduced by Law and Mol (1992; 2010), such as *ordering* (or aligning) and *coordination*, have immediately obvious applications when the characteristics of organisations are being explored (Czarniawska, 2016). Indeed, when sociologists are sifting through and sorting data in order to identify patterns and regularities, including, in the terms of the ANT framework, “the uncertainties, ambivalences, transgressions, controversies, and resistances,” they are attempting to weave a network of relationships between the various actants that are involved (Murdoch, 1998, p. 364). These relationships often point to the various ways in which individuals and organisations aim to achieve security in their different circumstances, as well as the ways in which, conversely, they attempt to identify the issues that result in them being insecure. Such an understanding of *security* could involve a number of different aspects, including financial security, organisational security, or even an individual’s sense of their own (job) security within the organisation. When it comes to critical infrastructure developments or NSIPs, however, one of the main drivers of the process of securitisation involves the mitigation of risk in which security building activities are enacted, that span national as well as transnational spaces. This often results then, in construction workers bound by many policies and regulations.

Various policy tools that used for audit controls and record-keeping procedures are bound up in a broader system of accountability and compliance. This gives rise to networks of human as well as non-human actors, with the connections between them being continually arranged and rearranged, and the relationships being continually shaped and reshaped. On a similar note, as previously mentioned, Strathern (2000) views the universal term *management*, as it is used in organisations, as a means of denoting regulation and organisation. However, it is important to acknowledge that the various processes of assessment, evaluation, and measurement that are commonly drawn together under the overarching terms *audit* or *accountability* may also have social consequences, including constraints on personnel, resources, and time, as well as the moral decisions associated with management. This may be compared with the understanding of Law (1992), who regards immutable mobiles as being precarious.

Audit is a non-human actant to which all kinds of powers have been attributed. Similarly, ethics is a comparable principal actant frequently employed as a social actor in order to justify various auditing practices. Various implications follow from an audit in addition to ethics and policies. In this sense, we may refer to the work of Feldman (2013, p. 139) by comparing a network as it emerges in the ANT framework with his understanding of an apparatus, which refers to a complex system of different institutional processes that interact with one another in order to “produce, regulate, and collectivise separate policy subject-objects in the support of broader economic and security agendas”.

Policy targets are not usually achieved by means of direct engagements between bureaucrats and workers. They are more commonly mediated through secondary policy representations in various forms including administrative templates, standard guidelines, statistical estimates, and commodity values. As such, these forms constitute what Munro (2013) has termed intermediaries. Of particular interest here are the ways in which these intermediaries (devices as well as materials) have the potential to intervene in accountability relationships. As Munro (2013) explains:

“What gives accountability a special interest to researchers of contemporary organizations, is that accountability itself forms a sub-text – and more recently, often the explicit text – of current government and business agendas”.

Strathern (1996) has argued that hybrids formation (between human and non-human) results in a categorical division since the process therefore allows a new category to emerge. Latour (1988) has argued that Pasteur's breakthrough was ultimately dependent upon the relationship between an array of heterogeneous elements and their being held together for a sufficiently long time for a continuous network of effects to be sustained. This networking between the heterogeneous elements (animals, bacillus, disease, farmers, field experiments, the laboratory and scientists) was ultimately dependent on the social interactions that produced different circumstances and events. As such, it is possible to suggest that Latour's example of Pasteur's development of the anthrax vaccine provides a blueprint for others to follow Pasteur's approach. Strathern, however, points to a problem with such a consideration since the analysis of empirical events is potentially never-ending. Indeed, new accounts and forms are created during the course of analysis, with the result that "one can always discover networks within networks; this is the fractal logic that renders any length a multiple of other lengths, or a link in a chain a chain of further links" (Strathern, 1996, p. 523). Strathern continues to argue that the processes of analysis and interpretation must eventually come to an end, at a definite place or a definite time. One way of bringing the analysis to its end may be achieved by "cutting" the interpretations (Strathern, 1996, p. 523). Even so, the processes of cutting the connections and severing the bonds still enables particular relations to form as well as new hybrids.

Strathern (1988, 1995, 1999, 2005) emphasises that relations can connect as well as divide (forming attachments as well as detachments), before suggesting that attention should be focused on the persons, things, events, or occasions that are responsible for networks being severed in order for new forms to be realised. Even so, Strathern also argues that heterogeneous networks are limited. Specific networks, like "socially expanded hybrids," are equated by Strathern to "condensed networks," with the "condensation" representing an end (Strathern, 1996, p. 523). This is demonstrated through an empirical example of the discovery of the hepatitis C virus by a Californian corporation and their resulting claims of ownership. The virus was detected following the invention of a specific blood test, which was then patented by the corporation. However, the virus was investigated for 12 years prior to the patent eventually being awarded. As such, the discovery of the hepatitis C virus

brought heterogenous actors together within a social network and all of these actors could have had a claim to (contributing to) the patent, making their undertaking profitable.

Nonetheless, it remains the case that the various social networks that were involved in the studies themselves consisted of long chains of associations, which were truncated only by the final awarding of the patent. In this sense, only certain fragments or segments of these networks had the potential to wield a claim to ownership, with the result that “ownership curtails relations between persons; owners exclude those who do not belong” (Strathern, 1996, p. 524).

Even though networks consist of heterogeneous elements, Strathern also points out the fundamental homogeneity of the network itself, since it is only made sustainable due to a continuity of identities: “A string of obligations, a chain of colleagues, [and] a history of co-operation” (Strathern, 1996, p. 524). Nonetheless, such homogeneous networks are ultimately limited by the question of *who belongs*. In the example given above, for instance, the sustainability of the social network was *cut* by the commercial potential that resulted from the discovery of the virus. Indeed, the act of hybridisation was justified by the claim that part of the research solved the problem (Strathern, 1996). This resonates with the understanding of Law (2002), who suggested that objects hold together only if their relations hold together, and their shape does not change. Networks, however, are contingent upon the interaction of the people within them, rendering the durability of any one particular network fragile. At this point, it is useful to dwell upon the play between homogeneity and heterogeneity that both Law and Strathern acknowledge. Briefly, ownership has the power to cut both kinds of networks: a homogeneous network including social relations can be divided by those who belong, while a heterogeneous network (including non-human elements), which is held together by means of an artifact (for example, the invention), can be curtailed by proof of its hybridity (Strathern, 1996).

It is the cutting of networks, then, that determines their lengths. Whilst technologies are perceived as expanding networks, it remains the case that ownership condenses them. Strathern (1996, p. 531) has suggested that “the kinds of interests, social or personal, that invite extension also truncate it, and hybrids that appear able to mix anything can serve as boundaries to claims.” However, another way of bringing analyses and interpretations of endless webs of empirical events to their ends involves paying close attention to the

concerns relating to the research question itself. By drawing on material semiotics as a set of tools and sensibilities that allow a range of concerns to be explored, Law (2019) concludes that, since it is impossible for a researcher to follow all the different webs that are potentially involved, only those that are most important for the individual study ought to be traced.

3.4.2 ANT, Identity, Belonging and Migration

Individuals and organisations aim to achieve security by mitigating potential risk factors, in a wide range of differing circumstances. At the same time, one may also consider questions of ontological security by exploring the “security of the self” (Shani, 2017, p. 277). In essence, individuals must feel secure about who they are, in terms of their identities and their selves, in order to achieve a stable mental state and sense of continuity that accompanies their experiences of everyday life. Indeed, it is important to remember that identities are formed and sustained through relationships, and that a sense of belonging results from forming attachments and alignments. Munro (2013, p. 134) has argued that people are always displaying their identity (a type of performance), by “attaching” to or “detaching” from a range of materials – as demonstrated, in a different context, by the example of the hepatitis C virus that Strathern (1996) presents. As a consequence, identities can be thought of as being in perpetual states of translation (Munro, 2013). Thus, one’s personal experiences (as well as one’s sense of belonging) inescapably involve attachments to several different communities, based on one’s national identity, gender, class, and political persuasion, as well as one’s personal values and the situations in which one finds oneself. Similarly, the politics of belonging may be understood by ascertaining what exactly is involved in being a member of a specific community and what is required to achieve a sense of belonging, as well as considering the specific nature of the resulting identity. Such ideas can be related to the construction industry by thinking about who belongs and who does not belong; common values, such as loyalty and solidarity, often determine the questions of membership and responsibility that emerge in the realm of the politics of belonging.

Another way of approaching such a sense of belonging is through exploring the concept of relatedness. Desmond (2014) has linked relational ethnography to the processes that are

bound up with the relationships between actors and institutions, and how they are organised. In this way, relational ethnography employs an ontological approach, which involves emphasis being placed upon the configurations of the relations, as opposed to the actual groups or places that are involved. According to Becker (1996), in fieldwork this system allows a researcher to explore how things hang together in a web of mutual influence or support or interdependence. Similarly, Marcus (1998, p. 90) has described how the ANT framework has been designed to examine “chains, conjunctions, paths and threads” which may be achieved by focusing on “processes of migration” for example, rather than focusing on the “migrants themselves” (Desmond, 2014, p. 554).

Emirbayer (1997, p. 289) argued that this system of relationships is “dynamic in nature”, meaning that it constitutes an “ongoing” and “unfolding process” (Desmond, 2014, p. 566). What is more, Emirbayer (1997, p. 300) and Mische (2011, p. 88) view such systems in terms of “relations and transactions”, as well as processes of “communicative interaction”. Thus, actors are able to make meaning through collective representation or group culture. Collective representations enable the emergence of harmonious and stable relations, as well as shared beliefs and practices (resulting in a sense of belonging). Social actors also make meanings through “collisions”, in which distinctions emerge between people who are “dissimilar to one another” (Desmond, 2014, p. 568).

Individuals or groups find themselves caught up within the related processes of wanting to belong and wanting to become (Yuval-Davis, 2006) where the collisions that occur may be required for such processes to be ignited. This understanding of performative action, therefore, points to the repetitive practices that occur within specific social and cultural spaces, which are crucial to the formation of attachments. Here, once again, we can consider the example of construction workers, whose transnational relations often influence their sense of belonging. These senses may involve connections (or disconnections) and interactions either with other colleagues (who are known or unknown), on the construction site, or with the people who live in local towns and villages, where it is common for workers to reside on a temporary basis.

Construction workers who have migrated and may be living in the villages surrounding an infrastructure project may come to belong in this new (and temporary) place of residence.

Edwards and Strathern (2021) describe how the residents of Alltown (a pseudonym of a town in Lancashire) are able to construct chains of association as a consequence of their sense of belonging to the place. Within these chains of association, entities are *traced, assembled, classed together, or juxtaposed*. Even though the community is described in terms of “stability” and “communication”, it nonetheless remains the case that any breakdown would prompt “a loss of these things” (Edwards and Strathern, 2021, pp. 150–152). What is ultimately emphasised, is our way as opposed to their way. At the same time however, even though recent incomers may not be able to establish the same sets of connections as those who were born or raised in the town, they are still able to develop attachments and connections through their dedication and commitment. As Edwards and Strathern explain: “Their intentional activities of dwelling, of neighbouring, of preserving history, of conserving amenities, and of joining in – attaches them” (2021, p. 152). In Frankenberg’s (1957) classic study of English migrants to a Welsh village, the incomers actively engaged in community work, notably the local football team. Whilst the locals were happy for the English to take over, they were equally happy to apportion blame when things went wrong and in turn the migrants became a useful means of assuring cohesion among Welsh villagers. The English attached themselves, were othered and detached as expedient for the local villagers.

Acts of reciprocity, which require one to give back something are important to ensuring stability. Not reciprocating in a manner deemed appropriate to local residents is likely to result in criticism and effacement. The activities of “dwelling”, “joining”, and then “conserving” subsequently becomes part of the chain of attachments or relationships that result from the fact of someone’s belonging to a particular place (Edwards and Strathern, 2021, p. 152). The residents of Alltown do not merely trace chains of relatedness between kin but they also narrate them. Residents enrol a variety of heterogeneous actors, including aunts, uncles, and newcomers, as well as the underlying sense of place, gifts, and reciprocity, based on perceptions of kinship.

Munro (2013, p. 134) points to an understanding of “the circulation of identities”. The designations of an individual as a *friend* or *enemy* can be viewed as being mobile in character, since people focus on different things in different times and different spaces. Munro (2013) regards identities as being “transient” as well as “transmutable,” rather than

perceiving them as “immutable mobiles” (Munro, 2013, p. 135). In this sense, it is necessary to explore social processes of mobility that go beyond the traditional geographical imagery of fixed “terrains,” by including “a new *grand narrative* of mobility, temporality, fluidity as a pervasive condition of globalization” (Hannam et al., 2006, p. 5; see also Cresswell, 2002; Sheller and Urry, 2006).

Infrastructure projects can be understood as constituting socio-technical platforms that enable mobility (Larkin, 2013). The work of Edwards and Strathern (2021, p. 162) has similarly invoked human as well as non-human elements in order to explore the various relationships that occurred in the “networks” that had been established in the community of Alltown. Here, we can use the “infrastructural approach” to explore how migrant mobilities “are given significance and direction through the infrastructural processes” (Lin et al., 2017, p. 168). Rather than viewing infrastructure projects as operational systems, we can instead understand infrastructure projects as opening up a range of processes that are concerned with questions of the “order,” “structure,” and “technical objects” of migration (Lin et al., 2017, p. 168). Furthermore, we can also draw upon the work of Star (1999), who uses the term *infrastructuring* to refer to the unstudied dimensions of social organisation. For Star (1999) infrastructure projects are always relational and must always exist in relation to specific actors as they are embedded within, or sunk into, other structures.

Migratory movements have created new avenues for the transnational flow of identities, ideas, and practices. An anthropology of mobility imaginaries – narratives and ideas that depend on the creation of the otherness of one’s own identity as well as of the Other – reveals how mobile local lifeworlds are always negotiated and contested, and constantly under transformation.

(Salazar, 2010, pp. 64–65)

Infrastructure is inseparable from actions, tools, and environments (Greenblat et al., 2010). An ANT approach to infrastructure deepens our understanding of how migrants are fractured through a global political system that attempts to control the various parameters of transnational movements (Salazar and Smart, 2011). Within NSIPs the members of the construction workforce are bound up with a *fragmented production process* (Fellini et al., 2007; Dainty et al., 2013), resulting in reliance on mobile labour forces with consequent exposure to attachments and detachments. When it comes to questions of identity (and

migration) in the context of NSIPs, Munro (2013) argues that that these are not always fluid, since they may also be understood as being *punctualised* (Munro, 2013); that is, they are *held* or punctuated. Identities that emerge in the context of infrastructure projects adopt local characters, but they also emerge at crucial moments of need, with the result that such an identity is ‘...performed when it might have most effect...’ (Munro, 2013, p. 135, see also Frankenberg, 1957). Consequently, identities are worked and reworked in order to best represent an individual’s gender, class, ethnicity, or interests (Munro, 2013). In this respect, Lin and colleagues (2017) argued that infrastructure projects that necessitate migration no longer have to be the *black boxes* that they have been, since they can instead be considered as constituting networks of human and non-human actors facilitating ongoing migration within specific infrastructural frames. Moreover, such infrastructure projects should also be appropriated as frameworks for defining societies and individuals, especially the ways in which their identities emerge at particular times and particular places, as well as in the organisation of their everyday affairs.

Even though the term *infrastructure* originally emerged in a military context, to refer to a *fixed facility*, it is now very much the case that infrastructure is foundational to the ways in which organisations and societies operate. What is more, infrastructure is “entwined with cultural habits, with social and economic organization, with professional and personal identities” (Strathern, 2018, p. 51). Similarly, Harvey et al. (2016) have argued that various forms of infrastructure have the potential to generate effects that *loop back* onto the individuals within a given community or organisation, and, in so doing, *reshape* them. The emphasis of this looping effect offers an alternative view of infrastructure projects, which contrasts with the conventional understanding that they belong to a domain that is separate from economic, political, and social realms. Initial categorisations and subsequent presumptions of such a separation between domains will only give rise to the incorrect belief that infrastructure projects are *passive* and not influenced by economics and politics, as Harvey and company (2016) continue to argue. On the contrary, however, the repeated shaping of infrastructure by economic, political, and social considerations generates relations that denote *a posteriori* knowledge and are thus subject to experimentation (Harvey et al., 2016). In this respect, we have seen how the questions relating to policy, risk, accountability, migration, mobility, and belonging, as they emerge in the construction

industry more generally and in NSIPs in particular, are made explicit when they are considered through the ANT framework.

Even though the ANT framework allows researchers to analyse and interpret the heterogeneous elements of a single system or several networks, the main issue always involves the elements that constitute such systems or networks – including, crucially, those elements that are excluded. On a similar note, Harvey et al. (2016, p.17) have pointed out the “scales” of infrastructure that are generated through a process of “configuring, extending, maintaining, or disrupting infrastructures.” However, different “settings” or “situations” or “systems” are produced through these processes, both “large” and “small,” which have the potential for further transformations and reversals (Harvey et al., 2016, p. 17). As previously emphasised, though, when networks are being analysed and interpreted, it is essential to determine which aspect of which network will be discussed, and which other aspects will be ignored. In contrast to the brief discussion of categorisation above, Larkin argues that this very act of determining the networks on which to focus is itself categorical (Larkin, 2013). Nonetheless, it is also important to acknowledge the ways in which researchers “select and organize what we know, and do and feel and see,” in order to emphasise the inescapable role that reflexivity plays in the conducting of research (Law, 2019, p. 7). As a consequence, the various methods of social inquiry help to bring new discoveries into existence.

3.5 Chapter Summary

This chapter has demonstrated how the ANT framework is used to illustrate the symmetry that occurs between human and non-human elements. ANT offers an analytic and theoretical framework for social science enquiry that allows everything to be traced, potentially infinitely, in the social world, the material world, and the technical world. By tracing such heterogeneous networks, it becomes possible to realise not only the associations that are formed, but also their effects. What is more, new hybrid formations are created as a result of the patterning of such networks (Latour, 1984). However, to fully understand the kind of analysis that the ANT framework offers, a detailed exploration of the terminology that appears throughout such works is crucial. For instance, the process of

exploring the generation of patterned networks is termed *translation* – even though it has been suggested that the *sociology of translations* can never be complete or final (Law, 1992). Furthermore, it is also the case that some network patterns are performed more often than others, which results in them becoming *punctualised* (Law, 1992). The overriding point here is that the various processes involved in developing networks need to be instantiated for long enough in different places and contexts in order for such processes to be considered a network, with the resulting concepts being referred to as immutable mobiles (Law, 2002). In some cases, these resulting immutable mobiles can be rendered precarious if the heterogeneous elements that contribute to a network are not able to hold their continuing shapes for long enough.

The following chapter highlights the key considerations in exploring what are the impacts of NSIPs among Engineering Contractors and Subcontractors by discussing and reflecting on the methods used in the undertaking of research, while using the methodology of the ANT framework to guide the research. It identifies the utility of the ANT framework to conceptualise the symmetry that occurs between human and non-human actors in NSIPs, and how ethnographic methods can help us to better understand the everyday experiences of members of the construction workforce. ANT explicitly focuses our attention on acknowledging multiple contexts and the different perspectives that are involved in the different situations, while at the same time emphasising its importance (Strathern, 2018).

CHAPTER FOUR: METHODOLOGY AND METHODS

4.1 Introduction

The aim of this thesis is to explore the Impacts of Nationally Significant Infrastructure Projects (NSIPs) on Engineering Contractors and Subcontractors. This chapter highlights the methods used in order to operationalise the research and answer the research question: What are the impacts of NSIPs on contracting engineers and Subcontractors? Consistent with an exploratory research question, the methodology has been designed to capture the lived experiences of contractors working on NSIPs. Actor Network Theory (ANT) as the theoretical and methodological framework adopted in the study is explored in light of researcher beliefs about the nature of reality (ontology) and how the knowledge of that reality is understood (epistemology) and its influence on data collection, analysis and findings generated from the research.

The literature review highlighted how NSIPs are frequently cited as volatile and fragmented which results in reduced efficiency, increased costs and a decrease in research and development investment (Harvey, 1989; Dainty et al., 2013). At the same time, the future development of such critical infrastructure projects may potentially contribute to the realisation of sustainable goals, boost skills development, jobs, and economic growth (Planning Act, 2008). The literature has shown NSIPs to be highly complex and much is unknown as NSIPs are under-researched and that the transition to renewable energy sources would require more scrutiny (Bridge et al., 2018; Flyvbjerg, 2008, 2009, 2014; Flyvbjerg et al., 2003; Niewöhner, 2015).

In this context, ANT emerges as a framework from which to explore the various lived experiences of the contractors and subcontractors who work on these critical large-scale infrastructures. This research study aims to trace these heterogeneous patterns, while also exploring the various impacts that they bring about (Latour, 1996b; Law, 1992; Strathern, 1996). While the previous chapter emphasised theoretical understandings of ANT, this chapter will explore how ANT has been operationalised in this research.

The following sections will explore ANT's underlying rationale and the alignments that can be made between its theoretical and methodological approaches and the qualitative focus of the study. The chapter will then highlight the utility of ethnography as best suited to contextualise, describe and interpret specific concepts and phenomena, as well as gaining nuanced insights into them (Atkinson et al., 2001). More specifically the approach of virtual ethnography will be introduced. The final section will address the importance of research ethics throughout the course of the research.

4.2 Selecting a Philosophical Approach: Interpretivist

NSIPs are generally regarded as being extremely volatile, this is a consequence of technological developments, the complexities of geographic restructuring, political and economic developments and a fragmented industry (Harvey, 1989; Dainty et al., 2013; Tutt et al., 2013). The long-term construction that is necessary for NSIPs, such as nuclear power projects, may have a wide range of impacts on the members of the workforce who contribute to the delivery of such projects (Bridge et al., 2018). In this respect, Jensen and Winthereik (2013) emphasise the socio-technological impacts, describing infrastructure as constituting a fixed facility (including power grids, roads, and waterworks) that allows society to function in the social.

From its inception, ANT highlighted the ways in which non-human elements had the capacity to make equal contributions to social networks. The social science research of the time invoked work on STS that highlighted the turn to technology (Woolgar, 1991), in order to call attention to the *co-shaping* between society, on the one hand, and technology, on the other (Callon, 1986). People's everyday lives and work environments are essentially transformed by the availability of new technologies and the infrastructures that duly accompany them, whether these be offline, material, technical, textual, or virtual. Such co-shaping expressly relates to the relationship between society and technology, and the interconnectivities between the two. As a result, many studies have explored the various ways in which contemporary infrastructures are bound up with the social worlds that they generate (Clarke and Fujimura, 2014). For instance, large-scale infrastructure projects have been discussed in

relation to the social costs and environmental complexities that are associated with them (Harvey, Bruun Jensen, and Morita, 2016).

Actor Network Theory is relational as it examines relations between people, things and ideas (Emirbayer, 1997). ANT collapses the assumption that the non-human plays no part in shaping human actions or creating human meanings and the human, which has taken primacy in social science research, arguing that non-human components contribute to human social life and vice versa (Mutzel, 2009). Networks consist of both human and non-human entities and are all actants that come together through collective action to create meaning (Callon, 1986; Latour, 2005; Law and Hassard, 1999). It refuses to privilege the human from the non-human.

ANT offered a means of transcending snapshots by considering the relationships between human and non-human components. The ANT approach was developed in the social sciences as a theoretical and a methodological approach, with the result that it offered a nuanced platform for exploring actor networks in their fullness. What is more, the ANT approach starts from an ontological standpoint, which allows the study of concepts such as the nature of being or existence, or reality, which means that the resulting research can get to grips with understandings of “how things really are” and “how things really work” (Guba and Lincoln, 1994, p. 107), showing what has been accomplished through interacting elements.

Blakie (1993, p. 13) explains ontology and epistemology as, “claims or assumptions that a particular approach to social enquiry makes about knowledge and how it can be obtained”. In this respect, a researcher’s ontological and epistemological position will determine the subsequent generation and analysis of the data. This research adopted an interpretative stance that not only enabled actants (both human as well as non-human) to be traced, but also allowed them to speak for themselves, with the resulting data artefacts being the recorded interviews, textual transcripts and policy documents.

In accordance with the understanding that the data are epistemologically informed, the belief everyone creates his or her own reality, and that these realities are subjective ones (Guba and Lincoln, 1994) is adopted in this study. ANT distances itself from subject/object

distinctions as the action (Latour, 1986) or accomplishment is more important than the account individual actors provide. Furthermore, the various data artefacts that have been generated as a result of research activities are themselves social constructs, which have been co-created by the participants and by “whatever interactional cues have been given off by the interviewer about the acceptability or otherwise of the accounts being presented” (Miller and Dingwall, 1997, p. 59). Accordingly, it is important to recognise and acknowledge that the participants in the study may have had their own reasons for producing their particular accounts and making claims about themselves and others in the various networks. These subject positions are important as they are checked against actions, reports and accomplishments. Humans and non-humans may adopt a particular subject position, be they scallops, nets or fishermen (Callon, 1984) as they reflect a certain set of interests.

Ontological understandings are important, because they underpin the ways in which we think about the world, as well as influencing the kinds of knowledge that can be produced during research. As Farias has pointed out, “ANT is one of the few contemporary analytical frameworks that openly engages with ontology” (Farias, 2012, p. 128). To be sure, ANT posits that all interactions between the social and natural worlds occur in a context of constantly shifting networks. All of the elements of such heterogeneous networks, including ideas, objects, and processes, are considered equally relevant when *tracing* the creation and recreation of situations that bring together human as well as non-human components, allowing for the interpretation of such situations. Because of the very close attention that is required to be given to social as well as material elements, including people, things, and understandings, ANT allows meanings to be ascribed through the very activities of interaction and connection. In this respect, Latour follows ethnomethodological conventions (Garfinkel, 1967) in that what is important is the work, the movement, the flow, and the changes that occur when tracing the actants or actors (Latour, 2005).

ANT offers an analytical framework for tracing social as well as material relationships, in order to explore and understand a wide range of experiences, including benefits, challenges, and risks, plus social and cultural uncertainties of a workforce community. Moreover, it is in the very act of describing the “state of affairs” at hand (Latour, 2005, p.1) that the specificities of lived experiences can be discovered from the ground up, so to speak, as well as their potential social and cultural impacts. Indeed, in contrast to social network theories

(Berkowitz, 1986; Scott, 2000; Wellman and Berkowitz, 1988), in which the analysis is primarily concentrated on predetermined network definitions, ANT instead uses a qualitative “follow-the-actor” approach, in which the actors generate the connections themselves (Latour, 2005 p. 21). In this context, Latour once again highlights the concepts of ontology and epistemology making its meanings (of the nature of reality and how it is understood) explicitly clear.

The ANT approach is fundamental to studying large-scale infrastructure projects because the meanings of such projects are constantly being established, only to be reworked. As Latour (2005, p.128) has stated, “a good ANT account is a narrative or a description or a proposition where all the actors *do something* and don’t just sit there”. Moreover, he explains the concept of a network to be a “tool to help describe something, not what is being described”, and it is where “new translations” occur (Latour 2005, p.128 and 131). Similarly, an ethnographic approach enables a practical, problem-based research in order to understand the social and material conditions of the construction industry.

The selection of an ethnographic methodology allows for the possibility of deeper understandings of everyday social practices and relationships, which can result in new knowledge (Pink et al., 2010). This includes the meaning that individuals give to objects and themselves through the course of their activities as revealing a particular orientation, attachment and alignment. In the dynamic context of NSIPs an ethnographic approach enables adaptation to changing events, contexts and circumstance (Pink, 2009). The principal methods here are unstructured interviews and observation, to provide a *thick description* (Geertz, 1972) of a given social phenomenon that is responsive to a diverse range of questions in a diverse range of situations and circumstances. In other words, ethnographic work is inductive, the life worlds of participants are crucial, rather than prescribed quantitative methods, such as surveys that are ill equipped to accommodate the diverse questions and circumstances. As Macleod et al. (2019, p.180) argue, “practices themselves are multilayered and heterogeneous; therefore, understanding practices requires careful tracing multiple actors that assemble and give meaning to human worlds, activities and lives”.

4.3 Research Design: An Ethnographic Approach

In recent years, an emerging strand of social science research has drawn upon the insights that have resulted from empirical studies of construction sites, as well as of construction practices (see for example Gherardi and Nicolini, 2002; Marchand, 2003, 2007; Mars, 2005; Strati, 2016). According to Pink et al. (2010), the ethnographic methodologies of such studies, that emphasise qualitative methods, produce significant advances in interpretivist thinking, such as, understanding why actors act in the way that they do on construction sites. This contrasts with the positivist tradition that had previously dominated the methodologies in which importance was given to quantitative research that used structured questionnaires and official statistics to uncover general social trends and patterns, and which did little to inform (Black, 1999), for example, the impact of policy on individuals in the construction industry.

These qualitative advances in interpretivist thinking have in turn produced a deeper understanding of the specific contexts in which specific experiences unfold, from the perspectives of the actors themselves, resulting in a fuller picture of the social and material worlds that comprise such situations (Dainty, 2008). These include illuminating the various issues surrounding workforce practices at construction sites, as well as their accompanying differences, including questions of power and spatial relations, plus other more familiar questions of identity, such as ethnicity, gender, and class (Dainty et al., 2013 and Pink, 2012).

Paap (2006), for instance, in her fieldwork at a construction site, shaped her research design with a view to exploring important questions relating to gender and gender relations in the construction industry. She made use of tools such as direct and sustained contact, observations, and questions, in order to produce in-depth accounts of specific experiences. Other researchers, by contrast, have followed the apprenticeship approach, meaning that they participate in the activities directly, with a view to understanding as fully as possible the extents of the various cultural contexts that are involved (Pink, 2009). Gherardi and Nicolini (2002), for instance, used an apprenticeship approach in order to observe what remains unsaid in such environments, as well as conducting interviews, in their investigation of the different ways in which workers learn in practice (Dainty et al., 2013). By accompanying an apprentice, the researchers demonstrated an ethnographic methodology that was followed

through substantively. This example confirms how important insights, which are not easily obtained by other means, can emerge from approaches to research design that are shaped by an ethnographic methodology.

Pink and colleagues (2010) have also employed an ethnographic methodology to understand how migrant construction workers communicate on the work site, not only with each other, but also with their managers, focusing in particular on questions of health and safety. Prior to this, Strati (2016) had conducted a similar study, which involved examining safe working practices by exploring questions of aesthetics: observing a group of rooftop workers, for instance, the researcher was astonished by the apparent disregard for safety standards, calling attention to the “surprising agility of one plump workman.” In his conversations with the workers, however, Strati not only discovered how the work was undertaken, but also “how it was learnt” (pp. 57–60). This exemplifies the way in which the communication that occurs in construction work, especially in relation to skilled practices, is not merely verbal: rather, the transmission of skills happens through practice, with the result that specific ways of knowing “are located in practice” (Pink et al., 2010, p. 650).

The use of different ethnographic tools allowed Fletcher and Watson (2007) to gain unique empirical insights. For instance, they explored the interactions of workers and their perspectives within a small construction firm, with an aim to understand the organisation itself. This was achieved by observing everyday organisational activities as well as recording narrative accounts, including in contexts that revealed the complex power relations that were at work within the organisation (Dainty et al., 2013). Other ethnographic tools have also been used in research and viewed as particularly innovative. These include using photographic and video-based techniques that are participatory and collaborative (rather than being observational and distanced, as is traditionally the case). Such an approach enables other ethnographers to share these experiences, thereby gaining more nuanced understandings of the context of analysis as well as during dissemination (Pink, 2007).

Ethnomethodology (Garfinkel, 1984) provides a further ethnographic approach to the collection of data. Closely aligned and sharing many similarities with ethnography yet proposes the theory should be isolated from the research setting. This research discounts the ethnomethodological approach and instead draws on Pink et al. (2010) who argue that

the theoretical framework constitutes an essential part of the analysis and ensures the researcher maintains a continuing self-reflective awareness of how his or her work has inescapably been informed by theory.

Ethnography is an established qualitative research methodology that is very well suited for this research study, as it is focussed on exploring multiple sites that all contribute to our knowledge of a particular human activity. As such, by observing relevant contexts, collecting, and interpreting a range of visual materials (including photography, film, and video), as well as analysing narratives and forms of spoken or unspoken discourse (what remains unsaid), the research can result in the nuances of constructions being better understood (Dainty et al., 2013; Atkinson et al., 2001). As Pink et al. (2010) argue, while there has been significant progress in construction research, ethnography still remains an unfamiliar methodology in construction site studies. Crucially, previous research has not focused on the unique impacts that NSIPs can have on construction engineers (e.g., Bridge et al., 2018; Flyvbjerg, 2008, 2009, 2014; Flyvbjerg et al., 2003; Niewöhner, 2015). Given that this research explores the dynamics of NSIPs on the various members of the workforce, using the ANT framework and ethnographic methods was ideally suited to the aim of the research.

The ANT informed approach provided a framework to explore complex relationships that are involved in everyday practices. Given the tenets of ANT that give equal agency to humans and non-humans (Macleod et al., 2019) provided an ideal platform to understand how technologies and the infrastructure itself were implicated in the different perceptions of the workers. Secondly, ethnography provided the tools to explore a range of different voices, from the members of the workforce, including contractors, subcontractors, and management, to other stakeholders involved in the project so as to give a holistic understanding of critical infrastructures. Wider voices included trade association organisations, suppliers to NSIPs, and accommodation providers for the workers. Cumulatively, these differing narratives would turn out to be invaluable for the wide range of insights that they revealed, which ultimately provided a comprehensive view of the impacts of NSIPs, extending far beyond merely economic perspectives, and resulted in a much deeper understanding of their social contexts (Dainty et al., 2013; Pink et al., 2010).

Using an interpretive research design that engaged with qualitative methods helped this research study gain authentic insights into the perceptions and lived experiences of various participants (Dainty, 2008). Furthermore, by adopting the wide range of qualitative ethnographic methods, that included observing behaviours, taking notes, and interviewing a range of participant, as well as continually reflecting on the role of the researcher within the study (Pink et al., 2010, p. 649), it enabled a means to explore the everyday sayings, doings, and relations with objects that occurred in the everyday lives of those involved with NSIPs.

4.3.1 Virtual Ethnography as a Research Strategy

The onset of the coronavirus pandemic six months into the study resulted in a fundamental rethink of the ethnographic research design. Conventional ethnographic practices of being physically immersed were no longer possible and were replaced by information and communications technology (ICT), the term used to refer to all forms of communication technologies, such as the internet, mobile phones, computers, video conferencing and social media or social networking services. Thus, with the availability of ICT, ethnographic research methods could be adapted in the form of online ethnography or virtual ethnography while still allowing effective qualitative research in gaining a deep understanding of everyday life (Hine, 2000). Whilst virtual ethnography provided a different medium for this research study, it afforded a similar degree of access when compared with face-to-face ethnography and enabled meaningful insights of both the technology and cultural processes to be obtained. Beaulieu (2010, p. 7) explains “co-presence” as a way to shape fieldwork whereas “co-location” differs by requiring a physical presence.

Traditionally co-location has been central as a means of accessing participants, whereas co-presence “decentralises the notion of space without excluding it” (Beaulieu, 2010, p. 454). As such, embarking upon a virtual ethnographic approach opened the possibility and a unique opportunity of obtaining knowledge through different modes and aligns with the belief that co-location is not a prerequisite for a researcher going into the field, placing more emphasis on establishing co-presence. This was crucial in gaining access to the contractor community associated with NSIP and afforded the potential to bring about new kinds of ethnographic field sites, with their own distinctive sets of possibilities (Hine, 2000). ICT can

be understood as providing a space that not only allows for, but enhances democratic participation or virtual community, defining ICT as a medium that can be used to sustain relationships (Hine, 2000) and reinforcing a researcher's ability to form a rapport with the participant in a virtual setting.

The principal techniques of ethnography involve gathering data through first-hand experience, by means of participant observation and interviews, to explore a particular group or cultural setting (Atkinson et al., 2001). Thus, the traditional idea of face-to-face research being conducted at a remote field site has long been considered the prototypical form of authentic ethnographic engagement (Hine, 2000). As a consequence, ethnographic methodologies have long been perceived as essential to gaining in-depth understandings of personal experiences and social lives. For instance, Agar describes ethnography as an exercise in translation (Agar, 1987, p. 210) while borrowing the term "strips" from Goffman (1974) to denote the raw material of ethnographic data which in ANT, are actors or actants that generate effects and afford a viable option to conduct ethnographic research, and how it is able to offer different social experiences (Hine, 2000; Boellstorff et al., 2012).

To date little emphasis has been made on construction practices (Dainty et al., 2013; Pink et al., 2010), or on the impacts of NSIPs on contractors as a distinct category, but what is more unique is applying it in an ethnographic virtual setting. As Hine (2000) has argued, including the theoretical framework of ANT (Latour, 2005) and ethnographic theory (Pink et al., 2010), it is crucial that social processes are subject to critical analysis. Accordingly, multiple understandings of impact are required when analysing the research settings of large-scale infrastructure projects, which involve multiple perspectives from multiple people, depending on their age, gender, beliefs, and interests.

4.4 Operationalising the Research study: Data Collection

Data collection commenced in October 2019 following ethical approval (see Appendix D for a copy of the Swansea University Ethics Committee approval). This included attendance at a number of general meetings with trade associations and introductions to a number of officials within the trade association which afforded the means to obtain invaluable insights

first-hand, in person. In addition, the external communications manager at the NSIP which is the focus of this study was also interviewed, this crucial gatekeeper prevented access. It became apparent there was a reluctance to uncover tensions residing with contractors working on the project as addressing skills gaps would make a more useful contribution as opposed to the lived experiences of contractors, the construction work itself and the cultural activities that occurred in the local communities. Access would not be supported; an alternative strategy was devised which encompassed purposeful sampling to access those best placed to share their lived experiences.

On March 13, 2020, my daughter was sent home early from school. Messages about a pandemic started pouring in—and before I knew it the world had gone into lockdown...

4.4.1 Participant Selection – Purposeful Sampling

Accessing participants was hugely problematic partly due to the sensitive context of the NSIP and the refusal to permit access to the site. Onsite contractors were not permitted to engage with anyone not directly involved in the project. While access problems are certainly not unique to researching NSIPs, the problems did spur a creative approach to sampling. As noted, representatives from engineering trade associations were approached, presentations about the research were presented to engineers as a means of accessing those engineers who had been involved in the NSIP. The individual responsible for organising kitchens for the workers on the NSIP and therefore not directly involved in the project was also approached. After an arduous process involving calls, emails and capitalising on all opportunities, interviews were set up with on-site kitchen staff. Entering field sites to undertake ethnographic research is notoriously difficult (Geertz, 1972). The focus in terms of access strategy shifted from the contracting engineers at the field site itself, to owners and employees of the various accommodation sites in the surrounding towns where the engineers might reside. Ultimately, locating B&Bs closest to the nuclear project proved to be key in enabling access to the field. The participants are listed in **Table 2** below.

4.5 Data Collection: Qualitative Interviews

The field work involved 10 participant interviews over a period of fourteen months, from March 2020 to April 2021. In accordance with the virtual ethnography strategy, interviews were conducted using online video software (Zoom) and were supplemented by via email communications. Wakelin et al., (2024) outline the benefits of using an online platform to conduct research interviews. In this study they were semi-structured and in-depth that enabled questions to be probed in more depth as the conversation developed as part of the iterative process of data generation (Lincoln and Guba, 1985). Please see Appendix A for the questions used in the study. The questions were framed by the literature and were supplemented by probes which ensured additional information could be captured where appropriate based on the outcomes of previous interviews. Each participant was provided with an information sheet (see Appendix B) and consent form (Appendix C) prior to their interview. These included a brief introduction and an overview of the project. A few days before our meetings, participants were asked to read and sign consent forms.

The interviews ranged from half an hour to an hour in length, with the majority lasting for an hour, and the participants varied in terms of their age and gender, as well as the context of their direct or indirect involvement in the NSIP. As Kutzel et al., (1995) assert, sampling should reflect the diversity of the group or population that is being studied as it informs the comparisons that one is able to make with the resulting data (Barbour, 2007).

As previously discussed, the participants who were interviewed were accordingly diverse, ranging from T1 contractors to T3 subcontractors, who were directly involved in the NSIP, suppliers to and manufacturers of products for the NSIP, who were indirectly involved, those who provided accommodation sites for the workers, and those from the relevant trade association organisations. **Table 2** illustrates the distribution of the different participants.

Table 2 **Study Participants**

<i>Tier One</i>	<i>Tier Two</i>	<i>Tier Three</i>	<i>Major suppliers</i>	<i>Accommodation providers</i>	<i>Trade association organisations</i>
Health and Safety Manager in multinational company (MNC)	Senior Project Engineer	Director of electrical / electronic manufacturing company	Business Development Manager	Owner of B&B	Regional Manager
Health and Safety Lead Engineer in multinational company (MNC)		Operations Director of electrical company	Marketing Manager Energy and Sustainability	Hotel General Manager	

With respect to the various tiered groups, it has previously been acknowledged that the construction industry is categorised into various groups—T1, T2, and T3—which are differentiated by their size as well as by their level of responsibility, being organised in terms of a hierarchy (Department for Business Innovation and Skills [DBIS], 2013).

An important feature of co-presence in virtual ethnography is its performative aspect. Infrastructures, spaces, and texts are some of the many resources that can be involved in establishing co-presence within the field (Beaulieu, 2010, p. 458). Thus, in this study, paying close attention to the various meanings of *space* in a virtual (ethnographic) setting was of crucial importance. First, the *virtual* aspect meant that the meeting could potentially take place anywhere, at any time, without being restricted to a particular time or a particular location. Second, within the meeting’s virtual environment, where equal participation and engagement between the researcher and the participant ideally occurs, one was able to observe the *semiotic space* that Goffman (1989) pointed out. Similarly, observation also had a very specific role in the research in which it was conducted according to the ANT framework in that humans and non-humans “share equally in the same analytical space”, it enabled the study to give “co-performing non-humans a say” (Picken, 2010, p. 259).

Alongside the participant interviews, the study also drew on an extensive collection of research notes acquired from meetings at the start of the study, and grey

literature/secondary source materials, including newspaper articles and published works, a wide array of government documents, focusing on various aspects of construction in the UK, and non-technical developer reports, highlighting policies for construction work (seen in the Findings and Discussion Chapters). In addition, these secondary sources addressed the accompanying social impacts and environmental consequences. In both the primary and secondary source materials, the confidentiality of all of the participants has been maintained, with pseudonyms being used to replace any direct references that are made to particular people or places.

By drawing on the ANT framework, the study has included non-human actors or secondary sources to trace connections and develop leads and generate further interactions. Both the primary and secondary materials have played a part in generating the meanings that people have given to their actions and the world that surrounds them. As explained, “interviews provide opportunities to learn about people’s elicited narratives and representations of their social worlds, including beliefs, ideologies, justifications, motivations, and aspirations” (Boellstorff et al. 2012, pp. 92–93).

4.6 Data Analysis

While drawing on the concepts of credibility, transferability and dependability, this may be further shown in the data analysis. Moreover, adopting an ANT informed approach has enabled a deeper understanding of the social and cultural contexts of the NSIP and, more specifically, the engineering contractors working on the project. Such an approach allowed the exploration of various networks relating to the project alignments, and most notably the alignments between managers and workers in terms of the hierarchical organisation of the tiered groups of contractors and subcontractors. This includes, how different groups are positioned in relation to larger networks, for example, the infrastructure as a whole, or other networks in other places, as well as economic, political, cultural, and environmental aspects.

The analytical stage of the research began immediately following the first interview, which was transcribed from audio recordings. This was accompanied by adding various notes

alongside the text to highlight repetitions, pauses, and interruptions, all of which added specific nuances that contributed to the encompassing context. Transcription was a time-consuming process involving first and second plays for clarification and accuracy and was accompanied by research notes. This systematic iterative approach for transcription and analysis was followed for each interview to add both rigour and transparency to the process (Naeem et al., 2024). Being immersed in the data proved to be a pivotal first stage in the thematic analysis. The analysis followed Braun and Clarke's framework to ensure "transcription is an interpretive act, where meanings are created, rather than simply a mechanical act of putting spoken sounds on paper" (Braun and Clarke, 2006, pp. 87–88; Lapadat and Lindsay, 1999).

Transcriptions and accompanying notes were uploaded to NVivo (see Appendix F for a sample of the NVivo coding), which helped with organising data prior to analysis. The software was used to organise the data into codes and subcodes to highlight patterns that could subsequently be categorised into various key themes. As a result, an overarching theme of (in)security emerged, comprising of; physical or worker (in)security, and ontological (in)security.

The application of ANT revealed the alignments and attachments through lived experiences. These experiences are illustrated through participant extracts and are further supplemented by vignettes which are used to reveal the holistic experiences of contractors emerging from the study. Vignettes are short stories, scenarios and depictions of situations which can generate an inside story and reveal how participants perceive certain experiences, and an ideal way to present complex insights emerging from an ethnographic study. For Richardson (1997), vignettes provide clarity of understanding for both the reader and the author. The vignettes comprise a fusion of field notes and interviews and consistent with ethnographic approaches that are used to set the scene for the rest of the findings section. These will be illustrated and discussed in greater detail in findings chapters.

4.7 Evaluating the Research: Reliability and Dependability in Qualitative Research

This interpretive study has applied a qualitative and ethnographic research strategy to explore the impacts of an NSIP on engineering contractors. While qualitative approaches have a number of advantages, such as depth, credibility and trustworthiness, they are not without their limitations (Law and Urry, 2002). One key limitation advocated by the alternative quantitative approach criticises qualitative methods for their lack of *rigour* (Lee and Lings, 2008), yet rigour in qualitative research provides the insight into the contextual sensitivities and meanings that are unique to qualitative research (Sandelowski, 1993). In order to overcome this issue, Guba and Lincoln (1989) suggest a focus on the concepts of credibility, transferability and dependability.

Credibility is thus achieved by presenting various examples on each claim made. As Shenton (2004) explains, repeating the research process across participants will reinforce the credibility in the research design. By conducting semi-structured in-depth interviews with different participants directly and indirectly involved in the NSIP, a rich and complex dataset that was necessary to effectively answer the research question was obtained. In terms of transferability, this is demonstrated in the quotes from the interviews and documents seen in the research findings in Chapters 5 and 6 which may be applicable to other contexts and situations (Barbour, 2007). Dependability was achieved through the coding strategy employed which identified similar themes within the actor network of the NSIP and across other actor networks indirectly involved in the project. This contrasts with quantitative research which is concerned with obtaining the same results across different research sites that have the same context. Here and for qualitative research, the emphasis on reliability is gained through having consistency in how the research is carried out (Janesick, 2000).

Ultimately, despite the various drawbacks that can be attributed to qualitative research, it remains the case that the benefits of such an approach outweigh those of purely quantitative research: Qualitative research not only allows a researcher to gain valuable insights into the perceptions and experiences of those who are actually actors in the field, but also allows a researcher to turn such insights into new knowledge contributions. This

would simply be impossible to achieve by using quantitative methods, such as surveys and the resulting statistics.

4.8 Ethical Considerations

‘When can the subaltern speak?’

(Spivak, 1999)

The “reflexive turn” emerged in the 1980s, as a result of ethnographers taking a critical view of their own research processes (Lather, 2001, p.477). Issues of how participants were written into research and the ways this was mediated by the ethnographer came under close scrutiny, notably following Clifford and Marcus’ (1984) classic collection of essays. What was termed a crisis of representation, that is who (if any) had the legitimate right to speak for another came to the fore across disciplinary domains. Alcoff (1991) for example, highlights the tensions of speaking *for others*, the right to speak for others as well as the ability to reproduce this within the format of a largely white skinned, privileged, Euro- American frame of research. Tentative solutions such as attempts to ensure verisimilitude through co-production and respondent verification whereby the words were checked by participants provided some way to assuage the effects of ethnographic *expert* writing about the other (Denzin, 1997). However, the critical question posed by Spivak (1999) was when can the subaltern speak, when can those who are economically dispossessed, those already marginalised who are suffering the worst ravages of global inequality, when can they actually speak? For Spivak, the subaltern, those who are socially and politically excluded cannot speak, their voice due to their exclusion is always mediated through others and as such the subaltern can never speak.

These questions about representation and legitimisation, especially as they have been voiced in relation to contemporary culture (Marcus and Fischer, 1986), together with the important contributions of postmodern perspectives (Lather, 2001, p. 477), have resulted in the field coming to something of a “crisis.” There are two elements to this crisis: first, the problem of referentiality, and second, the various issues that are bound up with an ethical approach to writing. In order for these issues to be overcome, radical shifts have been

proposed, emphasising a very real need for change, not only in terms of field methods and techniques, but also in terms of the writing up of the research, too. Marcus and Fischer (1986) argue the core problem reflects ethnography's referential adequacy. That is, how well is ethnography able to portray other cultures and to what extent are the truths of those cultures demonstrated (Birth, 1990; Denzin, 1997). Strathern (1987) argued that the resulting ethical issues should not be overwhelmed by "representational tact" or a need to say the right thing at the right time but rather they should prompt us to think deeply and carefully about issues of strategy and complicity, as well as our relationships with others (Skeggs, 2001, p. 436). Ethnography is an approach to understanding the social and relational, allowing an understanding of meanings made and lives lived.

As is the case with feminist views where knowledge or "tacit knowing" (implicitly acquired) is gained through experience, the tension between the desire of the ethnographer to know, on the one hand, and a truthful acknowledgement of the limits of representation, on the other, allows us to question the authority of the researcher, without being *paralysed* by it (Skeggs, 2001, p. 432). It ultimately transforms conditions of impossibility into occasions for new possibilities (Skeggs, 2001). Nonetheless, such a reflexive approach has prompted important debates and raised important questions about authorisation and legitimacy in the production of knowledge, as well as the accompanying virtues of objectivity and subjectivity. Moreover, the issues of responsibility and interpretation that emerge in post-structural and postmodern approaches to ethnography, which call attention to the epistemological underpinnings of the acts of research and analysis, not only bring the self-reflexivity of the researcher to the fore, but also emphasise this quality within the actors themselves. In order to understand social change, however, one must place processes of reflexivity at the heart of modern identity, with a view to accounting for the transformations that the modern self has undergone.

Indeed, there is no way of escaping from the fact that sociologists or researchers are *social members* themselves, who experience difficulties when they attempt to remove themselves from the bonds of their own social categorisations. Latour (2005) takes the view that ethnographers are similar to actors when they are tracing social bonds, even though they are using different tools and have different ends in mind. Therefore, in any given interaction, it is important to acknowledge that there will always be an "overflow" of elements that are

already present, which are being produced by another “agency” and coming from another “time” or “place” (Latour, 2005, p.166). If the researcher is able to follow such “overflows,” he or she risks being led “away” from the site of interaction to “other places, other times, and other agencies” (p.166) that have similarly already been shaped. Latour, however, argues that this is not a problem in itself; rather an ethnographer is in danger of being led astray by not knowing where to go next, which can result in the researcher becoming confused about the distinction between the body politic and society (Latour, 2005, p. 166). This may point to a potential problem in representation because the *body politic* (of which the participant has no control over) constitutes habits and thoughts or cultural constructions of the body that may relate to issues such as national identity, gender, sexuality, race, crime and law (Latour, 2005).

In specific relation to this research and the experiences as a researcher, it was deemed appropriate to form bonds with the participants while conducting in-depth interviews. In doing so, however, one found oneself being caught up in the participant’s internal political views, which were subsequently reflected in the researcher’s analytical writings, meaning that the reliability and validity of the findings could be called into question. As a consequence, the researcher also became an actor, and inescapably played an active part in the data collection and the subsequent generation of effects in the interpretation of the networks (Cresswell, 2010; Law and Hassard, 1999; Mclean and Hassard, 2004; Singleton and Michael, 1993). After discussions with supervisor, the researcher was able not only to reflect upon one’s own position of responsibility, but also to reflect upon the ontological and epistemological positions during the data collection and analysis processes. The ANT framework requires all actors to speak about their social contexts and even to contest the perspective of the researchers. This relates to the reflexive (and ethical) positions of ethnographers during their research activities, which can constitute actions, conversations, and understandings, among other things. Therefore, while it is important to recognise that research activities can only ever be partial, researchers must continue to recognise the dangers of complacency during the process of knowledge production, by remaining mindful as well as accountable (Clifford and Marcus, 1986; Garfinkel, 1984; Strathern, 1987).

As discussed previously, the concept of performativity is frequently highlighted in ANT writings, with Law (2004) arguing that social methods are themselves performative, because

researchers end up realising social realities that only they represent. This can be compared with the thinking of Mol (1999), who refers to *ontological politics* when discussing the ways in which practices are constantly reshaping the real world. Therefore, ANT encourages us to ask questions about the kinds of worlds that one is able to legitimise, as well as the ways in which one is able to reconfigure social processes (Latour, 2005). On a similar note, to overcome issues of reliability and validity, researchers may draw on feminist views that describe an ethics of witnessing. That is, not only is it “responsive to,” but also “responsible for”, thus calling on researchers to adopt an “ethnographic attitude” of accountability and responsibility (Skeggs, 2001 pp. 437).

As noted, ANT’s scepticism of applying rigid frameworks and explanatory theories that have been predetermined to the specificities of unique field sites has enriched our theoretical as well as empirical understandings of the ethical and political natures of the social worlds that are encountered during research activities. As such, the ANT methodology involves attempting to replace “vague, all-encompassing terms with descriptions of more realistic and smaller sets of associations” (Latour, 1996b, p. 369). Moreover, Latour suggests that an inescapable feature of the social world is the constant tracing of the boundaries of one actor over those of another, which provides the researcher with an essential resource, even though controversies are inevitably created.

The ANT framework acknowledges that there are many shifting frames of reference, but suggests that a researcher will in time become accustomed to them, meaning that it is possible to understand the ways in which the social world is formed through relativist analysis. Thus, the ANT framework encourages an ethnography that is not purely objective, on the one hand, but also not totally immersed in, and blinded by, political entanglements, on the other. However, since it focuses on the forming of new associations and their various transformations, ethnography is unavoidably bound up with questions of political significance, as its fundamental concern is with issues of assembly. Even so, as a consequence of the relativist connections that can be drawn between different frames, Latour emphasises that it is ultimately a source of objective perspectives. The important question, then, involves the data that need to be collected—and the way in which this is done (Latour, 2005).

Considering this research study, which involves questioning engineering contractors about their perceptions and experiences of working on NSIPs, it is a project that is affected by a multitude of heterogeneous actants. This includes other stakeholders that may be directly or indirectly involved, as well as economic and internal political issues, and, furthermore, policy and technical concerns. In turn, these various issues simultaneously affect the other related networks, including the encompassing social forms and the surrounding landscape and environment more generally. Latour describes these systems as complex, with one actant's ability to act depending on the actions of others (Latour, 1996a). Therefore, the use of the ANT framework as the foundation for this ethnographic study, and the harnessing of its flexibility in order to explore the various perspectives of the various actors, has enabled the study to highlight the various responsibilities of the researcher, in a reflexive way: this includes reflecting on the way one writes and the way in which texts are constructed, one's personal relationship to the study, the spaces in which the accounts have been recorded, including the acknowledgment of potentially competing accounts, and, related to this, the recognition of difference and its accompanying complexity (Rapport and Overing, 2000).

This reflexivity also extends, crucially, to understanding the various ethical concerns that arise during the storage of data collection (See Appendix G for the GDPR Certificate). Not only is informed consent required from participants, in order to maintain their confidentiality and protect their identity but is it also essential to ensuring that their well-being, their dignity, their safety, and their rights are carefully considered throughout the research process, at each stage.

4.8.1 Ethical Approval Secured

Initially the project aimed to examine the experience of migrant workers experiences of construction work on a NSIP. The initial aim was to produce a 'thick description' (Geertz, 1973) of place making and belonging among migrant workers (principally from Wales) on time limited projects through interviews, observation and documentary analysis of news reports, policy and official documentation. The primary ethical issues concerned researcher safety, confidentiality and anonymity of materials produced by and with participants, anonymity of the research site. However, given the difficulties in securing access to the site,

the research examined the experiences of construction workers and the commute or stay in the locality. This research was approved by Swansea University School of Management Research Ethics Committee on the 3rd of February 2020, details of this can be found in Appendix D. Access to contractors was gained from engagement with employers' associations. As part of this, presentations were given to members and knowledge of the project spread through the association; indeed, the research appeared as an agenda item and enabled contact to be made with participants. To this extent the employers' associations acted as gatekeepers to contractors. Whilst this was not a direct endorsement of the research, it was grounded with approval from some members of the employer associations.

4.8.2 Confidentiality and Anonymity

Access to identifiable information was restricted to the researcher only, once used, all identifiable information has been destroyed. Material gained during the research from collection (specific sites and organisations), transcription from audio to textual file, analysis and in the writing up of this research has been rendered anonymous. The information provided by participants and engagement with a range of organisations requires anonymity in order to protect participants. Given the kindness offered in terms of time and support, it is important to recognise and respect these contributions to the research.

4.8.3 Participant Information Sheets Devised and Refined in Light of Feedback

The initial information sheets were reviewed by the supervision team and employers who were unclear of the purpose of the study. They were also seen to be too technical and required simplification and the focus was very much on the research, rather than on what elements of the research were useful for participants to come to an informed decision (See Appendix B). The information sheets once revised were sufficiently broad as to enable a variety of stakeholders sufficient information to make an informed decision to participate. Participants expressed that they appreciated the opportunity to take part in the research as it enabled their story to be *listened to* and expressed a willingness to further engage with the research.

4.8.4 Overcoming Barriers to Access

The major challenges for this research concerned access to the field site that made accessing accounts from the developer more difficult and the lockdown which provided practical challenges to performing ethnographic research (as noted previously). In terms of understanding experiences of working on a NSIP, being unable to access the field site did not prove too much of a burden. However, it was apparent that discussion of the field or the organisation was undesirable and as such means of gaining a more general picture of experience of such a project was required.

In order to get a feel for the site time was spent in guest houses, where proprietors provided insights into their experience of housing temporary workers. This was also important in terms of understanding the location, the effects of a mobile workforce on the local communities, the perspectives of residents and an insight into habits of contractors. In terms of researcher safety, the majority of the interviews were conducted remotely and required no travel to the participants with the exception of guest house and hotel proprietors. Whilst engagement with the local community was in person, this was undertaken in a popular holiday destination and as such incurred minimal risk. As a final note, towards the end of the research study, an opportunity was presented after Covid-19 to visit the research site. This enabled a better understanding and put into perspective the experiences discussed by the participants by revisiting the site in person. Please see the following photographic samples taken in Appendix H.

4.9 Chapter Summary

The world has multiple truths as well as multiple realities. Accordingly, qualitative research embraces the fact that the world is socially constructed, with *reality* being understood in different ways by different individuals, reflecting their different perspectives. The purpose of ethnographic research is to understand such subjective experiences of reality in epistemological terms. This qualitative research study, or ethnography, therefore, relies upon data that have been obtained (almost exclusively) through in-depth interviews and observations of a range of participants. As such, it is very much an inductive study, which

does not seek to express universal truths. Ultimately, this chapter recognises that there are many ways of conducting research—one contrasting example involves the use of quantitative methods, which employ numerical and statistical analysis. This chapter also recognises that qualitative research has some limitations. Specifically, the interviews in this study are semi-structured (or unstructured), which means that the results cannot be generalised beyond the sample group. However, this is appropriate for the aims of the study and the research question that it poses, the ultimate goal not being to obtain statistical results, but rather to explore the various perceptions and experiences of those who are best placed to share their insights about working on NSIPs. The following Chapter will present the findings of the study.

CHAPTER FIVE: FINDINGS - ASPECTS OF CONTROL

5.1 Introduction

The previous chapter highlighted how the qualitative research methods of ANT and ethnographic practices are best suited to explore the impact of NSIPs on engineering contractors. This Chapter presents the findings of the research and uses both interview extracts and data-driven vignettes to capture the lived experiences of the participants. The chapter also includes coding snapshots to highlight the evolving themes and data reduction process. The findings show two key themes emerging from the data which centred on different aspects of control. Firstly, policy control, which brings together issues relating to accountability, qualifications, and health and safety policy is presented in this chapter. The second higher-order theme of felt obligations focuses on the various obligations of the construction workers, to their work, their community, and their family which provides insight into the internal and individual controls imposed by workers and is presented in chapter six. These dual modes of control reveal how participants were subject to external regulation and self-regulation. Two central vignettes compliment the participant's words to illustrate the complexity of the network in a more holistic sense and to emphasise fundamental aspects of the impact felt by a contractor community.

By applying ANT to explore how workers are regulated on site, we see how precarities are generated through policy control and the emergence of two different forms of (in)security experienced by the workers, which are worker (in)security and ontological (in)security. The concept of worker security is understood in terms of physical security and the maintenance of social, economic and political conditions. In contrast, ontological security encompasses the psychological perspectives of security in which the security of the individual self is emphasised (Shani, 2017) to reveal how individuals need to feel secure in their identities and experience a sense of continuity in their everyday lives.

The ANT framework shows how the concepts of security are better understood, as emphasis is placed on the different ways in which the different elements are interconnected and the effects that are generated. As Law (1992) argues, heterogeneous networks take part in the

social and at the same time shape it, and in the process, knowledge is produced. As such, these different heterogeneous relationships or interconnections in patterned networks that include both human and policy actors will be demonstrated throughout the chapter.

The following diagrams provide a choreography of emerging elements, concepts and themes developed from the data collection and its analysis (NVivo) derived in the methodology. For instance, **Figure 1** demonstrates the main concepts, as they had been analysed as two higher order themes. This includes this chapter that concentrates on policy controls and Chapter 6 that concentrates on felt obligations. **Figure 2** shows the interconnections that start to emerge between these different concepts, resulting in a single underlying (or overarching) theme being generated, as (in)security – which includes both worker or physical (in)security and ontological (in)security. Moreover, to illustrate how networks are generated in ANT, in **Figure 3**, these interconnections are further mapped out using an ANT map that show patterned networks of human and nonhuman actors that occur within a particular NSIP.

Figure 1 *Development of Higher Order Themes*

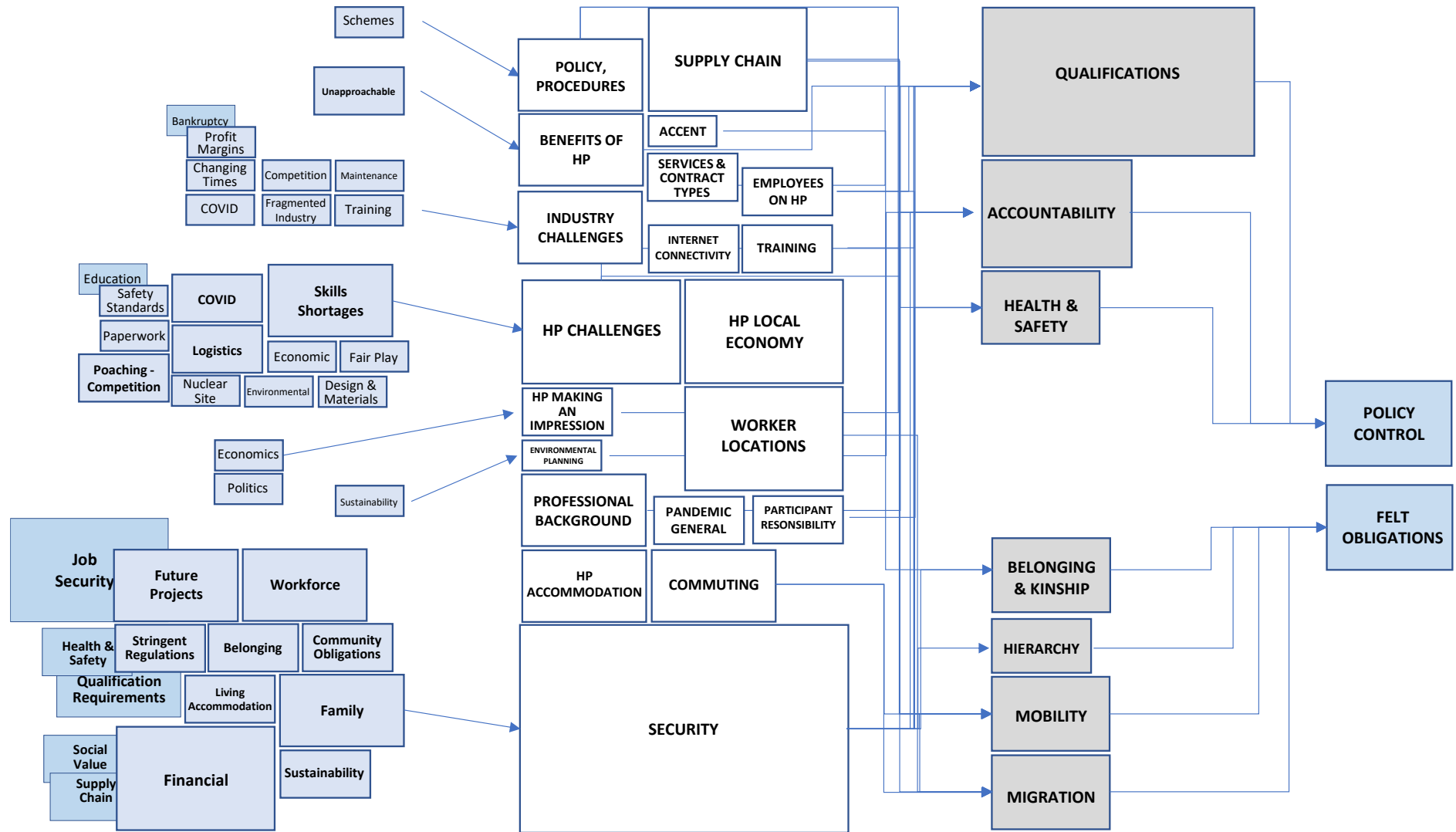


Figure 2 Emergent Key Theme – (In)Security

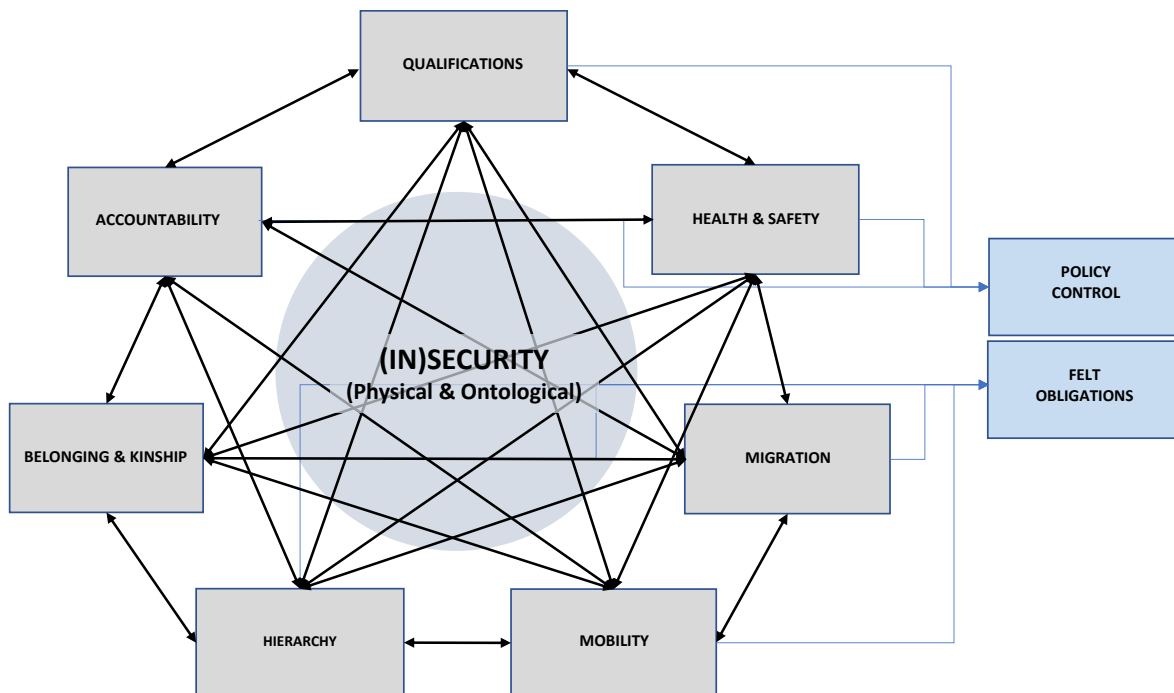
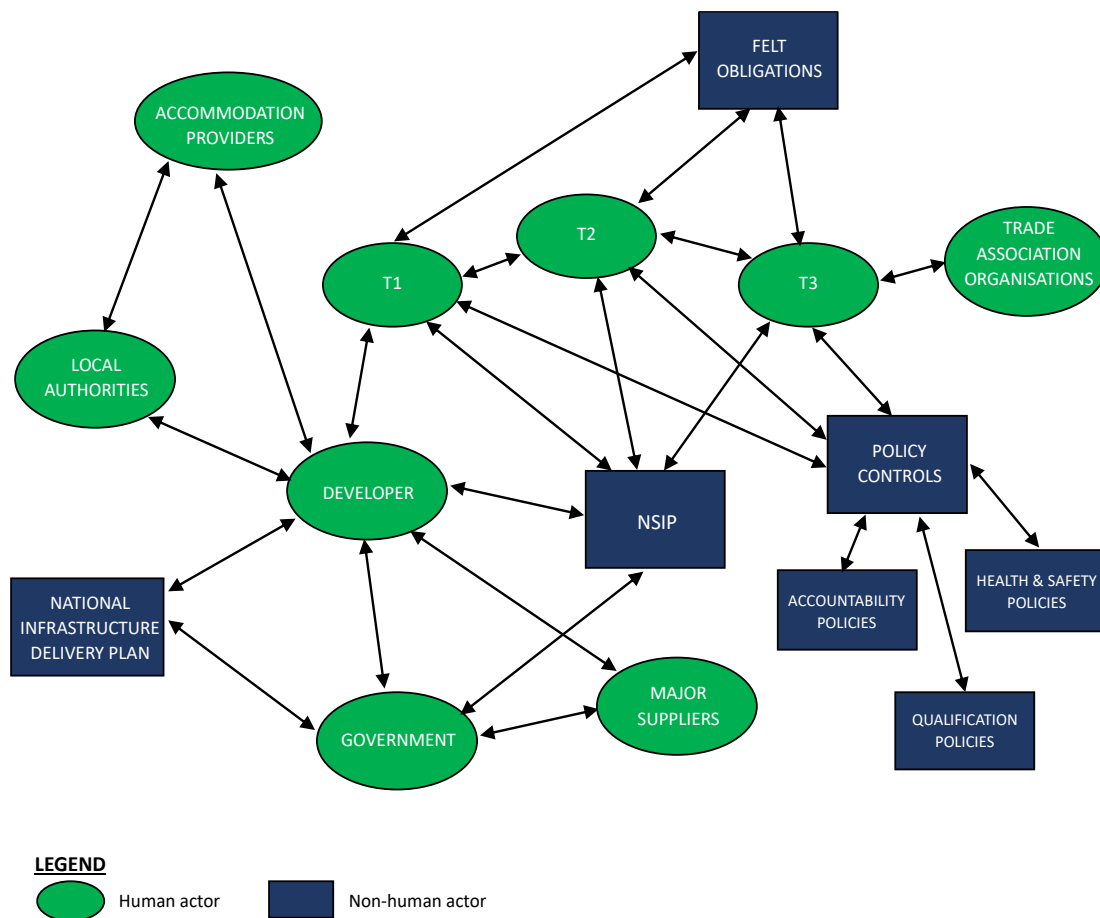


Figure 3 NSIP Contractor ANT Diagram



5.2 Regulation - Policy Control

Policy control outlines how policies are created and passed through the network via a series of exchanges. This starts with the contractual obligations established by the Developer in response to numerous energy targets (GOV.UK, 2016, 2018, 2020) which are transferred to T1 contractors. These together with the addition of T1 specific commitments regarding accountability are then passed down to other subcontractors, T2's and T3's, to establish the contractor obligations.

The following sections highlight the lived experiences of the subcontractors, all of whom are involved in the NSIP and are subject to comprehensive vetting procedures. If successful the subcontractors are further subject to an array of detailed verification and quality control (or audit) processes, both in the manufacturing of components and during construction.

The contractors' experiences reveal an audit trail through the network from its origin (the Developer and T1's) through to the T3 subcontractors. Whilst the level of accountability and responsibility for delivering on the project remains with the Developer (evident in rigid policy regulations) the trail highlights how aspects of the regulations are lost along the way. This is significant as the impact will only be felt at the level of the T2 and T3 subcontractors. For example, the experiences of Tom, a senior projects engineer for a T2 contracting firm, emphasised how robust measures can make access extremely difficult. The impact includes both qualifying to work on a nuclear site, as well as getting on site:

'I know from experience that it is very difficult to get onto a nuclear site. And it's very difficult to do your work on a nuclear site...., the health and safety aspects, security aspects...., means it takes an awful long time for you to get registered to work on site, and then there's an awful lot of restrictions placed on you when you're on site. I'm glad I don't have to go there too often' (Tom)

In the following sections I will be tracing the policy control trail from the Developer to the T3 subcontractors thus revealing the lived experiences through the participant extracts. Just to highlight a few examples, **Table 3** below provides an overview of the differential impacts of the policy controls on the different actors involved.

Table 3 **Summary Table – Policy Control**

	Topic	Tensions	Differential impacts				Impact of ANT
			Developer	T1	T2	T3	
1	Policy documents	Can be flexible	Volatile environment requires Developer to make necessary changes	Fully aligned with the Developer on document requirements	Stringent requirements present challenges of competition and poaching	Policy presents logistical challenges	Generates a sense of (in)security and ontological (in)security
2	Type of language (e.g., right kind of people, right first time, right skills)	Performative	Using a type of language that reinforces and ensures every contractor is in alignment	They themselves corroborate and use the same language	The challenge of finding the right skills creates barriers	A sense of not belonging is felt	Seen as policy actors that are enrolled in performing the network to generate alignments and non-alignments
3	CABs	Controls	Preventing risk of failure	Enables the identification and segregation of 'others' who do not conform	Unanticipated time delays in getting design work approved	Financial impact	Conformity actors actively reinforce the network and make it temporarily stable while 'cutting' other actors from the network who do not conform
4	Nuclear culture	Creating a separate culture	The aim is to bring about a strong organizational culture	Stands in unity with the Developer culture	Seen as an organization of selectivity and exclusivity	Associated with instability, discrepancies and contradictions	Creating attachments and detachments
5	Induction	Mitigating risk	Emphasis on delivering on time and within budget	Ensuring the prevention of health and safety implications	N/A	Loss of income, time and loss of trust	Reinforcing alignments with some actors while causing others to experience insecurity. Generating effects of new alignments in other places

5.2.1 Accountability and Qualifications

Regulatory control and the duty of contractors and subcontractors to uphold their responsibility is a universal commitment in construction (Dainty et al., 2007; EDF Energy, 2020). The NSIP reveals the added emphasis placed on the actors in the network to become accountable through the introduction of additional procedures and qualifications. However, how policy is enacted will depend on how it is interpreted by the specific actor involved. For example, one developer's policy documents revealed that it expects:

'...supply chain partners to operate in a manner that demonstrates a commitment to sustainable, responsible, and ethical business [in the same way that the Developer] requires of its own people and business activities.' (Developer Policy)

This was corroborated by two T1 managers (MNC – from a multinational company) involved in the construction of cooling water pipes for the NSIP, who were fully aligned with the Developer requirements for implementing nuclear policy. In the first example alignment was associated with managing the health and safety aspect of the project, and getting approvals in the paperwork to reduce opportunity for incidents and accidents during construction, maintenance, and final dismantling:

'On nuclear projects that is quite common, but you don't always get that outside of the UK. You see, I worked in the Middle East and the number of fires in high rises is not a fluke it's happening for a reason because the quality is not where it should be.'
(Charles)

A similar insight emerged on the current NSIP when compared with other infrastructure projects. This is explained as:

'Personally, I've worked on petrol and chemical sites on construction projects, um, mechanical and electrical environment. But nuclear safety culture was a completely different beast, and it raised that level a little bit higher.' (Dan)

According to the Developer, the NSIP requires the introduction of an accredited environmental management system, which involves agreeing to following procedures and regulations. On that account:

‘As a qualified supplier, you will be able to demonstrate you can meet the stringent requirements to work in this industry – from demonstrating robust design and procurement capability, to a robust manufacturing process focussed on right first-time quality....’ (Developer Policy)

Charles notes the requirement also signals alignment with the Developer’s values:

‘So, there’s a big initiative to get it right the first time on a nuclear site. Just to put in perspective, it’s imperative to get it right first time, and you don’t leave behind latent errors that can cause a significant incident in the future.’ (Charles)

Viewing policy controls in a positive light was not consistently shared, some did not see the benefit of policy control. Accordingly:

‘...previously certain individuals didn’t see the benefit of what we were doing on their site whereas here, is a completely different change in direction, where it is embraced and it is genuinely, still I believe it is genuinely top of the target. Yes, we’ve got to build it. Yes, we’ve also got to make sure we don’t kill anyone in the meantime. I think that’s a fantastic way of doing it.’ (Dan)

The implications of not meeting the regulations further explained, this time on the T3 contractor:

‘There’s so much attention to detail... So much more attention that I’ve ever experienced, and rightly so. One really good thing that I did see, and this was early 2018, was another contractor on site had not followed the inspection test procedure prior to conducting some work, and after lots of meetings between that contractor and the project directorate, it was decided that all that work would be stripped out and done again, to ensure the quality of it, and in this instance, it was a 300kg cube

of concrete. So, they had to pick out all the poured concrete, do all the finishing again, and start from scratch and pour it again. So, that's just an example. And from a safety perspective, it's really enthralling to actually see that sort of mentality.' (Dan)

A further emphasises was made on how mistakes were being made by 'others':

'If you want to get 60 years, if you want to get 60 years' work out of that facility, and there has been things that were missed there... not by us.' (Dan)

What becomes evident is how the policies created to provide security, in terms of safety (of the workers and environment), productivity, quality, and efficiency, have the potential to cause unanticipated challenges for the contractors involved thus illustrating the precarity of NSIPs. In the case of the concrete example, repeating the process had significant financial implications of undoing and redoing the work. Moreover, seeking approval while simultaneously competing with contractors from higher tiers may have been an additional burden. The various processes such as administration and evaluations of qualifications may have also generated anxiety and trigger uncertainty for the contractors, contributing to ontological insecurity.

While regulations can hinder the achievement of the desired culture, it can equally be the mundane that has implications on those financial costs which negatively impacts the network. This is further demonstrated by a T3 director, in the unanticipated time spent in the daily safety briefings:

'We felt that they were never on the contractors' side, they were always looking to... not attack you, but they were... there was never any fair play up there, so, you know, it was just one thing after another. For example, a couple of instances where, say, a member of staff on site would have the wrong type of boots, so the whole site would have to stop to have a talk and have a briefing on having the correct boots. So, if you have 15 guys on site, to have a team talk, that's 15 hours you've lost, through no fault of your own. Yeah, it was just one thing after another, and we couldn't wait to get away from there.' (Christian)

The data demonstrates how policies may favour some contractors but not all. For instance, for the T1 contractors' who are in alignment with the Developer, security and risk (regarding health and safety policy) worked in their favour, however for the other subcontracting firms they experienced personal and financial risk. In this sense, it shows the alignments that start to emerge between the Developer and T1 contractors.

The following key narrative represents a holistic story of unfolding events concerning the T3 subcontractor of having to redo the work on the cube of concrete. This is further illustrated by a diagram of an ANT lens that is used as a sample extract of The Concrete Job shown in **Figure 4**. The darker shades thus representing a lens and highlighting the relevant actors involved. The sample illustration is an example that represent the various precarities seen in the network. All of which are discussed further in the chapter, including the underlying recurring theme of security.

The Concrete Job

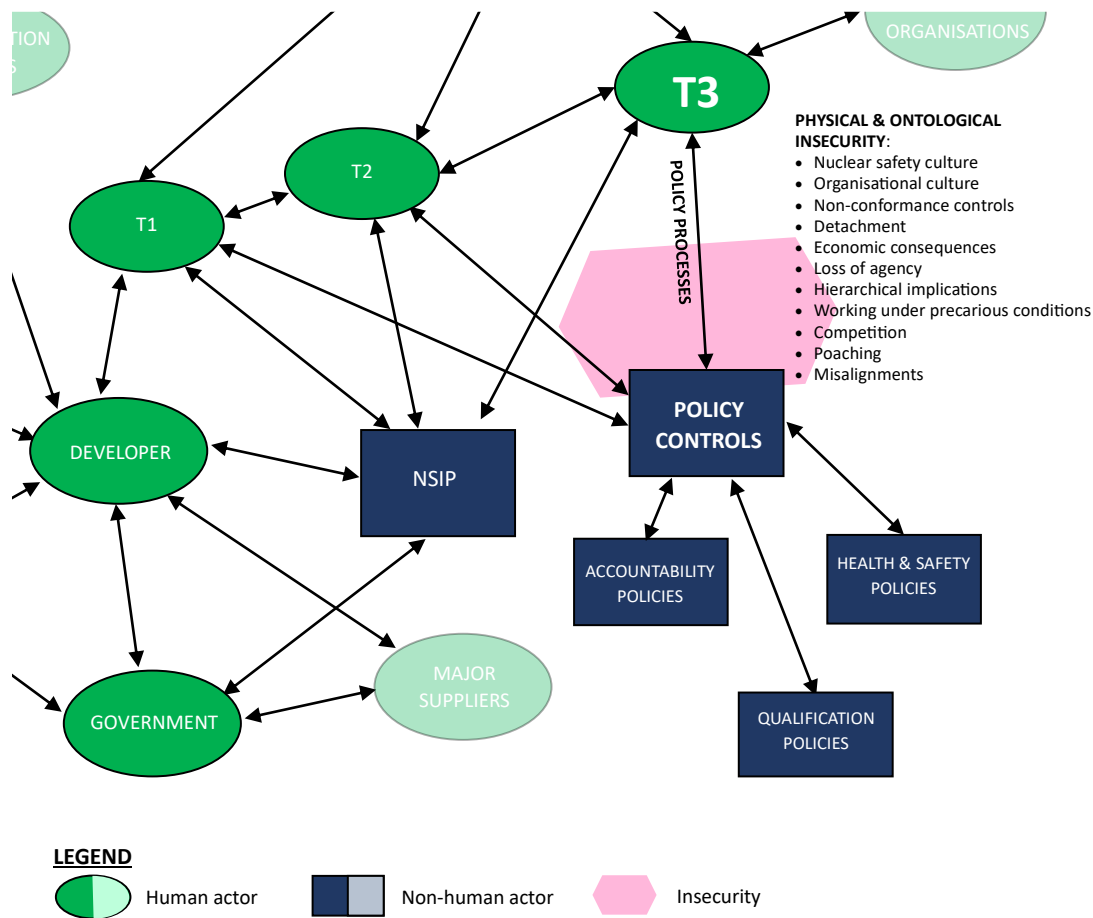
Dan, being in complete agreement with the Developer, emphasised the importance of paying attention to maintaining and upholding health and safety regulations and controls. On this particular day, his attention was keenly focused on a T3 subcontractor who did not conform to the regulations. The centre of attention was a 300kg cube of concrete that would have to be stripped back and removed by the subcontractor and the whole job redone - this time in compliance with the clear regulations. This, of course, would require additional man-hours and would therefore incur additional costs that had to be borne by the T3 subcontractor. For Dan it was an opportunity to demonstrate that tough decisions were being made, regulations were being strictly applied, and offending individuals were being held to account.

Despite Dan's views, there is that lingering question: how did the contractor get to this point of vulnerability and precarity given the numerous rounds of administrative and procedural vetting that would have had to have taken place before the job even started? Notwithstanding this concern, there had been no sympathy for the T3 subcontractors.

As Dan emphatically pointed out, for a job to last and avert any safety or environmental risk, it would have had to be correctly done in the first place. Security was assured for the T1 contractor and Developer as non-conformers were taken care off. Dan made this suggestion of subcontractors, of making mistakes at the same time exonerating themselves of ever being in that situation.

The opposite was true for the T3 firm with insecurity most certainly experienced. Nevertheless, for that moment in time, for Dan, the risk was mitigated; the network was made stable as the homogeneous values of the T1 contracting firm and the Developer of maintaining quality and efficiency were aligned and by definition, reinforced.

Figure 4 The Concrete Job ANT Diagram



5.2.1.1 The Generation of Effects

Accountability that is mandated through policy practices, and the generation of its effects may be compared to Law (2019) who refers to the concept of material semiotics. The concept thus referring to an analysis of the meaning behind the language used to convey a particular message and its effects thereof. Moreover, accordingly, all the elements involved in the analysis are relational and include the involvement of heterogeneous actors. For instance, policy documents (material actors) are enrolled by the Developer (human actor) to relay a particular agenda to other actors (i.e., the subcontracting community) who interpret the communication. In doing so the material actors not only shape those relations but they are also shaped by them.

As such, importantly, material semiotics studies the extent to which this communication is supported or resisted in the context of regulations and controls in the contractor vetting processes. This is demonstrated in Developer policy documentation in which compliance will determine the allocation of contracts for nuclear projects:

‘Compliance with these expectations is a deciding factor when [the Developer] selects the third parties that comprise its supply chain.’ (Developer Policy)

Drawing on Law’s (1991) *material semiotics*, the above extract thus reveals how policies (material actors) are shaped to enact the will of the Developer in order to ensure compliance. In the same instance the policy actor (Developer) will determine which contractor is selected through the vetting processes to enact a particular agenda. This is further demonstrated in the selection process, where emphasis is placed on the importance of *the right kind of people* doing the job and where the Developer makes a point of reciprocity in terms of commitment.

Accordingly, they are:

‘committed to working together with its supply chain to deliver excellence in everything it does. This is achieved by having the right people, with the right skills in place to deliver works, materials, goods, and services at the right time.’ (Developer Policy)

However, reciprocation and commitment produced challenges. For example, according to Christian, it was not about being properly qualified, or having the necessary experience (as the T1 contractor previously pointed out), but rather it was more to do with all the inconsistencies experienced in the policy itself. The following extracts by Christian are further highlighted in the narrative of *The Golden Egg* featured in Chapter 6. As explained:

‘... the amount of paperwork that you had to do just to get on site, and then say you eventually gotten guys signed up to go on site, they would come back to you and say that they needed another 20 guys. And then we would say that your vetting process doesn’t allow that to happen...’ (Christian)

Further explanations were given of how qualification controls impact from the time to start work to the point where the work generates income for the contractor. This leads once again to the discrepancies associated with the policy contracts, thus leading to questioning its validity:

‘We were doing the fire alarm systems. These guys have to have checks, CRB checks, their past detail checks, their family checks, you know just to get on site ... You know, there was no nuclear reactor on site, so why was it so hard to get in there.... We worked alongside another electrical company, and he lost a lot of money up there, and we’ve been hearing these stories from quite a lot of people within this area, you know.’ (Christian)

When it came to bureaucracy, it was also revealed how construction companies did not anticipate the prolonged qualification processes when agreeing to take on a project, resulting in detrimental effects:

‘...they tried to expand too rapidly, and they went into administration last July, so they folded basically at the end of August.’ (Tom)

Tom described the huge challenge that presented in the lack of skilled labour experienced in the UK, and even more so in the nuclear industry. This is similarly discussed in news reports, with the most recent reporting the relaxation of visa rules for foreign construction workers due to the skills crisis made worse by Brexit (Kollewe, 2023). According to Tom, the limited skilled labour, in turn, presented a major challenge in issues of competition and poaching of the workers who were already experienced and properly qualified. Moreover, a further challenge developed in the minimal opportunities of getting that necessary experience needed:

‘If they are not properly qualified and experienced in nuclear work, they will be very reluctant to use you... So, there is this limited skills pool of people that can do the work. Then they are taking them away from companies who are already using them, and they will leave that company without. There is no replacing them... So, you don’t get the chance to get really qualified to work on nuclear sites, or manufacturing on

nuclear sites, unless you've got the experience. So, it's a bit of a closed shop in that regard.' (Tom)

Tracing the actors through the network not only highlights inconsistencies but how viewed together they present a picture of why feelings of insecurity arise. For example, a firm's profit margins may be impacted in the process. In this regard, for Christian (being a shareholder of a company) the impact felt would be both personal as well as professional with implications of detachment:

'Yeah, so we won't go near it again, and I wouldn't recommend it to anybody. I suppose there are contractors there working away, and maybe they're doing OK. What we thought, as well, is that once we got vetted, once we got processed, and once we were in, that would make then other work on the site easier for us, but it just didn't work out like that, and in the end, we didn't bother, we stayed away from it.' (Christian)

Emerging from the findings are differences in expectations for the actors in the network, specifically subcontractors compared to directors. For example, the commitment expected from subcontractors through qualification controls, quality controls, and vetting processes, for Tom it is experienced in terms of a highly selective and exclusive industry, with the unanticipated controls even causing a firm's detachment from the network. Christian's experience shows that once one had passed the stringent selection process the same level of commitment was not reciprocated by the Developer as stated in the policy documents (set out earlier in the chapter). As a result, tensions arose due to the inconsistencies experienced in which Christian had to employ additional people even though that was not stipulated in the contract. At the same time, it also shows the precarity of the construction industry and volatility (Harvey, 1989) that can result in the Developer having to make the necessary procedural changes as situations unfold. In turn, fluid or flexible labour arrangements are organised by the Developer. Harvey (1989) explains it as a way for large firms to lower their costs. Volatility may also be associated with the lack of skilled labour experienced in the construction industry, for instance, through

the words of Tom, it gives rise to issues of competition and poaching. Consequently, those feeling the most impact are the T2 and T3 subcontractors as the evidence shows.

5.2.1.2 Unintended Consequences of Policy Control: Intentions to Leave

The data reveals that policy accountability controls (that include material actors) intended to make the contractors feel safe and secure, can have adverse effects. Emerging was a sense of insecurity due to the inconsistencies experienced and through frustrations of bureaucracy associated with the Developer, in the everyday workings of the infrastructure project. Like Christian, other T3 subcontractors were also keen to leave:

‘Yeah, certainly the logistics, and then the politics...! I was glad to finish there and get out of it in the end, as it was becoming more and more difficult to operate there. So, I don’t really envy anybody, and we would stop and think long and hard, and certainly we would take more work in there, but we’d have to pile a load of money into that for the messing around factor. But yeah, at the point that we were finished, I was pleased that we were detangling, coming away to be honest.’ (Curtis)

The ongoing operations and procedures of the project in which instability and contradictions are experienced emerged as a source of frustration. This was expressed as:

‘I’m sure that people right at the top [the Developer] would not like to hear that, but it is a difficult site to work at, logistically and socially, I think. You know, the guys... you’ve got to be a certain type of person to work there. Certainly, there were opportunities there for senior people to move there and take roles – you know, they’re quite open about those, ... but it wouldn’t quite be for me.’ (Curtis)

In terms of bureaucracy, it is perceived as activities undertaken that are associated with internal politicking whereby certain policy agendas are promoted through powers of authority. For instance, the suggestion of a *certain type of person* appears to reinforce the statement made by the Developer earlier of the *right people* needed for the job. This is further suggestive where he

argues that this type of environment attracts a particular type of person who is well suited for it. Moreover, from a social aspect it would also require one to have to live and work in such an environment. In terms of attachments, either one feels attached to the network of the NSIP or detached from it depending on the type of individual.

5.2.2 Health and Safety

The findings reveal a *nuclear safety culture* is enacted through health and safety policy controls. Tracing the audit trail from the point of origin (the Developer) to the lower tiered levels reveals a process showing the effects generated or the knowledge produced through the unfolding attachments and detachments in this precarious and complex environment:

‘We have developed a ‘Nuclear Safety Culture Policy’ [such as] strong supervision, stop when unsure, questioning attitude, personal responsibility, organisational learning, build as designed, record as built and trust, which outlines the key values and behaviours that we as the client will operate to.’ (Developer Policy)

This illustrates how the policy actor is once again enrolled in the form of a document and is laying out the Developer’s agenda of instilling a *nuclear safety culture*. By doing so, the Developer is building a framework for other contractors and subcontractors to follow. What emerges is the setting out of an agenda that will then be transferred to the lower tiered levels.

This framework is established not only for the contractors in which behaviour and responsibility is emphasised, but also for other material actors that include components, equipment and systems in order to ensure specific nuclear safety and quality levels are maintained. As such, firms are required to keep and provide records to demonstrate their compliance. This record keeping process is a contractual arrangement, to enable the material surveillance, traceability, and verification activities that are performed by the Manufacturing Surveillance and Inspection Teams (human actors), which can either be internal bodies (organised by the Developer) or external bodies known as conformity assessment bodies (CABs). Introducing these controls not only limits the risk of failure, but also, more importantly, limits the possibility of safety risks.

While this is common practice to have systems and procedures in place that can be audited, what is significant here, however, is that even on a nuclear NSIP the focus is on ensuring the mundane, the ordinary and basic quality are delivered to an acceptable standard. The fact that this needs to be reinforced is one of the surprising aspects of the research. For instance, as the Developer pointed out, by preventing the installation of substandard components, equipment, and systems, they should further minimise the risk of the work on the project having to be performed again, as seen in the case of the concrete job. Accordingly:

‘These arrangements should enable the identification, segregation, control, recording, and reporting of non-conformances against the processes, procedures, or specifications.’ (Developer Policy)

Ultimately, such construction design and management regulations (CDMs) are quality controls that are intended to mitigate accidents and incidents. In this light, health and safety become forms of security, ensuring that the right measures are put in place, as well as enabling accountability. What becomes evident is that process creates security for some, for others insecurity is experienced which reinforces alignments between the Developer and the T1 contractors. As shown previously with Dan in his discussion on the concrete job (seen in section 5.2.1), this may be further demonstrated by another T1 (MNC) contractor who emphasised the obligation of the subcontractors to get the design and the construction right:

‘All these functions have specific responsibilities. And they have got a duty to design correctly to reduce opportunity for incidents during construction, and for accidents and incidents during maintenance use and final dismantling.’ (Charles)

The alignments that are made between the T1s and the Developer are thus reinforced. This may also point to an “us” and “them” distinction that Carsten (2000, p.152) refers to, similarly discussed in Chapter 6 in terms of belonging. However, in this instance, the network is showing alliances being made through health and safety processes to mitigate risk.

The audit actors (that include the ‘CABs’) appear fundamental to the whole process, ensuring appropriate quality control activities are passed down through the network (from the Developer

to the T1s and then to the T2s and T3s) reinforcing auditability, traceability and control and shape the relationships that emerge. For instance, the contractor for the concrete job was required to rectify their work as it was subject to non-conformance controls and rendered insecure. This reveals that relationships can be categorised in terms of for those who do not conform become segregated and subjected to further controls to ensure compliance. This shows the performativity of the network in which heterogeneous elements actively create alignments while also “cutting” connections (Strathern, 1996, p.523) with those deemed as non-conformists. In this way they become detached from the network. As stated:

‘The arrangements should also include preventative actions to eliminate the cause of potential non-conformances.’ (Developer Policy)

In this respect, eliminating instances of non-conformance will ensure that the desired *nuclear safety culture* is in place:

‘...it is the culture of the organisation that will ultimately define how rigorously those standards are implemented.’ (Developer Policy)

However, the culture of control is further reinforced by the creation of a social network within a network whereby common ideals and values are followed. Actors are creating and generating their own social culture through collective representation, what Desmond (2014, p.568) refers to as “group culture”. Again, this performative action is crucial in forming attachments (Yuval-Davis, 2006), but also supports the understanding of that health and safety culture with an international workforce (who are culturally different). Thus, communication challenges were experienced with the workers on the team who were mainly Portuguese:

‘So how do we embed that standard and that safety culture into our international colleagues, and how do we bring them up to standard and make sure that we communicate with them effectively, give them the clarity that they need, translate documents... That’s always a challenge for us in construction, because literally, if we can’t communicate verbally or individually, then we have to find other ways of making it work, because we’re expecting people to work to a standard.’ (Charles)

As Desmond (2014) argues, while culture can generate stable relations, “collisions” may also occur where individuals are “dissimilar” to one another (p. 568). Dan also discussed the challenges of instilling a *nuclear safety culture*, this time however, exacerbated by cultural differences:

‘The Belgian guys that we’ve received coming to the site were Jacks of all trades, it was difficult to get through to them... For us, it was one man, one job, one task, and that’s it. But it works a little bit differently in Belgium.’ (Dan)

Other implications arose whereby comparisons were made between international health and safety standards and regulations and those of the UK, with many foreign companies claiming to adhere to ISO (International Organization for Standardisation) standards. As argued, adhering to those standards was often not the case:

‘So, the British standards versus the international standards – it’s something that we talk about a lot in our industry, particularly when we bring the foreign labour to site. So, like I said, we’ve got a heavy Portuguese workforce, who worked in the UK before, but never worked on a site like this before...But these things should have been taught to them on other sites, and it’s not just because we made a rule up, it’s law.’ (Charles)

This shows how foreign workers are out of alignment in the network. Moreover, there are constraints in imposing health and safety rules and establishing a nuclear safety culture where there are multiple regulations at play as exposed by an international workforce. For example, because construction work is often fragmented, involving a great deal of mobility, the necessary knowledge is gained through experience and mobilised in practice. As such, it is not fixed to one particular area, but is rather “learnt, adapted, modified and engaged in practice” over time (Pink et al., 2010, p.653). Generally, in the same way that a social society enters a social space with its own preconceived norms, workers may arrive on site with their own sets of beliefs, values, norms, and assumptions, which in turn will inform their understandings of the policies and other requirements.

Not only does a nuclear safety culture generate effects for the international workers and create non-alignments in the network, but there is evidence of it with the local subcontractors too. For example, concerns were expressed in the several induction rounds required, resulting in unanticipated time spent and the consequent financial implications:

‘...so, they’ll quite happily.... There’s a philosophy down there that it’s not about money, it’s about safety, and that’s fine but when you’re on a fixed price.... If you’re there on a day work, you know, paid by the hour, and then it doesn’t really matter to you. But if you’re an engineering company like we were, on a budget, and expending money, burning money, it does matter. Now that’s not to say that we take health and safety or anything else lightly, but they will happily spend days and days of your time and your guy’s time when you haven’t really got it.’ (Curtis)

With this *messing around* factor, again, this clearly shows how the financial hits taken by contractors create precarities. Christian, a T3 subcontractor further explained:

‘Unfortunately, for us, it wasn’t a pleasant experience at all. I feel that the other contractors I spoke to also had similar stories on that site. I don’t know where to start, to be honest – we lost quite a lot of money up there with regards to downtime’ (Christian)

The desire to implement a *nuclear safety culture* has resulted in workers feeling singled out and excluded, to the point where they would rather not return. For example, Christian calls attention to other contractors with “similar stories” and in doing so, he creates new alignments. For Curtis, financial security becomes threatened as routines, trust, and social relationships all have huge impacts on being able to feel physically as well as ontologically secure (Fellini et al., 2007). Moreover, they also have huge impacts on attempts to establish a lasting sense of self, through consistency in both cognitive and biographical processes (Kinnvall and Mitzen, 2020). However, from the developer’s perspective, by contrast, such a culture allows for identification and segregation, in order to enforce conformity and establish control. Nonetheless, when the

policy is enrolled as a preventative action, it affects all workers, regardless of whether they have conformed or not.

5.3 Chapter Summary

This chapter has traced the network as related to the Developer, in their capacity as the winning bidder to support the construction of a NSIP. The chapter has highlighted how the Developer was tasked to deliver on those sustainable energy commitments through contractual and accountability obligations or face financial penalties. In order to deliver on commitments made, the Developer has put tight regulations or controls in place to ensure security not only for Government, in terms of economic security, energy security, and environmental security, but for their own securitization (financial and internal political security) purposes too. While the construction industry has always been associated with complexities (Dainty et al., 2013), the recent increased changes in political, environmental and economic contexts due to for example, Brexit, the pandemic, and the ongoing war in the Ukraine, the level of infrastructure complexities has significantly elevated securitization challenges.

The chapter highlights how policy controls are transferred down to the different tiered levels, from the Developer to the T3 subcontractors, with both the T2's and T3's mostly impacted by its effects. ANT provides a perfect frame in tracing the audit trail, firstly through accountability and qualification policies, and secondly through health and safety policies, where the everyday lived experiences of the construction workers have been explicitly demonstrated throughout. Moreover, by using ANT as a theoretical framework to explore relationships, the chapter has revealed how these policy controls are enacted through the different contractor and subcontractor tiered levels. What emerges are instances of alignments been made primarily between the Developer and the T1 contractors. These alignments are the result of performativity activities between heterogeneous actors to ensure rigorous policy agendas are met – Hence safeguarding their own security while holding others responsible. In this context, where precarities are experienced in the network, it has also shown instances of resistance or even failed networks occurring.

These instances of connections and disconnections or alignments and non-alignments may be seen in the accountability and qualifications section whereby the T1 contractors (MNC) stress the importance of being suitably qualified. This is achieved by enrolling accountability actors in the form of documents and vetting procedures. However, the precariousness of the network is seen when policy effects (by both human and material actors) at the T2 and T3 levels of the construction hierarchy start to emerge. These experiences generated implications of disconnection from the network with the T3 contractors wanting to withdraw from the project altogether due to financial risk. Other discrepancies were revealed in terms of processes involving qualifications, resulting in questioning the extent of rigour and its validity as it made access very difficult. This was especially significant for one particular firm as the unanticipated time it took to get all the paperwork approved resulted in actors becoming insolvent, and what followed was the effect of being cut or detached from the network.

Regarding the health and safety section, the conformity actors played an influential role in once again generating alignments and attachments between the Developer and the T1 actors. While it has been used as a symbol to represent a strong and united organisational culture, it has also been implicated in cutting (Strathern, 1996) others from the network such as the subcontractors involved in the concrete test inspection procedures. Other precarities involved cultural differences and practices of a predominantly international workforce. In addition, regarding ISO standards, an ubiquitous platform was used in the implementation of safety standards to the international workers. This can be compared to the understanding of ubiquity that Strathern (2000) sets out in Chapter 2, whereby values and practices are rendered universal and applied across the board in the name of accountability. Thus, in all these instances it has shown how relationships have been shaped through the effects of policy controls.

These are just a few of the participant examples amongst others that demonstrate the precarities in the network. However, the findings reveal that while some actors become detached and form attachments in alternative networks, simultaneous alignments and realignments or attachments and re-attachments are generated with others. Nevertheless, each of the actors are performing their own agendas. For example, this may be seen with the

Developer actively performing and creating a type of culture. Whether it be in generating the right kind of people, and the right nuclear safety culture, in every respect, the Developer who is aligned with the T1 contractors are, as mentioned, securitizing their own positions in the network. With it being primarily evident between the two actors, it can also include all other networks who are aligned with the same ideals. However, language actors may also generate contrasting effects. While it re-enforces alignments in some instances, in other instances it generates a sense of disconnect with phrases used by T3 subcontractors such as *closed shop*, and *you've got to be a certain type of person*, as the impacts are felt. In essence, while precarity is kept at the lower end of the construction hierarchy, security can be maintained for the Developer and the T1 contractors, causing other subcontractors to experience insecurity, as well as ontologically insecure. In the following chapter these understandings are further explored in terms of mobility and migration, kinship and belonging, through the concept of felt obligations that focus on obligations to family, community and work.

CHAPTER 6: FINDINGS - FELT OBLIGATIONS

6.1 Introduction

Building from Chapter 5, the following empirical sections further illustrate humans (stakeholders) as significant actors but cast light on the importance and involvement of nonhuman actors in various ways, for example, in the use of *darts*. The chapter discusses the second higher order emergent theme of felt obligations to reveal the individual felt obligations by internal and self-regulatory processes, the obligations, thus focussed on family, work, and the local community. These are brought about through issues concerning mobility and migration, and belonging and kinship, that emerge through the different tiered levels. New meanings are created through the various kinships, alignments and non-alignments that are formed in the network. Through applying an ANT framework, there is no explicit differentiation between the different elements, but rather what it shows is the relationship between them. Moreover, what is emphasised is how these relations are formed in the network, or fail (due to precarities experienced), including the agendas that are carried out through processes of performativity (Law, 2019).

To further highlight the precarities, contradictions and felt obligations of the actors, summary tables are provided, including the key narrative entitled *The Golden Egg* that represents the felt insecurities of the subcontractors. This is followed by an ANT map that focuses a lens on the connections between the existing relationships.

6.2 Felt Obligations

Through tracing the network trail and exploring the lived experiences of the contractors and subcontractors involved in the NSIP, what becomes more explicit in the analysis of the findings is how family, work and the local community are implicated within the network, including the worker and Developer obligations to them. For instance, a subcontractor's felt obligations may

include their obligations to an international workforce in making certain proper communication is achieved. A further example is the Developer's obligations to local hotel accommodation providers in ensuring they are included in the benefits obtained from building a NSIP in the area. Also emerging is how the ontological aspect of security is brought to the fore with the subcontractors and local community looking to maintain this sense of self, and continuity (Kinnvall and Mitzen, 2000; Shani, 2017). As such, ontological (in)securities become more relevant when exploring issues of mobility, migration, kinship and belonging. **Table 4** provides an overview of felt obligations that emerged from the findings and highlights the differential impacts between the different actors. Drawing on the previous example of the Developer's felt obligations to local hotel providers, the differential impacts, for instance, highlight the challenges when commitments are perceived as been broken by the Developer. These impacts will be explored in more detail throughout the chapter.

Table 4 ***Felt Obligations and Differential Impacts Between Actors***

	Topic	Tensions	Differential impacts				Impact of ANT
			Developer	T1	T2	T3	
1	UK Economic benefits	Variable access	Confirmation statements made on the largest benefits benefitting UK supply chains	Largest percentage of the workforce is not UK based. Therefore, benefits also felt overseas	Questioning validity of statements made based on evidence from map	Benefits not felt, but rather loss of income experienced	In some instances, in the network attachments are created and in other instances, controversies
2	Future contracts	Variable guarantees	Ensuring continuity in the aligned supply chain for future projects	Major benefits felt on current projects as guarantees made for the future	Prospects are not guaranteed as precarious conditions are experienced	Confirmation that working on NSIPs is not viable, but rather security is guaranteed in less significant future projects	Kinship networks are performed while simultaneously actively creating detachments
3	Bureaucracy	Volatile	Carrying a duty of responsibility and accountability to Government	Continuous reinforcement to ensure alignments are maintained	Treating Developer with certain scepticism	Developer perceived as playing internal politics, creating insecurity and ontological insecurity	A nonhuman actor that generates differential effects
4	ISO Standards	Standardisation	Due to movement of people and materials it is important to maintain ISO standards	Challenges experienced in communicating ISO standards to multi-national workforce	Equivalent skills are lacking in the UK, thus implications of skills gap	N/A	ISO standards generates continuity in the network, as well as controversies associated with values, ideals, and cultural contexts
5	Mobility	Felt obligations to family, work, and community	Creating space for mobile workforce to meet obligations through accommodation sites	A sense of obligation to family, work and community is created - reciprocal arrangements	N/A	Obligations to family, work and community are more secure and ontologically secure in other places	Heterogenous actors are mobilized to ensure obligations are met

6.2.1 Mobility and Migration: Globalisation, Resourcing, and the Lived Experience

6.2.1.1 Creating Precarity

As we saw in the previous section on the differential challenges experienced by the different actors, here we see how mobility involves the large-scale movement of people, objects, capital, and information through transnational spaces that impact on everyday life (Erikson et al., 2010). The findings showed that mobility can be differently accessed and experienced (Urry, 2007), for example as seen in the effects of the ISO standards on the Portuguese and Belgian workers. This is important as before understanding the experiences of mobility and migration in NSIPs, the findings show one must first explore the who and how of access. In other words, who gets access, and how does one obtain access to the network.

In order to meet their contractual obligations, the Developer has secured an extensive network of contractors and subcontractors, consisting of multinational firms and smaller national and local companies. They acknowledge the largest percentage of construction costs, that include the procurement of people and materials would be spent within the UK, with the largest proportion of workers coming from local regions:

‘This multi-billion-pound national infrastructure project – our studies show that 57% of construction costs can be spent in the UK, [and] 64% of the construction value of the project will be spent with UK companies. [Moreover], apart from the local workers at the Somerset site, the largest group of employees come from Wales.’ (Developer Policy)

Despite these claims, it was noted by one MNC that previously when the work first began, the workforce was equally divided between local and overseas workers. However, that soon changed as the work progressed with most of the workers now being from overseas rather than from the UK:

‘...our workforce has pretty much more or less been 50/50. So, 50% British and 50% foreign workers ... Now we are about 75% expats, and about 25% British workforce. So, the majority of our workforce is Portuguese.’ (Charles)

The composition of the workforce was illustrated together with additional information on who benefited from the NSIP on an interactive map:

‘Want to know more about the [NSIP] contracts that have been awarded in your area? Use our interactive map to explore our supply chain across the UK.’ (Developer)

The validity of the Developer claims was however questioned:

‘There’s a map that [the Developer] have sent out themselves, showing how they are benefitting local companies. It’s like a map of the UK. Some of them are not local companies to be honest with you. But they’re trying to demonstrate that they’re creating local work.’ (Tom)

Emerging from the analysis are the uncertainties associated with accessing the network and who the beneficiaries of the NSIP are. Participant accounts appear to contradict the Developer’s claims of an equal playing field. For instance, it was stated that the deciding factor on whether one is awarded a contract would be primarily dependent on compliance during the vetting stages, on who can supply them with the skilled labour and materials they need, yet their own policies suggest the locality will be unable to supply the NSIP:

‘The detailed verification and quality control required for components that will go into a nuclear power station are unique and there are relatively few companies in the UK that already have the mechanisms in place to provide this level of detail.’ (Developer Policy)

While the Developer has aligned with overseas networks and firms who can provide the necessary resource needs (to meet their sustainability and contractual obligations), the lived experiences of the local subcontractors who have been successful in getting contracts introduces a new dynamic. This is significant because the external network appears to place

even more pressure on those subcontractors on getting *the job done*. In this way the subcontractors are held responsible:

‘There’s a massive skill shortage in this area, as far as experienced pressure vessel fabricators go, and which is definitely difficult to overcome sometimes. We’ve had to overcome this by bringing in fabricators [from the] outside, to be honest, to keep the progress going, to prove that we can get the job done.’ (Tom)

This illustrates how *getting the job done* places pressure on the subcontractors to prove their capabilities and avoid being cut from the network and replaced by other actors. The effects of this precarious, insecure network are particularly acute and emerges as a recurrent theme for the contractors at the lower tiers:

‘Certainly, there is pressure to use local electricians, local engineers, but finding them is a problem. We always struggle to find good guys, you know. We are today looking for men at other sites, it’s an ongoing process, really.’ (Curtis)

Due to the need for skilled labour, and the urgency associated with the NSIP for highly skilled contractors the rewards follow, they are both desired and well paid and encourages instances of poaching within the members of the network as explored previously in Chapter 5, section 5.2.1.1. This adds further to the pressures in the network and adds significantly to the precarity of the subcontractors lived experiences as increased hiring costs may not be factored into the contract.

Anger and resentment were expressed when the question of the NSIP benefitting the local economy was discussed:

‘[The developer] is quite ruthless the way they deal with... we believe now that they actually use a lot of contractors from France, which obviously, they’re French. So, was that the ploy all along, bringing them in? Because they use their other nuclear sites. I think everybody thought this was going to be amazing for the economy, but I think it hasn’t had any effect. I think somebody needs to be brought accountable for it, and

answer some questions... why are we feeling this way, you know, and why is it not produced? And they would most probably bring some stats up and say, “Well, you know... we’ve brought in about 10% into the [local] economy.” Unless you speak to someone with some good experience of it, it’s just a lot of negativity and it’s not great.’ (Christian)

This has highlighted feelings by the T3 subcontractor of not belonging, highlighting their ontological (in)security through the emphasises on how the developer has formed alignments with overseas networks and the subsequent economic securitisation of overseas networks. This is extremely difficult for local subcontractors with the knowledge that the Developer will do what it takes to maintain the network and their own place in it. In terms of the procurement of the supply chain, Jamie, a key supplier of materials to critical infrastructures also emphasised the precarities felt by the subcontractors regarding the lack of local economic benefits. Moreover, like other participants, he too highlighted the contradictions of the Developer:

‘[This nuclear power station], a great example of public procurement, in my opinion, gone wrong... So, it’s a Nationally Significant NSGI... whatever it is... project..., which is great for the main contractors who are building it, ... and politicians will say, um... because they’re paid in pounds, that there’s 99% local content. No! you have to ask the next question, just because you’re paying the main contractor in pounds, where’s the money go after the main contractor, and where is that money going? Because until it reaches the bottom of the supply chain, and that bottom isn’t a UK-based manufacturer or material, how is it benefiting, um, social... the locality, etc.’ (Jamie)

The economic precarities are again highlighted and corroborated by the local subcontractors working directly on the project:

‘We worked alongside another electrical company, and he lost a lot of money up there, and we’ve been hearing these stories from quite a lot of people within this area, you know. People are refusing to work there because of bad experiences, and we’ve put some contractors off from down this way on even going to the place. It’s a

real shame, because we thought it would be ... what you call a “golden egg,” thinking it was going to be amazing, it was going to be 10 years' work, it was going to benefit everybody in South Wales, Southwest region, and I've got a feeling that isn't the case.'

(Christian)

Working on a NSIP was initially considered as the contract of a lifetime, however lived experiences reveal a range of precarities experienced by members of the network, especially contractors at the lower tiers of the network. This had the effect of actively discouraging potential members joining the network to prevent other local networks the same *negative* experiences. This suggests that as a result, contractors aligned themselves with other networks in other places. Further detachments from the network arose from financial precarities they experienced. Contractors expressed their intentions and desire to leave the network and with the implication of detachment from the network. This may be compared to Latour's (1999) notion of a black box, whereby on the outside, all the technical and contractual processes (i.e., policy strategies) are seen to be invisible and part of the process of a NSIP. However, by unpicking that black box the internal workings are made visible in which subversion is the lived experience.

Drawing on Christian's experience highlighted in the above extract, and those presented previously in Chapter 5, the following *Golden Egg* narrative summarises the general sense of the precarities (and insecurities) felt by the subcontractors. As with *The Concrete Job* narrative presented in Chapter 5, together they capture the holistic story of the T3 subcontractor through the ANT lens as seen in **Figure 5**.

The Golden Egg

Everybody thought it was going to be a “golden egg”. The Developer promised ten years of work on the NSIP. This meant dependable and predictable work that would allow local businesses to expand at relatively low risk. In the contracting world this was a rare opportunity and could potentially put a new contracting business like Christian’s on the map.

This was the view, that is, when Christian first started out on the project.

After many months of preparing and submitting the necessary paperwork Christian’s engineering firm was approved as a T3 contractor on the project. But the feeling of belonging to something nationally significant quickly dissipated as incidences of precarities began to take their toll. For Christian, it was the inconsistencies that they routinely experienced when unexpected changes were made to their contract.

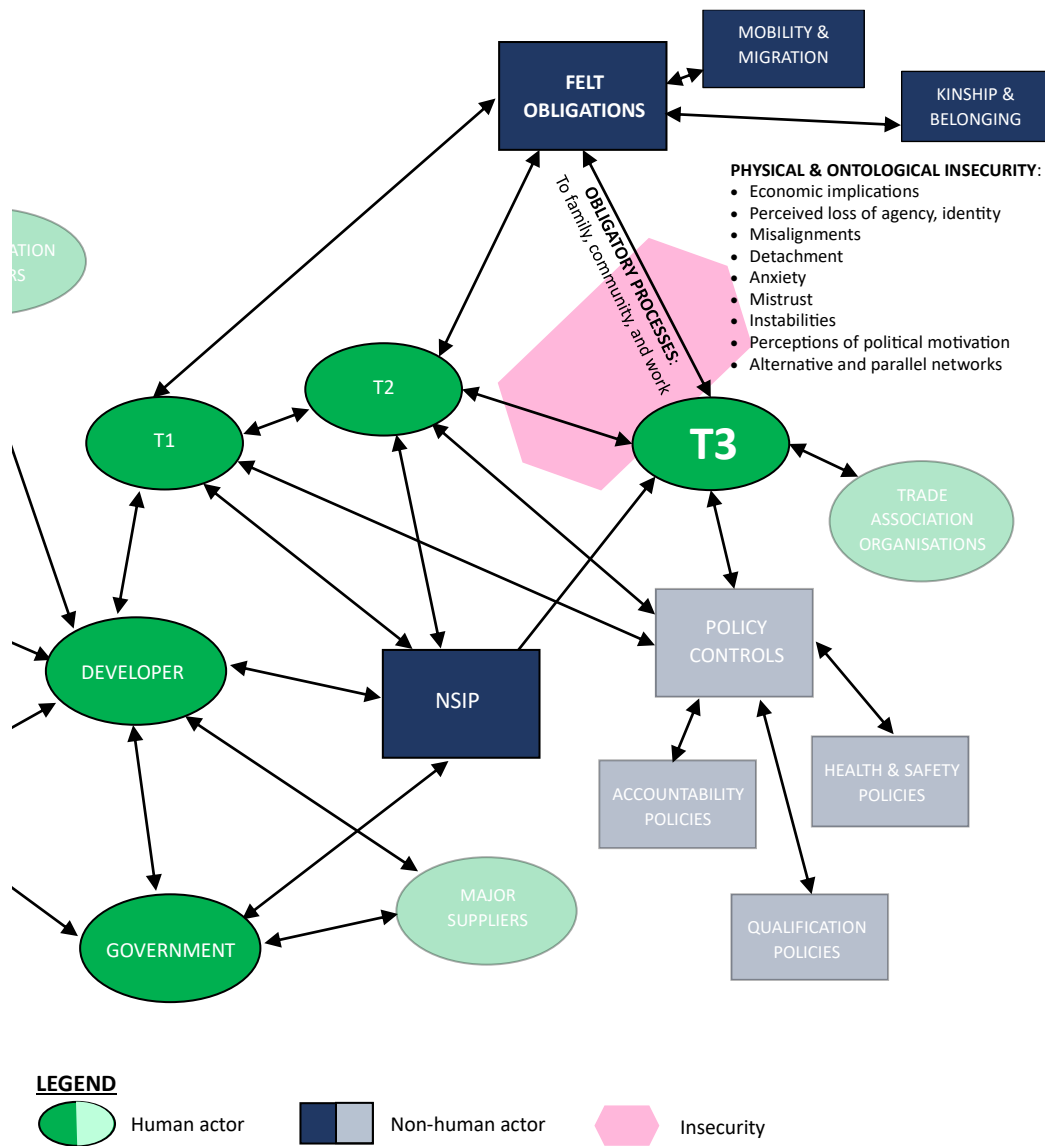
Christian truly believed that once they had passed the vetting stages and got processed, things would get easier, and this would pave the way for more work. He soon discovered, however, that they were far better off working on smaller projects with more stability as it ensured both worker security and ontological security to be felt.

Christian remembered an incident involving an agreed task, but changes were subsequently made with a request of a further twenty people needed for the job. Not only did it go against the vetting processes of the project, but the allocation of employees had already been organised according to the original requirements. This meant that each of the twenty additional employees had to be subjected to the prolonged vetting process and the cost overhead had to be borne by the T3 firm.

Daily induction procedures are a routine occurrence, but they are especially stringent on nuclear projects. On a different occasion, somebody from another T3 firm had not been wearing the correct safety boots and everybody was subjected to further safety briefings. Firstly, Christian couldn’t understand how that should have involved his people. Secondly, given that his firm were working on a site completely unrelated to the nuclear project itself, the need for further safety briefings was incomprehensible.

The “bad experiences”, as Christian put it, kept others away from the project as word quickly spread of the economic losses sustained by those already working there. When remunerated by the hour; in an industry where competition is rife and the profit margins are very thin, you cannot spend unacceptable amounts of time dealing with unrelated matters. For Christian and his T3 contracting firm, the impact was always going to be financial. The economic opportunities should have been immense for Christian and other contractors from South Wales and the Southwest regions. But this never materialised, and one could sense his visceral disappointment on the lost chance of being part of the benefits that the Developer had once promised.

Figure 5 *The Golden Egg ANT Diagram*



The contractors' lived experiences appear to be felt in wider networks. The following extract reflects a local engineering organisation's view on employment opportunities for locals:

'It's only about half a dozen, I believe. And then they would be tier 2, or maybe even tier 3. It's not a very large percentage from the Welsh regions. I just don't think there's been a huge appetite, or whether they don't meet the criteria, or maybe they just don't want to go work over there, I don't know.' (Michaela)

Emerging from the data are examples of how subcontractors, their extended networks and other indirect networks appear to align views. This shared consensus reflects how access to working on the NSIP lies mostly with multinational and overseas companies, and the enrolment of heterogeneous actors and performativity reflects how one gets access. Emerging from the data is also a sense of what type of person may work on a NSIP:

‘Yeah, and you’d find it interesting sitting in the canteen there, the range of accents you hear... the local workforce pool is just not sufficient to resource that. So, you’re sat there, and, you know, there’s tables of Welsh guys, Scottish guys, Irish guys, all sorts there from London and from everywhere else, because that is the only way they’re going to find those people, really. It’s that kind of job that attracts the right mind and the right kind of individual that will follow those kinds of jobs. So yeah, what you’ll see is lots of people like that.’ (Curtis)

This again highlights the transient workforce and its association with the lack of local skills. By reference to the *type of person* or *people like that*, special attention is drawn to a category of contractors who are willing to work on the NSIP as opposed to those who have either decided not to align themselves with the network or detach themselves completely from it. Moreover, by drawing on his statement, may further point to this disconnect felt due to perceptions of a bureaucratic (internal political) undertone. This may be suggestive of previous statements seen in Chapter 5 (section, 5.2.1.2) of how it *takes a certain type of person* to work there, and how he was happy to leave once the job was finished. Essentially, this may suggest a sense of disconnect with those who are involved in the project and from the project itself, thus emphasising a sense of not belonging.

In the context of mobility and migration, and most importantly, resourcing, what emerges once again is the Developer’s priority to determine *right kind of person* and the alignments needed to get the job done. To achieve this, the Developer has maintained their international networks to ensure they avoid the impacts of skills shortages. T1 firms (MNCs) often have leading roles in these international networks:

‘We have a handful of people from Belgium, that’s senior people.... So, the senior people are from Belgium, um’ (Charles)

Also emerging is a sense of belonging for various actors aligned with the network, a type of worker/s willing to engage in performance activities to achieve their goals, a certain type of person suited to this environment or network. In contrast, not belonging is experienced among those who feel a sense of disconnect due to precarities felt such as bureaucracy and contradictions and that they are not *the right kind of people* or suited for that network. As such, tracing the network shows how a sense of belonging is highly subjective and reflects the actors’ lived experiences. This includes the Developer, T1’s, T2’s and T3’s, and those indirectly involved in the project.

6.2.1.2 Working with Tensions

Given the nationwide skills gap (Lorimer, 2022) and the shortage of qualified workers on the site, the Developer had plans to hire another 1,700 workers over the following year, again committing to hiring a third of the employees from local areas (Harvey, 2021). In preparation for the NSIP the Developer had invested financially in educational schemes with local colleges, with a view to narrowing the skills gap. Further evidence is also demonstrated in the data:

‘Over the coming months we will also be launching new training programmes and opening new facilities so that everyone can make full use of the future opportunities available.’ (Developer)

Efforts were also made to facilitate collaborations between firms in the UK and firms in France:

‘... [the Developer] is also facilitating meetings between UK firms and their French counterparts who are experienced in the nuclear industry. By encouraging collaboration of this sort, the company hopes to create a legacy from this project of UK firms being ready to compete for other nuclear contracts in the UK and around the world.’ (Developer Policy)

From an ANT perspective, in recognising the skills gap challenge, the Developer as not only recognised the skills problem, but has also offered a solution, highlighting Callon's (1984) notion of *problematization*. By tracing the network, we see the Developer has achieved this by enrolling educational schemes and colleges, that include locations, buildings, material supplies, formulations, educators, and students. Thereby, engaging with heterogeneous actors who could offer a solution. What is interesting here is that alliances are formed with extended networks overseas with an educational agenda as priority, for example, linking with French firms with nuclear experience although the success of reducing the skills gap will depend equally on these alliances and processes of "interessement" or interventions by heterogeneous actors and their "enrolment" (Callon, 1984, pp.196-224).

Despite the Developer actively performing in those networks, including enrolling other material actors such as news reports and media to demonstrate their efforts and commitment to the NSIP, tensions and contradictions remain:

'They're building one of the largest nuclear power plants in the UK, but they're using French design. I mean this is a long project, and I'm not involved heavily, but what I do know, is that the design of the nuclear, and the reactor, and all these things..., they've not said, "Oh, let's look how the capability of the steel supply chain, or the concrete supply chain, in the UK, and build our project like that." No, they've said, "What do we do in France.... we'll copy that in the UK, doesn't matter what the procurement looks like.'" (Jamie)

To further demonstrate a general sense of tensions generated in the data, **Table 5** provides a summary of the contradictions. The table highlights selected examples extracted from Chapters 5 and 6:

Table 5 **Summary Table – Contradictions**

	Topic	Expression of view / facts	Contradiction
1	Benefits of accommodation providers	When the NSIP was first announced to the local accommodation providers it was promised that they would benefit from the project as they would be the main service of accommodation for the workers	Subsequently, large campuses were built on the field site to house the workers. Moreover, local councils approved and facilitated the construction of hotel chains, preventing local private hotels from benefitting
2	Family attachments	According to a local B&B owner, workers are seen as having no family. Rather, they were compared to oil rig workers who spent most of their free time getting drunk	Most of the contractors interviewed were family men. Some even brought their families with them. Others planned to be with them whenever they got the opportunity
3	Workforce procurement of local contractors	It was stated in the policy documents that the largest portion of the workers would be coming from Wales	As reported by the participant trade organization who managed the South Wales regions, that was not the case. Accordingly, only a small number of contracting firms came from Wales
4	Reciprocity and commitment	As was demonstrated in the Developer policy documents, an emphasis was placed on commitment. A commitment by them (the Developer) and at the same time the expectation of a commitment by the workers	Due to the inconsistencies and contradictions experienced resulting in insecurity experienced, it was viewed that a commitment by the contractors was not reciprocated by the Developer. For example, in the amount of people requested to perform a particular job
5	Equal playing field / access	Policy statements suggest contracts should be awarded primarily based on compliance in the vetting stage. This statement similarly compares with the previous assertion that most of the contractors would be UK based	The declaration of the statement contradicts the notion of access as further statements by the Developer suggest that few companies in the UK meet the verification and quality controls in the components needed for a nuclear project, and therefore, look to France for those requirements

The NSIP is located within a construction industry that is highly fragmented and volatile (Dainty et al., 2013; Barry, 2020), a context already exacerbated by existing precarities such as Brexit and the global pandemic 2019. Tracing the network, we see evidence of the rising costs, revised policies and trade agreements, time delays and crisis in the procurement of labour and materials reflect the prevailing conditions of the industry. Against this backdrop the Developer is held accountable at the top of the network yet will pass responsibility to the lowered tiered levels. By working in this way, the very security that is promised by the Developer is undone and replaced by insecurity with the precarious conditions having the most impact at the lower levels of the hierarchy. As such, the network is rendered fragile and unstable.

Industry suppliers indirectly involved in the current nuclear NSIP reflected on the fragmentation of the industry and how unanticipated challenges may have a ripple effect:

‘It’s very fragmented, very diverse. It is a big challenge for [Developer] to bring into fruition what they desire to bring into fruition... You can imagine in terms of the construction hierarchy that you’ve got the developer up here and the investor and the main contractor, and then you have various contractors doing various pieces. Then you have possibly a trader of some sorts, or supplier, or stockist, or fabricator, and then right at the bottom you’ve got steel supply... So, after 2 or 3 Tiers, and you get down towards the fabricators and the stockists and the actual suppliers, a lot of the contractual stuff at the top has dissipated away.’ (Rusty)

The general fragmentation of the construction industry is also be associated with mobility and migration of subcontractors:

So, the majority of our work is in the UK, but we have a number of clients we will work abroad for. That particular client tends to be longer reach. We’ve another one, and in the last 18 months we’ve done work in Spain, France, the Netherlands, but they’re smaller-value contracts, they tend to be a month’s work at a time. But certainly, the client in Russia that we do the core processing or recycling plants for are large-value contracts.’ (Curtis)

Fragmentation allows for a more fluid and flexible labour market and mobile supply chain, thus lowering the costs for the Developer (Harvey, 1989; Fellini et al., 2007; Pink et al., 2010). However, unanticipated, or increased costs are shifted to the subcontractors involved thereby increasing the cost of production resulting in less investments made on researching the social effects of the industry (Dainty et al., 2013). In many instances, this fragmentation and mobile environment and its effects have been the cause of anxiety or ontological insecurity for many subcontractors, but in other instances it has also allowed for future possibilities with national and international networks working on a project, as will be discussed in the next section (Barry, 2020).

6.2.1.3 Creating Positive Impacts

Despite the difficulties that some of the participants had encountered in terms of the skills gap, the ensuing competition, and resulting lack of economic benefits, for others, the NSIP had not only provided job security, but the experience had also contributed to their ability to secure work on other projects. Furthermore, the opportunity of having worked on a NSIP has strengthened a sense of obligation not only to work, but to family and the local community. For instance, this was emphasised with the sentiment been repeated several times:

‘Yeah, I’m immensely proud of having been working on there. Very immensely proud of having been working on there. Um... because it’s.... it’s ...personal. Personally, for personal reasons, it’s great on the CV.’ (Dan)

The NSIP creates economic security for the T1 contractor (MNC), protected from the insecurity. this is demonstrated by Dan’s sense of pride, which in turn generates a sense of self and continuity (Kinnvall and Mitzen, 2000; Shani, 2017) in his everyday life, resulting in a feeling of belonging. Similarly, ontological security was also felt by Charles (MNC), where he discussed working on the current NSIP – in comparable terms, calling attention to the way in which working on this nuclear project opened the possibility to work on other future NSIPs that are currently at the planning stage:

‘So yeah, I just want to make sure that you are aware that this is going to happen. That after this, I think the plan is from [the current NSIP], then [NSIP B].’ (Charles)

This contrasts with the experiences of T3 subcontractors for whom the NSIP was a source of insecurity, to a point where some became detached, and others stayed away and elected to form alternative networks elsewhere and acknowledged the low percentage of local contractors working on the project.

In this respect, it appears that ontological security is easier to achieve at the top tiered levels and becomes more difficult to achieve further down the hierarchy.

Other networks, who are members of the local community surrounding the site, had also benefited, by providing accommodation to the construction workers. For instance, a couple who own a B&B in a town that is close to the NSIP site, with several cottages on their property usually provide holiday accommodation to visitors to the area. Indeed, because they live within an Area of Outstanding Natural Beauty, they generally focus on leisure. During the COVID lockdowns, however, there were no holiday visitors, and as such, they were able to accommodate essential workers:

‘To be quite honest, during the COVID lockdown, we’ve really benefitted from it, because some of them are essential workers. So, they’ve come to stay. We’ve had to cancel all the holidaymakers, because we were able to put people from [the NSIP] in there.’ (Hannah)

Moreover, a full list was given describing where the workers came from. Additionally, this points to our previous discussion on the extensive workforce network from different places:

‘We’ve had engineers, a lot of engineers. They come from Staffordshire, Birmingham, Leeds. I’m just trying to remember, the guy that was here over the winter, he was here for a few months. He actually came from Norfolk. He was a top consultant. He worked on the Eurotunnel as well. He was one of those big project consultants. I’ve got Birmingham, Leeds, Staffordshire, and South Wales.’ (Hannah)

Hannah further pointed to other accommodation networks in the area who also benefitted:

‘There’s a lady around the corner from me who has three guys from [the NSIP] staying permanently. And just as we moved here, she had a feed company selling livestock feed. But she couldn’t really compete with all the internet orders, like the big farming companies, so she gave it up. I think she’s got three guys who stay with her.’ (Hannah)

In this sense, the construction engineers have established a sense of obligation in supporting the local communities with whom they stay over extended periods of time.

6.2.2 Belonging and Kinship

This section focuses on the theme of belonging which has emerged during the analysis and explains how belonging represents the contractors’ lived experiences in terms of the contractors’ felt obligations to family, community, and work.

6.2.2.1 Family

When considering previous questions of mobility and migration, it is important to remember that what constitutes a *family* in a social network can have different meanings in different contexts. As such, using an understanding of *kinship* to explore feelings of belonging and not belonging can help to illuminate the various relationships and kinship networks that are established in such specialised circumstances. For all the contractors who were interviewed, for instance, family ties (i.e., obligations to family) remained very important to them, especially when they were working long hours, for long periods of time. Most of the male participants had wives and children, while those who were single had families who they wanted to return to – every weekend, ideally, if possible. The maintenance of such kinship networks was so highly prized because it constituted an important sense of belonging, even though the workers in question were away from their families for long periods of time:

‘When I moved here...like I said, I worked away from home all my life, really, and now I kind of refused to work away without the family. But in reality, if you can get home ... You know, we used to travel, and we’ve got guys on this side who can travel six, seven and eight hours on a Friday evening, and do the same on a Sunday night, just to be home for one and a half days. I know one person, or two people, who drive to Cardiff every single day.’ (Charles)

Similarly, having lived in a small B&B in a village near the construction site, and rather than commuting to see his family, Dan decided to rent on a more secure basis, for his family to be able to stay with him:

‘I moved into the bungalow, and I rented that on my own, because I wanted somewhere where if my wife and children did come down, they would have somewhere where they could sleep.’ (Dan)

For contractors, having family enabled attachments with the local community, but it also highlights how contractors can be alone:

‘They often don’t have any family ties. I think there’s a lot of people who probably don’t have a lot of family, it’s a bit sad really. But I don’t know, I just get that feeling.’ (Hannah)

A clear distinction was made between the construction workers, on the one hand, and the members of the local community, on the other, pointing out that the former did not belong to the latter. Thus, from Hannah’s perspective, creating attachments through a sense of belonging or ontological security with the contractors may be seen as precarious, as will become clearer in the next section. Also emerging from the data was a distinction for some contractors who needed boundaries between work and home rather than making use of the purpose build onsite accommodation, whereas others often without familial links these were hugely popular:

‘From what I’ve seen, they’ve been really popular, but it was just not my choice, because again you’re restricted... One of the campuses is right on the doorstep of the

site, which doesn't get you away from the site, and again it brings with it all the other issues, um... But for me, for me personally, not to say that I've been there, because I certainly haven't, it reminded me of an open prison. If that makes sense.' (Dan)

This highlights how the relationships of the workers were performative in generating attachments with the local community, and how a sense of belonging beyond the site remained important. Moreover, while maintaining the different networks with work and with the local community, obligation to family (or personal network) remained an important element of the contractors' sense of self or ontological security.

6.2.2.2 Community

The ability to create a sense of belonging and kinship is further empirically demonstrated by the workers that seek to develop attachments within the surrounding community. As noted, it creates a space for both worker security and ontological security. For example, Dan not only chose to stay in rented accommodation in local towns, despite the availability of purpose-built campus sites, but also had become involved in the local community:

'I stayed in a little village [where] there was a population around about 500, 600.... and I just embraced that village culture. I went there from a project in Essex, to that nice little quiet, peaceful, tranquil little village, and I loved the place. And um... I quickly found my way onto a dart board, and I quickly found my way onto two dart teams, and I represented two pubs for darts, for the time I was there, and that was a nice thing.' (Dan)

This insight reflects the importance of social structures – in this case, the pubs, and the darts teams. For an outsider, the place itself, as well as the pubs and the various elements that come together to create the necessary circumstances for the darts teams as nonhuman actors, all mobilised in the forging of these connections to the local community. As such, Dan's commitment to the local community – by representing the darts teams and, therefore, the pubs themselves – also constitutes a form of attachment. For instance, as shown, Dan is involved in

performing in different networks, first with the accommodation providers, and then recreationally by enrolling other actors to create those attachments to feel like he belongs. For the pub owner and other members of the darts teams who belong to the local community, the attachments made is conditional on the type of alliances that are generated in representing the darts teams. In this sense, the idea of forming kinship networks is shown. Similarly, Carsten (2000, p. 152) discusses “kinship” as having “network and transaction” and “reciprocation” elements. Consequently, then, kinship networks are formed through transactional relationships.

It is also the case that non-alignments – between the locals and the workers, for instance – can emerge within these social networks. Thus, drawing on the previous discussion on the absence of family ties, a clear distinction is made between the construction workers and locals, whereby forming alliances, and creating attachments are seen as precarious:

‘I do think the infrastructure project attracts a certain type of person. The workers are a particular type of person. It’s like oil rig workers, isn’t it, they are a particular type of person? You see them staggering out of the pubs.’ (Hannah)

Here a contrast is shown that draws on the distinction between “us” and “them,” or “our ways as opposed to their ways” (Carsten, 2000, p. 152). This was similarly discussed in Chapter 5 (section, 5.2.2) regarding the T1 contractors and non-conformists. However, as noted, for Hannah, the workers had the inability to generate any attachments or kinship ties. This is despite contractors like Dan that emphasised the importance of family and belonging to a community or place.

To further highlight issues within the network, the concept of ontological insecurity in the sense of not belonging is explored from the perspective of accommodation providers. This contrasts with our previous discussion on how they benefitted from the NSIP in the context of mobility and migration. However, the evidence also shows that many other B&Bs and hotels in the surrounding area who relied upon the business that came their way from the NSIP had to now compete with new hotel chains that had been recently built:

‘It is sadly a rather sore subject for small hotels in the area. Due to the building of the project, [the Developer] built a number of large campus-style developments to accommodate their workers, meaning that local accommodation providers have and still are missing out on vital revenue that they were promised when the project was announced. To make matters worse, the local councils have approved the building of a large number of large chain brand hotels within the area, which has further intensified the problem, by further diluting the small amount of corporate business which still stays in hotels. This has taken what should have been a great opportunity for the local hotel market and made it into a very acute challenge, as we seek to compete with ever more large brand hotels, while the workforce is accommodated in purpose-built campuses, meaning that less of the investment is spent with local businesses.’ (Patrick)

By tracing the network, the emergence of alliances between the Developer and other heterogeneous actors, such as, the town council, hotel chains and campus developments emerge. In creating security for themselves (i.e., human actors) such as the Developer, local authorities, and hotel chain developers, it has generated insecurity for the smaller, private accommodation providers. Thus, alignments and attachments are created while simultaneously generating effects of detachments for other actors in the network. As such, there are those that belong to the network and those that do not, demonstrating ontological (in)security. The data also reveals the detachments or broken promises. Moreover, not only are such precarities felt in the present, but they are also feared over space and time:

‘I sometimes look forward and think what on earth is going to happen in 10 years’ time. If there’s going to be a glut of short-term rental property in this area because I don’t know how long the project will go on for – I think it will go on for between 10 and 20 years. Then it has a much lower staffing level. I don’t know, but [the local authority] has invested a hell of a lot of money recently, as it’s had a big financial boost from the project. Not that they are doing it very nicely, either. I’m horrified at

the look of it. Yes, I don't know what it will look like in 20 years' time, but I probably won't be around then.' (Hannah)

In essence the contradictions and discrepancies of Developer rhetoric involving contractual arrangements of the T3 subcontractors as previously seen in Chapter 5 emerge once again and highlight issues of mistrust and disappointment. The findings reveal the disconnect between the construction project and the local community, those who were supposed to benefit from the project.

6.2.2.3 Work

Obligations to family and the local community, including the various kinship ties have been explored. In this section, obligation to work (and kinship) is discussed further. This may be demonstrated through the idea of symbolism that is being used to extend notions of belonging to the working environment itself. For example, the data reveals how *pin badges* were used as a means of rewarding and recognising achievements in the workplace. In the context of health and safety, it was important to achieve certain milestones, with no accidents or incidents being reported over a certain period. Whenever such a milestone was successfully achieved, pin badges would be awarded:

'It is rewarding and actually be part of that and be able In fact, I've got to get [something] for you, let me get it. One of the little things that we do on site is every time we hit a milestone, they issue, um...a little pin badge. Now, I don't know ...apologies for my kitchen in the background, so you can see it, um... So, I just take that off [Dan removes the filter on zoom]. OK, right! Now, you see my kitchen. So, every milestone that we do, every milestone, we get a little pin badge. All these are a record of all the milestones achieved while I was on site. Now, there's quite a few there, but.... I'm into things like that. I collect coins, so a little thing like that does a lot for me.' (Dan)

The achievement of such milestones, together with his work colleagues, was a personal success: not only did it enhance feelings of confidence and self-esteem, and stimulate aspirations for further achievement in the workplace, but in doing so it also helped to generate an encompassing sense of belonging. Indeed, even though the badge itself had very little financial value, it was enormous in terms of what it signified, for example, in its symbolic meaning. As such, it shows how material actors, such as the pin badges, were responsible for generating and maintaining a sense of identity, self, or continuity in the construction workers, unlike in the case of Hannah and Patrick. In this example, a strong sense of ontological security is demonstrated. Moreover, despite Dan's desire to keep his private life separate from his work life, or his different networks, the pin badges, as actors, ultimately connected the two – as when, for instance, he showed them off to his children:

'It's good for the guys, my two boys can talk about it at school, look at this, and the kids will go, wow. So yeah, it's great, it's just a badge....' (Dan)

Maintaining relationships within the network of the work community was another way of achieving a sense of belonging, on two distinct levels: with one's peers and, in the case of the T1 supervisors, in the management of other workers. For example, it was important to be able to discuss various health and safety issues while driving to work together. This allowed the development of a peer relationship, while also contributing to the mitigation of any potential health and safety issues. Once again, a place (or a space) is created, but in a different context: the car, as another nonhuman actor, is the enabling condition of such alignments or connections. In a similar way, the nuclear site that is the workplace also enables the creation of further places (or spaces) for cooperation and companionship between colleagues with shared responsibilities:

'Charles would pick me up, that was one of the benefits of living in one of the villages down from him.... But yeah, we would get a coffee, get all the supervisors in, have a good laugh with the supervisors, talk about the set of work, and then go out all day long.' (Dan)

In the case of Dan, maintaining good relations with the workers under him was also important, not only for successful communication with the Portuguese members of the workforce, which sometimes posed a challenge (seen in Chapter 5), but also for continuing to be respected as a supervisor. The sense of belonging in the workplace can be further explored by returning to the understanding of emotional (ontological) security. Giddens (1990), for instance, refers to ontological security and insecurity as *emotions* that are rooted in the *unconscious*, rather than being cognitive processes. As such, as seen throughout, a person who is ontologically secure is secure in their identity and confident in their social surroundings and material environments, while an ontologically insecure worker, by contrast, may not have a positive sense of their identity, and therefore underachieve. By attempting to create these ontologically secure alignments, for example, with his peers as well as with the workers under him, Dan is also attempting to make sure that the health and safety practices that occur on the site are also secured. However, as noted, these alignments created in the network, and the generation of ordering effects – such as co-workers, health and safety practices, pin badges, and spaces (i.e., the car), are only made possible through processes of performativity (Law, 1992).

6.3 Chapter Summary

As established, the different tiered companies in the construction industry are categorised in terms of a hierarchy, according to their size and levels of responsibility. The top of the hierarchy typically includes multinational companies that are involved in multi-million-pound projects. Such companies are often able to wield more power, exert greater political influence, and have higher levels of overall profitability than those companies that are lower down the scale. Where previously this was seen under policy controls, here it is emphasised in the context of kinship and belonging, and mobility processes, including the *who* and *how* of access when working on NSIPs – all of which contribute to the precarities experienced. Moreover, the fragmentary conditions of the construction industry are also highlighted. These conditions are the result of and dependent on the required scope of work, and the companies at the different levels that contract out some of their work to other contractors or subcontractors at home and abroad.

However, with the Developer passing on responsibility to the other contractors and subcontractors further down the hierarchy the volatile and complex nature of the industry has caused the NSIP network, in some instances, to become unstable and insecure with the bottom tiered workers experiencing most of the impact.

In terms of the levels of security that are experienced by the Developer, contractors, and subcontractors, these can often be differently perceived and experienced, all of which may be traced in the network. For instance, in the context of mobility processes that include globalisation and resourcing, the tracing began with the Developer making statements about how most of the benefits would be felt by UK companies. To re-enforce their statements, they engaged in a process of *interessements* and in the enrolment of other actors in the form of maps and calculations. However, precarities emerged with contradictions on Developer claims. Controversies and resistances in the network began to emerge when subcontractors questioned the validity of the statements regarding who *really* benefitted from the project. This was compounded by the lived experiences felt at the bottom of the tiered levels in the construction hierarchy, where scarcity in skilled labour resulted in situations of competition, poaching and economic difficulties. In addition, fuelled by bureaucratic processes, perceptions of internal political motivation were pointed at the Developer.

Further precarities developed with the issue of resourcing challenges in both people and material. This resulted with the Developer once again having to engage in performativity activities by aligning themselves with other networks (i.e., overseas), to secure skilled labour and the necessary technology. Moreover, to solve the skills gap challenge, the Developer enrolled other nonhuman actors such as educational schemes and colleges. However, despite the Developer engaging with the different actors to find a solution to the problem of skills in the UK, the controversies remained with the Developer seen as consistently aligning with overseas networks, thus, adding to issues of detachment and a sense of not belonging. In essence, with the insecurities experienced, obligations to home and work become implicated with the subcontractors looking to secure those obligations by attaching themselves rather to other networks or other infrastructure projects to establish a sense of security and ontological

security. At the same time, by forming relationships with heterogeneous actors (while simultaneously passing responsibility), the Developer could get on with accomplishing key objectives of getting the NSIP built and securing their own position with key networks, for example, Government. As such, regarding a hierarchy, depending on the firm's position in it, those at the top that include the Developer and T1 firms experience more security than the T2 and T3 firms.

Understandings of a hierarchy that generate instances of security and insecurity are further explored. For example, when tracing the T1 contractors (MNC), and how, when working on the NSIP it would act as a platform that enabled them to secure further work on other critical NSIPs. Whereas other subcontractors such as the T3's working at lower levels of the hierarchy were impacted by circumstances of controversies (or insecurities) that involved agreements being broken by the Developer regarding the terms and conditions of the initial contract. Moreover, controversies by the Developer also involved other networks, for instance, in their failed promises with the local community that implicated small private local hotels. This includes implications of detachment as a consequence of other alliances and attachments made by the Developer with other networks such as the campus sites, local authorities and hotel chains. In this instance, obligation to community by the Developer was not fulfilled, therefore, creating a sense of insecurity for those accommodation providers. These examples of precarities or insecurities are especially highlighted when underpinned by an understanding that the main objective of a NSIP is to award both national as well as local economic benefits and uplift the well-being of local communities.

While controversies occur in some networks (i.e., T3 subcontractors and hoteliers) and stability in others (i.e., T1 contractors), this can be traced once again when further exploring the concept of belonging and kinship. Moreover, in this context, understandings of obligation to family, community and work become more prominent and help to illuminate relationships and kinship networks. For example, regarding obligation to family, for the engineering contractors, securing family networks were prioritised especially when working away from home over long periods of time. This was demonstrated by a T1 contractor who formed alliances with local

accommodation providers and other actors (i.e., family cottage) that would support and enhance a family network.

The contractor also sought to form alliances and attachments with local community networks through performativity processes, enrolling actors like the darts, pubs, and team membership to generate feelings of belonging and in turn achieve ontological security. However, for some of the local actors, forming attachments was conditional on a reciprocal relationship and therefore dependent on the success of membership and the contractor's cooperation in representing two darts teams. For other local actors, forming attachments was seen rather as precarious. This was because the contractors were viewed as not having any family networks, and who were associated with drunkenness and anti-social behaviour. As a result, any type of alignments formed, or long-term attachments could not be made – hence, a precarious and unstable network.

When exploring instances of obligation to work, here the networks were reinforced and made secure with the enrolment of the *pin badge* actors who generated symbolic meaning. This could be translated into a stable sense of self or a positive sense of identity, and continuity for the contractors. As seen in Chapter 5, we may draw on Law (2019), that denotes material semiotics to relations in the social world that are simultaneously semiotic and material. As such, where in some networks precarities have been seen (with resistances occurring or have failed), here we can see how networks have been achieved and made stable.

Importantly, one may also trace the different kinds of kinship networks that may be formed by an individual – these include the connections with the individual members of the darts teams, as well as the pub owner. In the work context, there are also the connections with contemporaries (i.e., other T1 supervisors), and the members of the Portuguese workforce. The different networks that can be generated provide examples of different kinds of kinship relationships, with the result that different alignments, attachments, or connections come into being, all of which play a part in establishing a sense of belonging or ontological security for the individual contractor involved. This is achieved through performativity processes to secure a certain agenda in that moment in time and place, thus, ensuring security. In this way, a sense of

self or different selves can be established depending on which network (i.e., family, locals, or work) the individual is engaging with.

These processes of performativity that involve different selves may be extended to every actor involved in the different networks. More significantly however, these circumstances are most notably explored, observed, and holistically understood when using the ANT platform, as demonstrated throughout. This includes our understanding of precarious work that subcontractors find themselves in. As Kalleberg (2018, p.15) puts it, precarious work is “employment forms that are insecure and uncertain, [leading to] a decline in employee well-being”. In **Table 6**, some examples of precarities are given, extracted from both Chapters 5 and 6, to show how they have emerged from the data, their uncertainties and why.

Table 6 **Summary Table – List of Precarities**

Type	Explanation	Impact	Example
Limited control	Control over activities can be stringent	Implicate income ability, logistics, capacity, and time	Developer policy requirements during accountability and qualification controls that present personal and financial risk for T3 firms
Limited skilled labour	A significant challenge is presented due to the lack of skilled labour in the UK	As a result, issues of competition and poaching emerge	T2 subcontractor struggling to find qualified and experienced workers, especially in the nuclear industry
Bureaucracy	Developer policy accountability controls to mitigate risk	Impacts income ability and logistical challenges. It also creates insecurity as instability and contradictions are experienced by the subcontractors	Developer bureaucracy is perceived as internal politicking with the promotion of certain agendas by powers of authority
Fragmentation	Associated with a volatile industry made worse by issues of Brexit that include rising costs and revised policies and trade agreements	Increased costs are passed onto subcontractors at the lower end of the hierarchy. Therefore, increased costs in construction materials and procurement of workers	T2 and T3 subcontractors feeling the most impact while less investment is made on the social impact experienced
Globalisation	Associated with mobility, migration, resourcing difficulties and the lived experience	Employment is insecure causing local worker insecurity and ontological insecurity	Mobilisation of large number of international labour and materials, and perceived as benefitting the most in the project
Ubiquitous platform	Induction processes during health and safety controls that presents Unanticipated challenges	Unanticipated time implicates financial risk, especially when working with thin profit margins	T3 workers experience challenges with additional daily safety briefings seen as not applicable to them

CHAPTER 7: DISCUSSION

7.1 Introduction

This research project aims to explore how engineering contractors and subcontractors perceive and experience working on NSIPs. The chapters on the findings, Chapters 5 and 6, detailed various circumstances and experiences in the everyday lives of engineering contractors. The analysis of the findings enabled key concepts to be categorised into two major themes, namely policy control and felt obligations. Further analysis then revealed greater complexity and the inter-related nature of the two themes which led to a sense of security as the overarching theme throughout the study. What emerged, however, as significant is how security could be understood as worker (in)security and ontological (in)security depending on perceptions, experiences, the hierarchical nature of the industry as well as the general context of the participant. Please note, with the analysis mostly concerned with construction workers, in many instances physical or human (in)security, as seen in the literature, is also referred to as worker (in)security. In this way a distinction is made between worker and ontological (in)security.

To gain a better understanding of worker (in)security and ontological (in)security, the analysis drew on the findings of the ANT framework. This framework provides a comprehensive theoretical and empirical understanding of social networks (discussed extensively in Chapter 3). It also, drew on STS, which views technological developments (i.e., infrastructures) as completely integrated with social, cultural, and historical contexts. Using ethnographic methods, the analysis revealed how infrastructure and infrastructure projects provide platforms for both human and non-human accounts (Barry, 2020; Strathern, 2018). As detailed in Chapter 4, these methods included semi-structured interviews and participant observation that produced detailed reflexive and critical accounts of worker experiences and perceptions, together with their beliefs and values. The suitability of the ANT framework as a means for exploring heterogenous networks has been well established as it has been used to explore not only human and material phenomena, but also how infrastructure is capable of instabilities, vulnerabilities, and “liveliness” (Edwards 2003, p. 188; see also Amin, 2014;

Björkman, 2015). This includes, how infrastructure can evoke responses of “imagination, emotion and suffering” (Latham and McCormack, 2004, p. 705; see also Petryna, 2002).

In addition to generating the central theme of (in)security, NSIPs themselves are deeply embedded within the everyday lives of the members of the worker community. This chapter will further discuss the implications of the findings and their significances. First, it briefly offers general insights into human (worker) and ontological (in)security. These insights, in turn, provide the basis for an analysis of the development of the key themes established in Chapter 5 and 6, including new knowledge about the larger theme of (in)security. Following these general insights, the concepts of policy controls, mobility, and migration, belonging and kinship, will be re-examined in light of the findings from the existing literature presented in Chapters 2 and 3, which explored the economic, political, social, and technological aspects of various networks. By drawing on the intricacies of infrastructure in this context, the overarching theme of (in)security will be better understood. However, doing so, will involve going beyond normative understandings of security, to consider the material and social elements that emerge from the analysis.

7.2 Insights and Perspectives on Security: Human (In)Security and Ontological (In)Security

According to the *Human Development Report* of 1994 by the United Nations Development Programme (UNDP, 1994), the concept of *human security* is discussed. The report argues that an earlier definition of the term, *security of territory from external aggression*, is too limited, since human security involves more than simply the absence of conflict, it involves, “freedom from want and freedom from fear” (UNDP, 1994, p. 22). Furthermore, the interactions that create human security are dynamic. For the purpose of this research, the term security primarily refers to the area of human security. Most crucially, ANT provides the tools to trace human security and the processes of “security in action”, enabling the creation of a “thick, ethnographic” description of a specific process (Salter, 2019, p. 349). In this way, ANT serves as both a theoretical and a methodological resource to unpack security problems (Salter, 2019).

Security is a multifaceted construct that covers a wide and diverse terrain. For instance, human security is understood as a precondition for achieving and maintaining order (Foucault, 2006). However, it is also treated subjectively in that insecurity can be felt through perceptions and experiences of danger, risk, and threat (Hanson, 2018). At the same time, individuals need to have a sense of “security of the self” regarding their identities and mental wellbeing in order to feel ontologically secure (Giddens, 1991; Shani, 2017, p.277). When faced with uncertainty and a risk to one’s health, economic security and emotional welfare, individuals experience ontological insecurity (Giddens, 1991).

In terms of questions of ontological (in)security, which was addressed in Chapters 5 and 6, the *psychological* aspects of security are emphasised, whereby establishing a coherent “sense of self” is the main objective (Shani, 2017, p. 277). According to Laing (1960, pp. 41–42) and Giddens (1991), ontological security involves “the need to experience oneself as a whole, continuous person in time—as being rather than constantly changing — in order to realize a sense of agency”. As with Callon (1999; also see Chapter 3), who also refers to notions of performativity, here ontological security may be attributed to a psychological self who is also reflexive and whose social behaviour has performative features.

To maintain a sense of continuity, performativity is closely linked to a motivated self through personal goals, values, and envisioned future projects. For social actors, the “effectiveness of the performance” becomes central (McAdams, 2013, p. 274). Given all the transformations experienced by the self over time and across different situations, identity then becomes important. Accordingly, identity is, concerned with maintaining the self continuously over time through those various situations and social demands, and in the context of different social roles (McAdams, 2013).

In ANT, the self is understood as multifaceted — Individuals may have different selves to deal with the demands of different social situations. But as shown, actors cannot be explored in isolation; one must focus on the array of relationships among actors that sustain them and make them act or perform in a certain way (McAdams, 2013; Alcadipani and Hassard, 2010). Similarly, and in terms of (in)security, construction workers can be seen and understood through these multiple selves. This includes exploring (in)security of the self, in relation to work, the family, places of accommodation, and the local community. In this

sense, a distinction between human (or physical/worker security), and ontological security, begins to emerge. Ontological security represents an understanding of the security of being, as opposed to security as survival (Giddens, 1991). Again, these distinctions are made by the contractors themselves in which attachments and (non)alignments occur through various policy controls and issues of mobility, migration, belonging and kinship. What is most important, however, is how these securities are generated and how they are navigated and managed (and performed) in a precarious environment. This will now be discussed in detail in the following sections of the chapter.

7.3 Developing the Theme of (In)Security Through the Data

This section brings the insights on (in)security from the literature to this research. Importantly, it will explain how the analysis is associated with the existing literature — how it confirms or adds new knowledge to what is already known.

As noted, the results and findings from the research were presented over two chapters (Chapters 5 and 6). In the chapters, two major themes emerged from the analysis of the data: policy control and felt obligations. The former mainly involved questions relating to accountability, qualifications or auditing, and health and safety standards. The latter mainly involved issues of family, work, and community obligations; these could be approached via ideas related to mobility and migration (including globalisation and resourcing), belonging and kinship processes. Yet, through further analysis, it became clear that the various concepts emerging in the data were connected to one another. This resulted in the development of a single underpinning or overarching theme of security that included both elements of worker/physical/human (in)security as well as ontological (in)security.

7.3.1 Accountability Policy

Chapter 2 invoked a discussion by Collier, Lakoff, and Rabinow (2004) about how future situations could be scrutinised in the domains of politics, policies, and governmentality. Luhmann (2005) similarly questioned whether an unknown threat or risk could be operationalised. There is an understanding that, over time, lessons will be learnt, knowledge

will be improved, and better models will be created, with the data becoming more precise. Consequently, future risks can be made more manageable and secure, or even controlled, through the implementation of new policy controls.

This may be similarly compared to a nuclear power project involved in the management of security to mitigate risk, whereby, for example, getting the paperwork and the design right and approved is vitally important to prevent environmental and health and safety disasters. Importantly, a network is formed when types of knowledge (e.g., policy controls) is adopted by other actors (e.g., the state, the Developer and T1 contractors) who see themselves, their interests and goals aligned. These different actors are bound together through sharing “perceptions of reality” and through specific “codes of conduct” (Rutland and Aylett, 2008, p. 632), stipulated through policy documents, vetting processes and induction practices to achieve certain policy objectives, as seen in Chapter 5:

Yes, it is a process. The design policy is a process that is...um Checks and balances must be in place from a quality perspective. There's a duty on the client and the principal contractor and principal designer.... All these functions have specific responsibilities by law. And they have got a duty to design to reduce opportunity for incidents during construction for accidents and incidents during maintenance use and final dismantling (Charles).

However, despite policy objectives to mitigate risk, researchers such as Fader (2013), Goffman (2014), and Rios (2017), for example, examined how security logics and practices span institutions and the social worlds that accompany them. These include governance and the unintended consequences that arose when, efforts to improve security only brought about insecurity (and precarity).

Similarly, ANT argues against any presumptions that risk can be fully operationalised. As the actions of heterogeneous elements are dependent on the enlistment of others (i.e., human and nonhuman), no *a priori* assumptions can be used to explain phenomena. All these elements are contingent on the assembling of potentially conflicting political (or internal bureaucratic) interests and ways of governing or implementing policy. Moreover, ANT opposes any suggestions of a superior actor imposing its will on others: “even nonhumans have energies that need to be recognised, massaged, and corralled”, in order for a

translation of interests or *interessements* to occur (Rutland and Aylett, 2008, p. 632; also see Chapter 3). ANT further argues that any alignments that were made are not necessarily because of similar interests, but rather, due to different interests that were translated, compromises made, and actors persuaded that working with significant others to move toward a certain objective is in their best interest (Rutland and Aylett, 2008). Such theoretical understandings are therefore comparable to research findings in Chapter 5, that discusses policy controls as heterogeneous networks, or *orderings*, that include organisations, people, technology, policy documents, rules, and regulations — all of which are effects generated in patterned networks (Law, 1992).

As Law (1992; see Chapter 3) puts it, these orderings in the network will hold so long as they overcome resistances. Controls become performative, and they will be maintained so long as the different actants “come together and work together to produce an order” (Rutland and Aylett, 2008, p. 633). Similarly, things are held in place, or constructed in some way owing to the relationality of materials, objects, and people (Munro, 2013). In the context of infrastructure projects, their risks can be operationalised to a certain extent. For example, risks were operationalised with the alignments made between the Developer, the T1 contractors, and all the policy protocols that were important in maintaining health and safety security.

Drawing on the unintended consequences of security, Rydin (2012) further explains this in terms of controversies, and how they are only evident against the backdrop of a certain level of stability over a given time (Rydin, 2012). As Rutland and Aylett (2008, p. 633) similarly explain, any order that is created is only temporary, and could even be precarious, which means it “requires ongoing work to keep it alive”. This precarity is seen in the NSIP, whereby, those elements not subject to control could present a greater risk, as evidenced in the testimonies of the T3 subcontractors detailing how they experienced a number of challenges, such as getting all the paperwork approved, that often resulted in time delays and thus lost income.

For the Developer, by contrast, the enforcement of such stringent policy procedures was necessary to achieve the common goals of establishing good practices, risk aversion, and economic efficiency (see Chapter 5, Sections 5.2.1 and 5.2.2; Fellini et al., 2007; GOV.UK,

2013). Here, agency is ascribed to different actors who have combined interests and formed professional and personal connections. In turn, translation is established by the ability to *partially* operationalise risk. Yet, the detailed and stringent policy documents (to ensure security), simultaneously acted to constrain the agency of the T3 subcontractors (causing insecurity), resulting in the network being broken. This outcome in the research findings not only corroborates Law but illustrates a break-down in the “ordering effects” (Law, 1992, p.386).

Policies can connect different institutions, actors, and discourses; they can also bring together a range of broader economic, political, and social processes (Maguire et al., 2014). Indeed, as seen in Chapter 5, emphasis placed on the *right first-time quality*, and *the right people*, served to introduce and then maintain a common language of accountability for those construction firms and workers in the top tier of the hierarchy. Such an approach can ensure economic efficiency, and therefore profitability. However, the aims of the contracting firms were also politically (internally) aligned with those of the Developer and the government in terms of delivering the NSIP on time and within budget. As such, the use of such a common language (to express common goals) affects social processes by reinforcing peer alignments in worker networks.

Using a common language that affects social processes is similarly emphasised by Bigo (2002) and Huysmans (2006) who called attention to some of the ways that the rationalities and vocabularies of security were introduced and withdrawn, appearing, and disappearing as a result of institutional and bureaucratic changes, along with social interactions. Here, their focus falls on migration and the control of access to, for example, the welfare state. More specifically, they look at the politicisation and mobilisation of groups and technologies such as politicians, the media, and security professionals to advance particular agendas. For them, what is most important is language itself, and how it is used in relation to the securitization issues of migrants.

The construction firms at the top of the hierarchy are thus better able to handle precarities owing to greater political and financial security, compared with construction firms at the bottom of the hierarchy. The latter firms, are constantly battling on a number of fronts, owing to issues of competition, fragmentation, and slim profit margins. In terms of

precarities, this creates patterning effects that are distributed all the way down the tiered levels where they are contested by the T3 subcontractors. In this respect, it is possible to interpret the different feelings of security and insecurity experienced by contractors and subcontractors according to their positions (or the positions of their firms) in the hierarchy that structures the construction industry.

This concept of precarity, “precarious work” or “precarious employment”, that potentially contributes to insecurity is also confirmed by Kalleberg and Vallas (2018, p.103). Such work is generally characterised by individual uncertainty in terms of the stability of their employment, income, and access to social benefits. Uncertainty also extends to the risks accompanying entrepreneurship and employment. The various manifestations of precarious work along with, consequences, can be prompted by a heterogeneous array of sources. Precarity affects a range of employment types, including temporary and part-time work, as well as one-person businesses.

In line with Kalleberg and Vallas’s *precarious work*, in the construction industry, work has always been precarious. But in recent years, the precarity of construction work has increased owing to issues such as the financial crisis, Brexit, and the recent pandemic. This has had a knock-on effect on already existing issues that include, shortages in skilled labour and increased costs in the procurement of both people and materials. As Kalleberg argues, firms introduce more flexible forms of employment and production to lower their costs and increase their profits (Kalleberg, 2012). In the construction industry, this shifting of risk is achieved by passing the risk all the way down the subcontracting chain (Bosch and Philips, 2003; Briscoe et al., 2000; M. Harvey, 2001; M. Harvey and Behling, 2008; Winch, 1998). This is evident for example, from the T1 contractors to the T3 subcontractors. Ultimately, precarious employment contributes to individual “distress” and has the potential to bring about a “new political economy of insecurity” (Kalleberg, 2009, p. 2).

More flexible forms of employment (extended to overseas companies) are further illustrated in the frustrations that some of the participants expressed, in terms of the economic benefits of infrastructure projects being felt abroad, rather than locally, and the perceptions of a lack of *fair play* (see Chapter 5, Section 5.2.1). Economic insecurity, then, together with a lack of trust, can bring about feelings of anxiety, with the accompanying deep uncertainty

having the potential to contribute to feelings of ontological insecurity. Thus, drawing on Kalleberg, such policies ultimately become a form of politics (or bureaucracy), or in ANT terms, controversies.

The goal by the Developer of finding the right people with the *right skills* (see Chapter 5, Section 5.2.1.1), may also create feelings of belonging or not belonging. After all, a sense of belonging is associated with identity. As such, the commonality of values, good practices and economic stability trigger the conditions in which alignments are formed, therefore emphasising collective identity. Still, identities are constantly in the process of translation, and in their alignments, strategies are formed. As Munro (2013, p. 135) puts it, “people read how the effects that flow from certain relations magnify a particular identity, or they may notice instead how alternative alignments could diminish other identities”. Identities are, thus, performed and may be evident in the research data.

Given the issues relating to the skills gap in the construction industry, especially in the UK, for example, competition among contractors and subcontractors for work is rife, with the result that only those who are suitably qualified and experienced can secure jobs. In this regard, and from the perspective of subcontractors, the system as a whole appears to be highly selective and exclusive, in addition to, being structured by a hierarchy within the NSIP. Again, this confirms Kalleberg’s (2009) discussion on creating a *new political economy of insecurity*. However, from the Developer’s perspective, tackling the lack in local skills and issues relating to accountability must be weighed in consideration for the time delays, increased costs, and risks of environmental damage that could be caused by underqualified and inexperienced workers.

The above examples in relation to performing the network and finding the right skills (by the Developer), is thus, once again discussed. Here, it is associated with Callon (1999), who compares such interrelations between actors to economic theory wherein different elements are involved in a market of transactions. Such theory highlights the notion of externalities which requires agents to factor into their calculations any possible shortcomings that arise in relevant markets: these shortcomings may include “all the connections, relations and effects which agents do not take into account in their calculations” (Callon, 1999, p.187). The idea of externalities emphasises all the investments

that must be made in order to measure or assess the relations in the network. By investing, network actors and their relations may be framed in ways that enable divisions to be made according to which agents will be useful and which ones can be ignored — hence, the exclusivity and selectivity felt by the subcontractors. Callon describes such decision-making as “performing the economy” (Callon, 1999, p. 192).

Ultimately, accountability policies designed to mitigate potential risks are inevitably accompanied by a range of other unexpected consequences. For instance, a number of local subcontractors (especially those working for T3 organisations), would rather give up opportunities of working on a NSIP to be able to work on smaller contracts that, are less prestigious, but also much less stressful, simply because they do not involve as many constraints. Additionally, these subcontractors were supposed to be the beneficiaries of long-term job security during their work on the NSIP — an opportunity that appeared to offer ideal contracts and the envy of others. Along with perceptions of internal politicking that cause ontological insecurities, the inconsistencies in the requirements for working on a nuclear site, and resulting delays, provide further examples of the unexpected consequences. Others include the amount of paperwork involved and the resulting loss of income, as well as the various logistical challenges. In all these instances, the participants were happy to end their work on the NSIP and had no desire to return to such an environment again.

Environments that are safe and comfortable, and that create a sense of belonging are, therefore, far more desirable for such workers, even if those environments are unable to offer the long-term job security that NSIPs do. As seen by Giddens (1990, 1991), processes of continuity are desirable for such workers. It is thus important to emphasise that the desire for a constant environment—that is, a safe and stable environment, that creates a sense of belonging or ontological security—is to be found throughout the data. Such a desire is continuous, as individuals will always try to belong. Similarly, as Munro has argued, “there is a [constant] circulation of identities”, even if it means that participants must detach themselves from their current networks to form attachments or alignments in other networks, and so, maintain a sense of security (Munro, 2013, p. 134).

The data are also consistent with ANT, who reminds us that everything in a heterogeneous network act. Actors may be in a position of power through which they enrol or dominate others or become enrolled themselves. Moreover, there is no stable theory for the actor. For this reason, one cannot assume the size of an actor, its psychological make-up, or even its motivations for a particular action (Callon, 1999). What is most important for ANT, however, is the “circulation of effects” in the shape of “motives, interests, and intentions” (Munro, 2013, p. 125). As such, actors become involved in a network of relations that are continuously connecting while reassembling identities.

7.3.2 Audit (Qualifications) Policy

It is not just the various policies relating to accountability that contribute to the precarity of the construction environment. Various audit processes do, too, with *audit* being a non-human actant to which all kinds of power are attributed, thus causing an effect (Law, 1999; Munro, 2013). These processes are introduced to ensure overall standards of accountability across the project as a whole, with manufacturers, contractors, and subcontractors all following the same rigorous approaches, in tender processes, vetting procedures, and design and manufacturing activities. In this way, policy statements and aims can be turned into “measurable outcomes”, and transferred to different locations (Law and Singleton, 2014, p.381). This may be demonstrated in the data, whereby, these locations include the mobilisation of policy outcomes all the way down the hierarchy of the project, from the Developer to the T3 subcontractors. Again, this involves each level arriving at the scene with their specific intentions of ultimately gaining security within the limits of the nuclear NSIP.

To achieve policy targets, *intermediaries* (Munro, 2013; also see chapter 3) are enrolled in the form of auditing practices and include various actions such as measurements, assessments, and evaluations. This is shown in the data, for example, in the vetting processes by the Developer and T1 contractors within the network of the NSIP. However, these intermediaries impose a range of social consequences, involving constraints on time, personnel, and resources (Strathern, 2000). This is evident in the experiences of the T3 contractors who arrived on the scene having assumed they had complied with all of the vetting requirements, only to realise that additional demands existed in terms of the number

of workers needed for the job. This directly impacted their profit margins and as a consequence, they decided not to return, and to look for security elsewhere.

Further examples can be found in the induction procedures, with the implementation of *blanket policies* in the form of auditing to ensure compliance with health and safety measures are complied with. On one occasion, there was a breach in health and safety when one of the workers failed to follow procedures (see Chapter 5, Section 5.2.1). But even the subcontractors not involved in the breach were implicated, with an extra induction organised for everyone, on top of mandatory attendance at the daily briefings. Here, intermediaries (i.e., induction activities) were accustomed to maintaining a health and safety policy for the Developer and T1 firms, but for the T3 subcontractors, the policy generated effects that placed constraints on time, personnel, and income. As such, the subcontractors endured most of the impact of the policy outcomes that had been mobilised down the chain of the hierarchy levels. This demonstrates how the intermediaries were directly involved in the attachments made between the Developer and T1 groups through the policy outcomes, and the detachment of the subcontracting T3 firms who wanted to leave.

These research findings may be comparable to Buzan, Waeber and de Wilde (1998) and Bigo (2006, 2007) who focused on the political effects of security or, more specifically, *what security does*. Accordingly, Buzan et al. (1998, p. 5) argued that the label of security is often fixed to issues that are “staged as existential threats” by securitization actors. By doing so, those actors generate effects, in the form of endorsements of emergency measures beyond legally binding agreements. As such, existential threats can be presented across different policy contexts, such as economic, environmental, cultural, political, and military settings.

7.3.3 Health and Safety Policy

The networked arrangements present within organisations can display controversies because of the effects generated by asymmetry between the centre (e.g., the Developer, T1 contractors, and various inspection teams), and the periphery (e.g., the T3 contractors), and as a result of being hierarchical in nature (Law, 1992). But, as noted, it is the relationality of

heterogeneous entities that hold a network. When tracing the network, the crucial moments lie in how the network is constructed (Munro, 2013). As Barbara Czarniawska puts it:

If all the characters are known from the beginning, there is no story to tell; if powerful actors can do what they want, there is nothing more to say. From an ANT perspective one should ask: 'By what route have certain actants become powerful actors and others have not, or how is power constructed?' (2014, p. 58)

Drawing on these theoretical underpinnings, similarly, the epistemological case is made through empirical evidence in the research whereby security is problematised by different authoritative bodies. As noted, this is demonstrated in the health and safety policy documentation and accompanying assessments (used as intermediaries) requiring construction firms to demonstrate that their systems, structures, and components meet the necessary safety standards. Chapter 5 (Section 5.2.2) called attention to the surveillance and verification activities that are conducted by the various Conformity Assessment Bodies (CABs) responsible for actively shaping performance measures through audit processes, by either those of the Developer or external manufacturing surveillance and inspection teams. The earlier discussion emphasised how both the contractors who conformed and those who did not conform were subject to further non-conformity controls.

In this instance, the hierarchy of tiers relates to whether or not construction firms conformed (in terms of their alignment with the CABs), in order to ensure a *nuclear safety culture*. In this way, as Czarniawska (2016, p. 4) argued, "the role of standardization, formalization, and classification" becomes explicit. With the enrolment of the intermediaries, the CABs successfully translated the action by construction firms to conform and eliminated those who did not. As a result, alignments emerged between the T1 contractors and the CABs. It is here that "translations [became] durable" and the "action of the contractors [was] made stable" (Munro, 2013, p.131). Moreover, there is also a clear distinction between the T1 contractors, who conformed, and the *other* contractors who did not conform (see Chapter 5, section 5.2.1). For the Developer, security was achieved by creating a nuclear safety culture through actively arranging and rearranging heterogeneous relationships and working those alignments (Foucault, 1980). As noted in Chapter 3,

translation is the process by which a new link is created through relations and associations whereby hybrid networks are formed.

This notion of asymmetrical relationships in the construction industry is further explored with controversies that come into play, this time, in how ISO standards are set out by the Developer, communicated by managers of the T1 firms, and then interpreted by members of the workforce, (many of them international in origin). Construction work is extremely fragmented and, takes place transnationally, with the result that knowledge is often gained over time (Barry, 2001, 2006, 2016; Pink et al., 2010). This causes workers to arrive on site with their own assumptions, beliefs, norms, and values (Pink et al., 2010). As such, the research findings have shown how the successful enforcement of a nuclear safety culture is likely to take time, with challenges occurring in terms of cultural differences as well as disparate national and international approaches. Moreover, local subcontractors perceived the international character of the workforce as contradictory and therefore precarious, owing to statements made by the Developer that claimed local economic benefits to the local workers. This resulted in the breakdown of relationships and the formation of detachments which can make accompanying questions of worker security and ontological insecurity, once again, explicit. These issues will be further discussed in the next section.

7.3.4 Mobility and Migration: Globalisation, Resourcing, and the Lived Experience

Like Foucault (1980), Strathern (1988, 1995, 1999, 2005) argues that relations connect as well as divide, but he also emphasises the importance of paying close attention to the persons, things, occasions, and events that result in one network being cut off and a new one forming. This understanding can be compared with the argument that Latour (1990) set out when he referred to the formation of hybrids that generate the modern world as emerging from people and things. By drawing on these ideas to better understand the alignments, non-alignments, and realignments that occur within the construction industry, it is possible to come to a better understanding of how mobility and migration are both accessed and experienced. This applies to the hierarchical context of the industry, the origins and concentration of the workforce (i.e., international, national, or local), as well as material and human procurement issues, for example.

As previously acknowledged, mobility relates to the large-scale movement of heterogeneous actors through transnational and international spaces; such movement greatly impacts the everyday lives of those who are involved in the process (Erikson et al., 2010). However, mobility can also impact those who have not had to undergo large-scale movement, such as, local workers. As Hannam et al. similarly argued, “such multiple and intersecting mobilities seem to produce a more ‘networked’ patterning of economic and social life, even for those who have not moved” (2006, p. 2). This may be relevant to the Developer, who claimed (including in news reports) that the largest percentage of economic and construction value would go to UK based firms. Given that the project was situated on the border with Wales, it was emphasised by the Developer that those in Wales would most benefit in terms of supply chains and manufacturing when compared with international or even national companies (Barker, 2020; Chapter 6, Section 6.2.1.1).

From the data presented in Chapter 6, such claims are perceived and experienced differently by different workers. Despite the Developer’s stated objective that local and national firms would benefit most, the inescapability of the skills gap ended up creating several challenges for both the Developer and the construction firms and, especially for subcontractors from Wales. The precarious situation (i.e., in lack of skills, and benefits felt by overseas suppliers) even prompted news reporting (Macalister, 2015; Stein, 2022). Indeed, the Developer *problematized* (Callon, 1984) the issue by attempting to address this skills-gap through a solution: financing new training programmes and opening new facilities in local towns. This shows how both human and nonhuman actors were enrolled to play an equal part in problem solving. What’s more, the alignments made between facilities, finance, teachers, apprentices, and material components were extended to other networks abroad, such as in France.

Despite these long-term goals, the events occurring on the ground (relating to the realities of, for instance, scrutiny, suspicion, competition, and poaching) resulted in the emergence of questioning, owing to contradictory statements. Along with previous media reports (Macalister, 2015), participants in the project suggested that the economic benefits would go to overseas suppliers and contractors, especially the specialised skills and components based in France. Making matters worse was the language used by the Developer to construct facts, for example, in the uniqueness of the components required. When it comes to the

construction of facts, it was not just material actants that played an important and equal role. Again, events demonstrated how they may play an internal political role, too. This understanding is in line with Salter (2019, p.352) where he argues that ANT denotes a “flat ontology; that is, all potential actors are granted the capacity to have a political effect.”

When combined with the skills gap, increased reliance on an international supply chain (of both people and technology), and the introduction of stringent policy controls to mitigate the risks of the project, the circumstances made it even harder for local firms to get a foot in. Those firms that managed to succeed still had to deal with the risks accompanying competition with larger firms that were likely more secure, in both economic and political terms. Still, each level in the hierarchy was concerned with making sure they were secure. This meant economic security (including national, regional, company-level, and personal economic security); political security; health and safety security; environmental security; and ontological security (both community and/ or personal wellbeing). Depending on the different contexts of the contractors and the subcontractors, the accompanying effects were experienced differently as the risk was spread to companies at different tiers and felt by the workers involved. As Salter (2019) argued, securitisation processes were not so much about the effects of power, but rather more about the assembling of resources in order to stabilize social links. This is particularly evident with the Developer who ensured the continuous supply of resources.

The introduction of policies (as actors) was successful in creating a sense of worker security. But such policies also generated a sense of distrust or ontological insecurity, to the effect that they instantiated an “image of political–economic space” (Hannam et al., 2006, pp. 3–4), subsequently creating detachments in the network. This occurred for two reasons: First, because the Developer suggested that the majority of the supply chain for the project would be based in the UK; Second, because they promoted the impression of an equal playing field. This contrasted with the implied reality that was, in fact, highly selective and based on qualifications, experience, and specialisation, as the data showed in Chapter 6.

Fellini et al. (2007) argued that the firms working on NSIPs range from local to global—something that has the potential to raise its own set of challenges. This is especially true regarding the hierarchical processes that can facilitate or constrain other groups or

institutions. When it comes to the hierarchy, larger construction firms, such as T1's (MNC) that aligned well with the Developer were often perceived as the firms that belonged; conversely, those that struggled at the periphery were often perceived as not belonging (Law, 1992). The concept of belonging will be further discussed later. Here the implications for hierarchy were exacerbated by the fact that the employees of those T1 firms were mostly multinationals themselves. this suggests that alignments are constantly circulating internally.

In this way, a firm's *not belonging* can open up the necessary space for further alignments to emerge. This includes, with other networks, as demonstrated by some of the Welsh T3 subcontractors who expressed a desire to never return to the NSIP, or others who were relieved that their contract with the NSIP had come to an end. The subcontractors then made attachments with other networks by signing up to smaller and larger value contracts, some of which were even located abroad. As such, it is helpful to understand these circumstances of the findings in the context of the *liquid mobility* or *liquid modernity* set out by Bauman (2001), which emphasised constant mobility and change in the context of globalisation.

As a specific consequence of increased mobility in our contemporary society, various group identities are increasingly subject to different kinds of pressure. The result is that an individual's choice to identify with a particular group can bring about a sense of (in)security—as well as a sense of ontological (in)security. Such processes are often highly unpredictable, as when complete strangers are brought together, their interactions can establish entirely new social dynamics and cultural forms. As discussed in Chapter 2, in the context of liquid mobility, this understanding adds an important dimension when discussing processes of “deterritorialization”, “rhizomic attachments”, and reterritorializations”, that refer to forms of connection, detachment, and reconnection (Hannam et al., 2006, p.3; see also Shurmer-Smith and Hannam, 1994; and Sheller, 2004). Accordingly, both mobility and migration are responsible for transforming the social realities of individuals, families, and local communities, in addition to the public and private spaces in which they exist (Hannam et al., 2006).

This understanding of mobility and migration that Hannam describes can also be demonstrated in the interviews presented in Chapters 6 whereby the workers on NSIPs (who

came from all corners of the nation, as well as from abroad), often displayed an increased sense of commitment towards the local community. They did so, by, for example, living in the village and embracing the community or joining the local darts team (see Chapter 6, Section 6.2.2.2). The data also emphasised the importance of workers maintaining their family and social networks, given their work on a relatively isolated site for extended periods of time. Owing to the volatility—and accompanying precarity—of the construction industry, the social actors within it often sought to, again, create the stability and continuity that results in a sense of ontological security, as well as an increased sense of agency. They did so, not only through kinship ties in their family networks, but also through new kinship ties they could potentially create in their work and living environments.

In line with Kinnvall and Mitzen (2020), these were manifested in their social and political (i.e., internal) behaviours through *narratives*, *practices*, and *routines*, in order to create spaces for cooperation and companionship. Two colleagues may have driven to work together, for example, or shared a cup of coffee with one another before the workday began (see Chapter 6). Again, in all these examples, material and non-human elements (i.e., the accommodation, local community, darts, the pub, coffee, the car, colleagues) were enrolled in their (i.e., workers) networks. These elements were crucial to the development of forming attachments. However, these associations would not have been possible without the *agencement* of the different elements (Callon, 2007; also see Chapter 3). As these heterogeneous elements came together, it was their mere association that enabled their agency and, consequently, the effects they generated. This is similarly corroborated by Munro (2013, p. 126), where “behind every action lies an intention”. But through their enabled agency and the *power* that was granted to them, it is also possible to explore and trace any “changes to the action” (Munro, 2013, p. 128). This may be evident in performativity activities.

Once again, ideas of performativity are highlighted in the data and is confirmed in Carsten’s (2020, pp. 319-21) discussion in which she differentiates between two different aspects of “kinship”—the “performative” or “doing” aspect, on the one hand, and the “ascriptive” or “being” aspect, on the other. The author stresses the importance of “becoming” kin in performative ways and viewing migration as a form of “kinship-as-doing,” focusing on the present as well as the future rather than the past (Carsten, 2020, p. 321). In doing so, the

creative processes that generate first a sense of relatedness and then a sense of kinship ultimately come to the fore. Similarly, the data is also confirmed by Andrikopolous and Duyvendak (2020, p. 306) whereby, “new assemblages and innovative forms of kinship emerge in new settings of migration and mobility”. An example of this can be seen in our previous discussion, wherein a construction worker became a member of two local darts teams. Looking at the dynamics of kinship, thus, opens up different perspectives on the shifts in and transformations of kinship that not only make migration possible in the first place, but are also a consequence of the act of migration.

7.3.5 A Sense of Belonging

This section further explores a sense of belonging. In a network system such as the construction industry, which is characterised by rapid socioeconomic and cultural change, ontological security arguably becomes important for establishing a sense of belonging. This is achieved by routinising relationships; in the process of doing so, trust is formed (Mitzen, 2006; Kinnvall and Mitzen, 2020). Reciprocity also becomes increasingly important as a means by which to link the activities of dwelling, joining, committing, and conserving, all of which contribute to the chain of attachments, by playing important parts in generating feelings of belonging.

Drawing on the previous example of the contractor who was able to participate in his local community network (in the context of mobility and migration), here ideas of belonging are explored through “transactions” and “reciprocation” (Carsten, 2001, p. 152). This includes the performative action of being accepted by the community, which is dependent on becoming a member of its social structures. The data shows how even though some contractors were not able to establish the same kinds of kinship ties as other members of the community, they were nonetheless able to form connections and attachments through “commitment” (Edwards and Strathern, 2021, p. 152). As Edwards and Strathern (2021) pointed out, connective term, such as *belonging*, *association*, and *relational*, have positive overtones, suggesting a productive and generative logic, and also signify homogeneity and shared values.

In line with Edwards and Strathern (2021), connective terms and the positive reinforcements they generate can also be explored in the example of the pin badges, in which the pin badge itself connects and becomes *relational*. For example, as a material actor, the badge acts as a symbol that marks the achievement of successful milestones. The pin badges were thus enrolled within the construction network, generating feelings of kinship among colleagues, as well as with the employer, and a sense of belonging to the NSIP project. These kinds of actors (i.e., pin badges) demonstrated not only the achievement of worker security, but also of ontological security as status was attached to the badge. The established attachments could then be extended beyond the network of the construction site to that of the family. Homogeneity and shared value were maintained in all of these instances.

Returning to the example of *transactions* and *reciprocation* between the subcontractors and local community, positive associations of belonging are not completely *value-free* (Carsten, 2001; Edwards and Strathern, 2021). As seen in the data for instance, it may be the case that the heterogeneous elements (i.e., workers and alcohol) that have the potential to influence the local community carry negative overtones; in which subcontractors were seen as drunkards displaying anti-social behaviour (see Chapter 6, Section 6.2.2.2). Therefore, the data shows how the concept of transactions and reciprocation may also be linked to implications of “marginality”, and controversy in the network, in turn (Edwards and Strathern, 2021, pp. 152–153; also see Chapter 3).

An understanding of commitment and reciprocation as not completely value-free can be further explored through those subcontractors at the bottom of the hierarchy who experienced the challenges of a financial burden. In terms of the need for additional extra workers for a particular job, as seen in Chapters 5 and 6, it appears that the commitments made by the Developer made to the T3 subcontractor regarding the terms and conditions of the contract were not fully honoured. But given other precarities of the NSIP, such as the volatility of the construction site, this resulted in the Developer having to adjust according to the demands of the day. The expectations that the Developer set out for the supply chain, which were to demonstrate commitment and compliance generated further controversies or precarity in feelings of distrust, which led to anxiety and in turn instability in the network. In essence, the concepts of commitment not being value-free highlights this contrasting idea about homogeneity and shared values detailed by Edwards and Strathern (2021).

Moreover, such attributes of commitment, compliance and reciprocation are not only generated in the network, but subsequently contribute to it, meaning these attributes shape the network, too (Law, 1992; see also Chapter 3). This understanding by Law (1992) is evident in the data. For instance, even though subcontractors themselves needed to demonstrate commitment, there was no reciprocal commitment from the Developer when initial agreements were subsequently broken alongside the chains of association. The affected participants revealed that other subcontractors had had to deal with similar experiences (see Chapter 5, section 5.2.1.1). When it comes to a sense of belonging, the subcontractors initially felt that they would play a part in the development of the NSIP, with the accompanying long-term benefit of financial security. This feeling soon gave way to a sense of not belonging. Once again, alignments were established among those who had similar experiences resulting in a sense of not belonging to the construction of the NSIP. This is confirmed by Yuval Davis (2006), who similarly explained these ideas in terms of individuals who find themselves caught up in processes of *wanting to become* or *wanting to belong* that can involve connections and disconnections or interactions with others.

The precarities faced by accommodation providers provide a further example in processes of wanting to belong and commitments being broken. In this instance, it was possible once again to trace the relations between heterogeneous elements and the (dis)connections that resulted from such evolving developments. At the beginning of the project, the owners of the small local hotels would have felt secure given the suggestions of commitment from the Developer. From the perspective of the Developer, however, the building of campus-style sites (with sports facilities, gym, cafes restaurants, and free Wi-Fi) would have been an attractive proposition as they could be marketed to prospective workers while simultaneously heightening the sense of belonging for those workers who worked and lived on site. The local town council also aligned itself with the Developer by permitting the construction of (chain) hotels in order to boost the local economy.

Here, the abilities of networking are explicit and demonstrates, as Munro (2013, p. 128) puts it, “the power of associations [and its] effects”. The *effects* in the findings included a large wedge between the two communities (i.e., the construction workers and locals) - with the local community and supply chain completely cut off from not only the contractors, but the project itself that they were to purportedly benefit from. Contrary to what the hoteliers

wanted in terms of belonging, the resulting effects were that of *marginality* (or detachments) and therefore a sense of not being part of the NSIP. As such, these examples both indicate the experience of worker (i.e., physical) and ontological insecurity.

7.4 Chapter Summary

Although this chapter has focused on (in)security as the key theme, the ANT framework has illustrated how the *social* is, in fact, materially heterogeneous. The framework further highlights some of the ways in which the processes of attachment and detachment can be assembled or reassembled. As a direct result of this approach, the aim of the research could be achieved in understanding how contractors and subcontractors perceive and experience their work on NSIPs along with the impacts of the NSIP on them. Moreover, through the various empirical examples in the data the chapter has demonstrated how the analysis is associated with the existing literature.

This chapter has featured a crucial understanding throughout: that in order to support their own network structures and interests, actors actively work on strengthening relationships by creating alignments in interests. In this way, they can attract different audiences in the context of their various social roles, enabling them to better achieve their objectives. Similarly, Latour (1987) compared the examination of scientific facts to the two faces of Janus in Roman mythology. On the one hand, there exists an already established scientific fact; but, on the other, there is the process of making facts happen. Tracing such processes reveal how facts are constructed through various collaborations. Latour (1987) further assigned technological and scientific innovation to *black boxes* in which an innovation's own success made it invisible (e.g., a light switch), and therefore the innovation itself needed dismantling. Throughout the chapter, a similar attempt was conducted to dismantle that black box of NSIPs purported to boost jobs, skills and social wellbeing, economic growth, and sustainable development in order to explore their inner workings and the effects on those responsible for their construction.

As noted, Law (1992) set out an understanding of *immutable mobiles* where networks were able to hold their shapes so long as their various elements remained enrolled. However,

networks comprising interacting and heterogeneous actors are often perceived as precarious and by no means do they function homogeneously. Even so, their heterogeneous elements often “fold together” to reveal the network’s economic, political, social, cultural, ethical, and technical dimensions (Harvey et al., 2016, p. 51). Drawing from these related ideas, one can suggest that patterned networks are performed more regularly than other networks, which Law referred to as “punctualisation” (see Law, 1992, pp. 4–5).

In this respect, the networks that are both more visible and more regularly performed are likely to be the ones in which new knowledge is produced, such as on occasions where (in)security and ontological (in)security occur. Even though networks are generally volatile and often encounter various forms of resistance (i.e., failed networks are the outcome of breaks in their chains of association), punctualised resources have the capacity for rapid adaptation, meaning that they can join other social networks (Law, 1992). Nonetheless, the main objective of network analysis or ANT is to consider how and when new knowledge is produced through the construction of facts. Such consideration enables a better understanding of how one can belong or not; how one can become entitled (including kinship relations) or not; and how one be included or not, owing to “their failure to be part of something” (Edwards and Strathern, 2021, p. 153).

Ultimately, the desire to achieve a certain level of security (not just physical security, but also financial or other forms of security) is typically a key objective, if not an ideal. The implications of the various activities designed to generate such security, however, underscore the relevance and importance of this research. Furthermore, it is common knowledge among contractors and subcontractors that working on a NSIP can essentially provide such a level of security over a certain period of time, as well as open up further such possibilities in the future. But, as the theoretical (e.g., Harvey, 1989; Harvey et al., 2016; Larkin, 2013) and empirical evidence has shown, infrastructure projects are extremely precarious. This means that a sense of ontological security is equally necessary to maintain a secure and homogeneous community of construction workers.

CHAPTER EIGHT: CONCLUSIONS

8.1 Introduction

The purpose of this final chapter is to present the conclusions of the thesis. This research explored the Impacts of Nationally Significant Infrastructure Projects (NSIPs) among Engineering Contractors and Subcontractors, specifically looking at Actor Network Theory as a theoretical lens to better understand the nature of NSIPs. This study shows that unfavourable conditions and challenges in such environments. This chapter begins with a review of the broader research aim and objectives that were set in Chapter One. Following this, the themes are summarised and highlight key theoretical, practical, and methodological contributions to knowledge, with a subsequent section on reflections discussed. The chapter then concludes with the limitations and identifies directions for future research, followed by closing remarks.

8.2 Revisiting the Research Aim and Objectives

This study aimed to obtain a broader understanding and attain a greater depth of how the work of contractors on NSIPs is distinctive and how participants experience it. The underlying argument is that infrastructures (and NSIPs) are precarious despite displaying a facade of permanence, reliability, and stability (Graham, 2009). Moreover, the construction sector constantly requires a specific commitment from a range of contractors, each with very different motivations and prescribed responsibilities (Dainty et al., 2013). NSIPs are a subset of the construction sector, and the nature of their environments requires employees to do more than counterparts in other built environments. NSIPs as a context are different and include distinctive security elements. This leads to experiences of working on NSIPs that may be visible, and some may reflect invisible work (Latour, 1999).

As outlined previously, this study adopted an ethnographic qualitative methodology to fulfil the broader aim of the current research, and an actor network theory lens was adopted to facilitate an in-depth exploration of how contractors experience working on NSIPs.

The findings of this study highlight three main themes that are related to working on NSIPs and are included in Chapters five and six. The first two include higher order themes namely, (1) policy controls and (2) felt obligations. Further analysis using ANT revealed the inter-relatedness of the two themes which led to the third overarching theme as, (3) (in)security.

8.2.1 Policy Control

Policy control brings together key concepts from the data that include issues relating to accountability, qualifications, and health and safety policies seen in chapter five.

8.2.2 Felt Obligations

Chapter six concentrated on internal controls (as opposed to external controls in chapter 5), whereby felt obligations of the construction engineers focussed on issues relating to their work, community, and family. These are revealed through the analysis of the key concepts of mobility, migration, globalisation and through a sense of belonging and kinship.

8.2.3 (In)Security

In both chapters five and six, ANT has revealed the complexities of NSIPs and how construction worker networks are regulated onsite. Through the generation of external and internal controls the emergence of two different forms of (in)security are experienced by the workers, which include worker (in)security and ontological (in)security. Worker security refers to physical security that maintain, social, economic, and political (internal bureaucratic) conditions, whereas ontological security refers to the psychological aspects of (in)security.

8.2.4 Conclusions of the key findings according to the research objectives (RO)

The conclusions of the key findings according to the ROs presented in Chapter one is summarised as follows:

RO1: To develop a critical and comprehensive understanding of work on a NSIP

In response to the first research objective (RO1), the literature chapter explored the NSIP context and applied ANT as a lens for the study. The discussion focused on infrastructure development, marked by complexity, and often accompanied by risk factors which are not entirely within the control of those in power (Flyvbjerg 2014; Flyvbjerg et al., 2003). Even though NSIPs are large-scale developments that fast-track the development process (Planning Act, 2008) to realise its benefits of boosting jobs and skills, economic growth, and sustainable development more quickly, it is also highly costly and inescapably affect broader cultural, economic, and political contexts (Bridge et al., 2018). Moreover, there is the emergence of a range of contemporary impacts: rapid changes in technology, the accompanying processes relating to obsolescence (to maintain consumer demand), increased turnover of capital, as well as an extensive and often volatile geographical restructuring (Harvey, 1989). Harvey also highlights the continuous restructuring of corporate entities, which resulted in previously dependable bureaucratic careers and union-negotiated labour contracts being replaced with more adaptable forms of production. In this sense, these challenges may impact the construction workers contracted to build them (Harvey et al., 2016). As such, control activities are put in place to mitigate risk factors (e.g. nuclear environmental disasters and health and safety risks). However, despite these activities, risks still emerge in different forms. These include through the concepts that are later developed in the analysis and findings chapters (as seen previously) relating to issues of policy, audit and accountability, globalisation, migration, and mobility, as well as kinship and a sense of belonging.

Policies and regulations that attempt to mitigate risks consequently cause contractors and subcontractors to be caught up in a series of never-ending controls. On the other hand, for the developer, control policies enforce a number of common goals: best practices, avoiding risk, and achieving economic efficiency (DBIS, 2013; Fellini et al., 2007). However, considering that workers are paid by the hour, there may be implications on, for example, profit margins. For other workers and firms, such an environment may bring implications of anxiety and a sense of not belonging. This is especially significant within the context of an industry that is seen as highly competitive (nationally and internationally), fragmented, and volatile (Barry, 2020; Dainty et al., 2013).

RO2: Analyse the significance of ANT to experiences of working on NSIPs

The findings of this study advance the current understanding of the significant role of ANT in exposing how contractors work on NSIPs such as precarious, unfavourable working conditions and location. However, ANT reveals how security becomes laboured into the progress of working on NSIPs and the erosion of security the further down the hierarchy the contractor is. Consequently, it is not surprising that contractors are unwilling to work on NSIPs due to their negative experiences. For example, contractors work to seek security through wider social relations rather than their contracts with the developer. In this sense, workers desire safe, stable, and comfortable environments that create a sense of belonging and ontological security (Giddens, 1990; 1991; 1994; 1999). Moreover, worker insecurities such as precarious employment, which involves instability in employment, income, access to benefits contribute to distress and a new political economy of insecurity (Kalleberg, 2012; Kalleberg and Vallas, 2018).

Essentially, the ultimate quest for a sense of security, encompassing not only physical security (e.g. financial) and ontological security (e.g., a sense of belonging), remains a central objective for contractors and subcontractors. The research underscores the importance of understanding the implications of activities aimed at achieving this security. In terms of ANT, its key theoretical and analytical component is its ability to be a framework in social science research that allows everything – in the material, social, and technical worlds – to be linked together in equally performing relationships that are referred to as actor networks (Law, 1992). Similarly, analysing these actor networks reveal the attachments, detachments and reattachments that are made by the workers. As such, this is the crux of ANT that is crucial for exploring NSIPs in which all of its components, human and non-human are implicated.

RO3: Develop an understanding of contractor relations in NSIPs

With the study informed by ANT, the findings reveal challenges of securitization. The developer is tasked with delivering on sustainable energy commitments, thus tight regulations ensure security is put in place not only for the government but also for the developer's own financial and internal political security. In this way, policy controls are transferred to different tiers within the construction hierarchy. The impact is most felt by T2

and T3 subcontractors. The findings show how ANT is used to trace the audit trail subsequently revealing the interrelatedness of the different actors involved within the NSIP.

In chapter five and six, alignments are primarily made between the developer and the T1 contractors, with performativity activities between heterogeneous actors to ensure policy agendas are met. In this way the security of the actors is maintained, while at the same time holding others responsible. The findings reveal instances of resistance and failed networks by, for example, T3 subcontractors. As a result, while some actors become detached and form attachments in other networks, simultaneous alignments and realignments are generated with others. Each actor is seen as actively performing their own agenda, attracting diverse audiences (non-human actors) to achieve their objectives (Latour, 1996b; Law, 1992; Strathern, 1996).

RO4: Outline the implications of the ANT perspective for contractors on NSIPs

This section is a signpost that the infrastructure is not fixed and many of the anticipated outcomes are not delivered. The temporal nature of NSIPs and how it depends on a mobile labour force, regular and irregular work, the hierarchical positions of contracting firms and the development of social relationships through routines and trust are highlighted (Mitzen, 2006; Barry, 2020, Dainty et al., 2013; Fellini et al., 2007). Construction workers experience a juxtaposition of attempting to establish a sense of self while being exposed to a rapidly changing system culturally and economically (Kinvall and Mitzen, 2020). For example, the findings draw on relationships in the construction industry where ISO standards are set by the developer and communicated by T1 managers and interpreted by the workforce. Cultural differences in approaches create challenges in enforcing a nuclear safety culture.

A further example points to the perception of an international workforce as contradictory to promises of local economic benefits can lead to the breakdown of relationships and the formation of detachments and questions about worker security and ontological security. The developer claimed that local and national firms, including local private hotels and B&Bs would benefit economically from the project, but the skills gap and new hotel chains posed challenges. As a consequence, local subcontractors especially from Wales, and local communities faced difficulties in benefitting as expected. ANT highlights how translation

processes between heterogeneous elements are key in creating new links and hybrid networks (Law, 1992; Strathern, 1996). Mobility (e.g., skills gap) can thus weaken relationships but also generate or regenerate relationships, potentially resulting in new forms of sociality (Anikopoulos and Duyvendak, 2020).

8.3 Contribution to Knowledge

Theoretical

The primary motivation of this thesis was to address an ongoing issue in the literature that suggests a need for more research in the development of NSIPs. By exploring how contractors experience working on NSIPs a new insight emerges of the workers lived experiences.

Firstly, prior research has somewhat overlooked NSIPs and their distinctive environments (e.g., Bridge et al., 2018; Flyvbjerg, 2008, 2009, 2014; Flyvbjerg et al., 2003; Niewohner, 2015). Notably and as mentioned, NSIPs have key dimensions: boosting jobs and skills, economic growth, and sustainable development. Moreover, the research highlights the crucial role of NSIPs in addressing the global climate crisis. As climate change becomes an increasingly urgent issue, infrastructure projects are at the forefront of efforts to mitigate its effects. In the specific case of nuclear power stations, benefits will include bolstering the domestic electricity supply at preferential costs to domestic consumers. Thus, research has mainly focused on the positive impacts of NSIPs (Dainty et al., 2007; Planning Act, 2008). However, current understandings of the experiences of working on NSIPs remains incomplete. To this end, the current study developed this area of research by exploring how contractors experience working on NSIPs.

Second, this study contributes to a limited number of studies on NSIPs. Moreover, an important revelation in the research study is that little emphasis has been made on construction practices (Dainty et al., 2013; Pink et al., 2010). However, what is most unique is applying an ANT's theoretical and analytical framework in a virtual ethnographic setting (Emirbayer, 1997; Hine, 2000). Virtual ethnography ensures inclusivity by allowing a broader range of participants to share their experiences as opposed to traditional ethnographic

methods in which geographical constraints, time, or other factors (e.g., Covid) could be a hindrance (Beaulieu, 2010; Hine, 2000). However, by combining the strengths of traditional ethnography with the opportunities offered by a virtual setting, virtual ethnography has enriched the ability of the research study to produce a valuable contribution to knowledge in the context of NSIPs. Thus, insights into new knowledge contribution would simply be impossible to achieve by using quantitative methods.

Third, by the nature of NSIPs, marked by complexity and often accompanied by risk, this research highlights the need for a comprehensive understanding of infrastructure's (i.e., NSIPs) multifaceted dimensions. This research, therefore, contributes by opening the door to this discussion and highlighting reasons that lead employees to continue to be so.

Practical and Methodological

The findings of this research offer practical insights using ethnography, and as indicated virtual ethnographic methods in the research study. By understanding the fluid and ever-changing nature of NSIPs, policymakers can make informed decisions that account for the complexities and uncertainties inherent in these projects. For stakeholders, including contractors and subcontractors, the study is crucial in understanding themes in security and insecurity in a precarious environment. By using in-depth ethnographic/virtual methods it offers practical guidance on navigating the challenges of NSIPs as it allows to identify not only formal relationships but also the informal, subtle connections that underpin the actor's experiences. In this way, ethnographic methods help uncover hidden controversies, alliances, and tensions within the network, contributing to a more comprehensive understanding. In sum, qualitative methodological methods (using vignettes and virtual ethnography) equip future researchers and practitioners with tools to better understand and address the impacts posed by NSIPs in an ever-evolving world.

Analytical

In addition to theoretical and practical contributions, ANT offers a unique analytical theoretical framework (Latour, 2005), that equally studies human and non-human components implicated in the study of NSIPs. This is different to other analytical frameworks, for example, social network analysis (Emirbayer, 1997), where human and non-

human components are analysed as two separate domains. Moreover, in contrast to ANT, the non-human elements play no part in shaping human action or creating human meanings which are crucial in understanding actor networks within the context of NSIPs. In this way, by applying ANT, the research transcends traditional paradigms, shedding light on the complex and interconnected networks within the realm of infrastructure development.

8.4 Reflections

Upon reflecting on the research study, one may draw on the following conclusions: (1) The absent voices in the research sample which reflected the Developers resistance to the study; (2) the appropriateness of the research design and; 3) the role of the researcher in this research.

8.4.1 Absent voices

The research had initially intended to work with a gatekeeper to facilitate access. Following a number of meetings, it became apparent that the in-depth experiences of construction workers on NSIPs might be difficult reading for the developer who would not be prepared to endorse such a study. This was a huge disappointment as the access had been assured to the point of rejection and alternative access was secured as discussed in chapter four. During the course of the study a meeting was arranged with scholars who had experience of ethnographic studies on large scale construction projects and their reassurance to persevere was significant. The insights generated by the participants provide depth that may have been withheld if gatekeepers selected the study participants.

8.4.2 Methodological Reflexivity

Although access restrictions limited the study population, this is balanced by the richness of this study lies in the nuanced, contextual factors that qualitative studies allow. The covid-19 pandemic and the demand to stay home also meant a traditional ethnography would not be possible during the study time scales. Virtual ethnography not only afforded a means to

continue the study but also provided a valuable addition to the initial study design. However, towards the end of the research study, an opportunity was presented after Covid-19 to visit the research site. This enabled a better understanding and put into perspective the experiences discussed by the participants by revisiting the site in person. Please see photographic samples seen in appendix H.

8.4.3 Epistemic Reflexivity

Examining the position of the researcher within the research process is an important part of social science research, acknowledging that the research is a product of the researcher, and that their assumptions and bias will undoubtedly have an impact on the research. The decisions made in the design of the research were made in order to provide an in-depth and credible account of the participants lived experiences of working on NSIPs as possible and the findings provide one of many possible insights. In this regard a different researcher with a different experience and focus or interest may have yielded alternative findings which is entirely consistent with an ANT and ethnographic approach. This research has involved exploring engineering contractors' perceptions and experiences of working on NSIPs, a project affected by a multitude of heterogeneous actants. These include other stakeholders directly or indirectly involved, plus economic, internal political issues, policy, and technical concerns. The issues impact other related networks, including the surrounding landscape and environment more generally. These systems are complex, with one actant's ability to act depending on the actions of others (Latour, 1996a). Using the ANT framework as the foundation for this ethnographic study to explore the perspectives of actors has heightened the responsibilities as a researcher in a number of ways. These include reflections on the way in which writing evolves and text is constructed, the relationship of the researcher to the study, the spaces in which the accounts have been recorded and the recognition of difference and its accompanying complexity (Rapport and Overing, 2000).

This reflexivity also extends to understanding the various ethical concerns that arise during the storage of data collection (See Appendix G - GDPR Certificate). Informed consent from participants acts to preserve their confidentiality and rights which were carefully considered throughout each stage of the research process.

8.5 Limitations and Future Research

While this study provides an enriched understanding of experiences of working on NSIPs this study is not without limitations.

Firstly, this research explored contractors lived experiences of working on NSIPs.

Consequently, a more focused attempt can explore back-of-house employees' perspectives to show how they experience working in heritage hotel back work areas.

Further, this study did not explore the developer perspective. Another limitation is that this study focused on one NSIP. In this regard, the research recognises that qualitative research has some limitations regarding the limited sample group whereby the results cannot be generalised beyond the sample group. However, this research study is appropriate for the aims of the study and the research question in which the ultimate goal is not obtaining statistical results as in a quantitative research study. Rather this research is to explore the various perceptions and experiences of those who are best placed to share their insights about working on NSIPs. In turn, this research may set the scene for future research in which other NSIPs may be explored.

In terms of ethnographic methods, Marcus and Fischer (1986) and Birth (1990) point to the limitations of ethnography's ability to portray other communities adequately, and to what extent are the truths of the participants demonstrated. However, according to Lather (2001), ethnography's limitation to representation and legitimisation of knowledge can be overcome by a *reflexive turn*. This is where researchers practice critical consciousness and remain accountable to accompanying complexities during their research processes.

Further on qualitative research limitations, the ANT framework acknowledges that there are many shifting frames of reference and one can get lost whilst following the actors. Latour (2005) however, argues that this can be overcome with the researcher making the right judgement calls as to which actors are important within a network and which are not.

Finally, this study is consistent with Dainty et al. (2007; 2013) and Pink et al. (2010) that there is a need for more stories about employment relationships on NSIPs.

Notably, this sector requires high employment commitment yet does not appear to provide the security one might expect of an NSIP. It is acknowledged in the literature in section (2.11) that there are long-standing contradictions that undermine the sector.

8.6 Concluding Remarks

The chapter has displayed the conclusions of this thesis, revisiting the research aim and objectives, presenting an overview of the study and outlining conclusions from the findings. The theoretical, practical, methodological, analytical and reflective contributions have been presented, and suggestions for further explorations outlined.

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APPENDIX A: PARTICIPANT INTERVIEW QUESTIONNAIRE

Participant Interview Questionnaire for Engineering Contractors

1. What is your professional background?
2. How many years have you been working in the industry and on this project?
3. What are the services that the company provides? (i.e., design, manufacturing, electrical works etc; directly or indirectly involved in the project; Tier 1, 2, or 3 or supply chain).
4. What are your main responsibilities?
5. Question for managers
 - 5.1 How many employees work on the project and what are their typical job categories?
 - 5.2 Where are the main workforce drawn from i.e., local regions or overseas?
6. Do you live locally or commute every day? If so, why?
7. If you commute are there any challenges to long range commuting?
8. What are the most significant benefits on working on a NSIP?
9. What are the most significant challenges on working on a NSIP?
10. If worked on other infrastructure projects, what are the main differences when compared to a NSIP?
11. What does a typical day look like if working on a nuclear site?
12. Are you able to provide me with other potential participants?

APPENDIX B: PARTICIPANT INFORMATION SHEET

Exploring the Impacts of Nationally Significant Infrastructure Projects (NSIPs) among Engineering Contractors and Subcontractors.

PARTICIPANT INFORMATION SHEET

Background to this study.

This research is an in-depth analysis of one Nationally Significant Infrastructure Project. The importance to the UK economy of such projects is expressed in the form of three key benefits including supporting sustainable economic growth across all regions of the UK, improving competitiveness, and improving quality of life. It is therefore unsurprising that in 2017 the Infrastructure and Projects Authority allocated £117bn to deliver infrastructure projects in the energy sector alone.

While previous studies have highlighted the long-term UK economic benefits, what remains less well known is the impact upon the local regions, both in economic and non-economic terms and specifically in relation to regional, social, and local economic benefits.

What is the purpose of this study?

The focus of the research is to concentrate on all the dynamics of the project, including the construction industry and more specifically, the workforce working on the project, hence the exploration of contractor's experiences working on a Nationally Significant Infrastructure project, and how the project contributes to local regions.

As such, it is an ethnographic research project that examines the impact of Nationally Significant Infrastructure Projects (NSIPs) on contractor's and subcontractor's management and construction workforce as well as on the regional supply chain. The study considers the multiple voices of stakeholders who have different interests in the project and therefore divergent understandings of the kinds of impact. By conducting a study of those involved in its delivery, it will provide a unique insight, a deeper understanding, and more of a holistic perspective of impact beyond economic benefits. The study is concerned with issues of who benefits, why, when and under what conditions are these benefits felt.

Stakeholders will be engaged with to take account of the tangible experiences of all those within and bordering the NSIP. In-depth ethnographic studies examine how both working and social life is experienced across a divergent range of stakeholders and crucially why developments such as this are experienced in the way they are. Taking account of distinct sets of challenges and benefits enables a close examination of processes that are involved in the successful delivery of such a dynamic project from a multitude of perspectives.

Why have I been chosen?

You have been chosen to take part in this study as you have volunteered to take part or have been suggested by another work colleague.

What would taking part in the research involve?

Taking part in this research will involve participating in a phone or video interview that will be audio recorded. You will be asked if you would like to continue taking part as part of a longitudinal study of stakeholder experiences on the impact of the project.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part, you are still free to withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision not to take part, will not affect you in any way.

What are the possible disadvantages of taking part?

There are no disadvantages, although taking part in interviews may take up to half an hour in length.

What are the possible benefits of taking part?

- Key opportunity to generate in-depth qualitative insights in a largely under explored area. Without this type of research, experiences, practices, and implications will remain unknown.

- This research explores how, why, what, where and when there are social impacts and under what conditions and contexts in order to identify opportunities that could influence future policy initiatives and in turn benefit stakeholders.

Will my taking part in this study be kept confidential?

The information that you provide is anonymous. The information will be stored using study numbers on a password-protected computer within a locked office at Swansea University. Your name will not be stored with your interview data. No information about any single individual will be made available to any other person. Only anonymised information will be given in any reports of the study with no indication of any participant's identity. When the research is completed and reported, all the transcripts and tapes will be stored securely for a period of 10 years to allow for reports to be made on the results of the research and so that the accuracy of the information can be checked if necessary, during that period.

Who is conducting the research?

This research is being undertaken by Maria Teresa Borraz Doubell. *Please see short biography attached.*

Who has reviewed this research?

Dr Paul White and Dr Jocelyn Finniear both of whom are supervisors to the doctoral study and are associate professors within Swansea University School of Management. They have had extensive experience in conducting sensitive field research in the UK and elsewhere. This project has also been reviewed and received ethical approval by the Swansea University Ethics Committee.

What happens if something goes wrong?

If you are harmed by taking part in this research project, there are no special compensation arrangements. If you are harmed due to someone's negligence, then you may have grounds for a legal action. Regardless of this, if you wish to complain, or have any concerns about any aspect of the way you have been treated during the course of this study then you should

immediately inform the researcher; Maria Borraz Doubell, or Dr Paul White or Dr Jocelyn Finniear (details below).

What will happen to the results of this research study?

The research will also be published in the form of academic papers in management, organisational studies and sociological journals and presented at academic conferences in order to disseminate the research findings. A final report will also be made available to inform public policy and will be available to participants on request.

Participants will not be identifiable in any of the research papers or reports.

How to withdraw from this research?

As noted above, you are free to withdraw from this research at any time without having to give a reason. If you wish to withdraw, please contact the researcher in order to ascertain whether you wish to withdraw altogether or retract any information already provided.

Who is organising and funding the research?

This research is funded by the SURES (Swansea University Research Excellence Scholarship) programme, and the research will follow British Sociological Association (Professional Body) and the Economic and Social Research Council (statutory funding body) ethical guidelines (copies available on request).

What happens next?

The researcher (Maria Teresa Borraz Doubell) will contact you by e-mail, or by telephone (if they haven't already done so) to arrange a date to take part in a telephone or video interview. Please keep this information sheet for your information; should you agree to participate in the research you will also be given a copy of the signed Informed Consent form for your records.

The research team would like to take the opportunity of thanking you for reading this information sheet. If you have any questions about this research, or require further information, please contact the study Researchers in Swansea University:

Postgraduate research student: **Maria Teresa Borraz Doubell**

E- [REDACTED]

Telephone: [REDACTED]

Or

Supervisor: **Dr Paul White**

E-mail: [REDACTED]

Supervisor: Dr Jocelyn Finniear

E-mail: [REDACTED]

Address:

Swansea University, School of Management, Bay Campus, Fabian Way, Swansea, Wales, SA1 8EN.



Maria Teresa Borraz-Doubell is an anthropologist who is currently studying towards a PhD at Swansea University. She is the recipient of the Swansea University Research Excellence Scholarship (SURES). She completed her Bachelor of Arts at the University of South Africa and obtained a distinction in anthropology studies and psychology. Maria then went on to study at the National University of Ireland Maynooth where she completed her Master of Arts in Anthropology and Development with a first-class honour. Her research interests lie in the area of infrastructure development and contested values. Of specific interest is the development of energy infrastructure projects, particularly in the context of renewable energy, decarbonisation, and sustainability. Maria lives with her husband and three children and is a keen hill walker, with a passion for the natural environment. She is a member of The Royal Anthropology Institute of Great Britain and Ireland.

APPENDIX C: PARTICIPANT CONSENT FORM

Exploring the Impacts of Nationally Significant Infrastructure Projects (NSIPs) among Engineering Contractors and Subcontractors.

CONSENT FORM

The participant will complete this consent form themselves.	(Please circle)
1. Have you read this information sheet? (Please take a copy with you to keep)	YES/NO
2. Have you had an opportunity to discuss this study and ask any questions?	YES/NO
3. Have you had satisfactory answers to all of your questions?	YES/NO
4. Have you received enough information about the study?	YES/NO
5. Do you understand that you are free to withdraw from the study: <ul style="list-style-type: none">• At any time?• Without having to give a reason?• That details of participation up to the time of withdrawal will be stored anonymously on file and may be used in the final analysis of data	YES/NO
6. Have you had sufficient time to come to your decision?	YES/NO

Signed (Participant):

Date:

Name (Please Print):

I have explained the study to the above participant, and they are willing to take part.

Signed (researcher): Maria Borraz Doubell.....

Date: 26/05/2021.....

Name (Please Print): Maria Borraz Doubell.....

APPENDIX D: ETHICAL REVIEW FORM

SCHOOL OF MANAGEMENT, SWANSEA UNIVERSITY

FIRST STAGE ETHICAL REVIEW FORM

*To be completed for all research involving human subjects OR
datasets of any kind OR the environment*

Name of PI or PGR Student	Maria Teresa Borraz-Doubell
Staff Number or Student ID	
Supervisors*	Dr Paul White Dr Jocelyn Finniear Professor Nigel Morgan
Date Submitted	28-01-2020
Title of Project	The impact of Nationally Significant Infrastructure Projects on community, worker and environmental wellbeing
Name of Funder / Sponsor*	Swansea University
Finance Code / Reference*	Swansea University Research Excellence Scholarship Programme
Duration of Project	01/10/2019 – 30/09/2022

* Complete if appropriate

Risk evaluation: Does the proposed research involve any of the following?

✓ **Tick** those boxes for which the answer is **YES**

X **Cross** those boxes for which the answer is **NO**

Participants

- ☒ Will the study involve recruitment of patients or staff through the NHS or the use of NHS data or premises and/or equipment? If this is the case, the project **must** be reviewed by the NHS. Please see the following NHS online tools for help with this <http://www.hra-decisiontools.org.uk/research/> and <http://www.hra-decisiontools.org.uk/ethics/>
- ☒ Does the study involve participants aged 16 or over who are unable to give informed consent? (e.g. people with learning disabilities: see Mental Capacity Act 2005. All research that falls under the auspices of the Act **must** be reviewed by the NHS)
- ☒ Does the research involve other vulnerable groups: children, those with cognitive impairment or in unequal relationships? (e.g. your students). This **may** require NHS review, and will typically require the researcher to get **Disclosure & Barring Service (DBS) clearance** (formerly CRB checks)

- ☒ Will the research harm or pose any risk to the environment? (e.g. research in environmentally sensitive areas (e.g. SSSIs); permission needed to access field sites; transport of samples between countries (e.g. soil); sampling of rare or hazardous material (e.g. invasive species) that could deplete or endanger)

Please describe the participants involved in your research (if no participants, state 'none'): *max 250 words.*

I have an extensive network of contacts in the various institutions and organisations. These include but not limited to: the financiers of the project, Electricité de France (EDF) and the China Nuclear Power group (CGN); contractors and subcontractors for example Balfour Beatty and Laing O'Rourke; representative bodies such as the Electrical Contractors Association (ECA) and Unite; statutory bodies such as Ofgem, local political representatives (local council), the infrastructure Planning Commission and the Department of Energy and Climate Change; local protest groups such as Stop Hinkley, community leaders, local residents and the construction workforce; the tourism sector such as the South West Heritage trust, the visitor centre at Hinkley Point as well as Cotswold Archaeology.

It is anticipated that participants will be stratified across three broad domains including:

1. Representative Bodies including Employers' Associations, Trade Unions, Developers (EDF & CGN), statutory bodies (n=20);
2. Construction industry, involving defined suppliers which range from corporations to small enterprise (Tier 1-Tier 3: n= 20) and from senior managers and engineers to unskilled workers;
3. Local Community, including local council members, residents, agricultural and tourist business owners (n=20)
4. Transient parties including tourists, protest groups, heritage groups (n=20)

The research will continuously establish a thorough and extensive network of participants as the project evolves by identifying all the stakeholders involved.

Recruitment

- ☒ Will the study require the co-operation of a gatekeeper for initial access to the groups or individuals to be recruited? (e.g. students at school, members of self-help group or residents of nursing home?)
- ☒ Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g. covert observation of people or use of social media content)
- ☒ Will the research involve any form of deception? (e.g. misinformation or partial information about the purpose or nature of the research)
- ☒ Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?
- ☒ Does the research involve members of the public in a research capacity? (e.g. participant research; participants as co-producers or data collectors)

Please explain the recruitment of participants involved in your research (if no participants, state 'none'): *max 250 words.*

Initially my first objective would be to gain the support and sponsorship by the various statutory and representative bodies mentioned above, some of whom will be the initial gatekeepers who allow access to key stakeholders for example the ECA. This will be achieved by organising meetings and presenting my research proposal to individuals and at organised events. I will then prepare to conduct an in-depth ethnographic study, a qualitative method that includes observation, interaction and interviews (using informal and semi-structured interviewing). This may be done in the form of fieldwork, where primary data collection is carried out by being immersed in the ongoing activities of the research subjects

Research Design

- ☒ Will the study discuss sensitive topics or require the collection of sensitive information? (e.g. terrorism and extremism; sexual activity, drug use or criminal activity; collection of security sensitive documents or information)
- ☒ Could the study induce psychological stress or anxiety or cause harm or negative consequences beyond the risks encountered in normal life?
- ☒ Is pain or more than mild discomfort likely to result from the study?
- ☒ Will the study involve prolonged or repetitive testing?
- ☒ Are drugs, placebos or other substances (e.g. foods or vitamins) to be administered to study participants, or will the study involve invasive, intrusive or potentially harmful procedures of any kind? (If any substance is to be administered, this **may** fall under the auspices of the Medicines for Human Use (Clinical Trials) Regulations 2004, and require review by the NHS)
- ☒ Will tissue samples (including blood) be obtained from participants? (This would fall under the terms of the Human Tissue Act 2004. All research that falls under the auspices of the Act **must** be reviewed by the NHS)

Please summarise your methodology in detail and provide reflective comments with regards to the design of your research: *max 250 words*.

The research will be conducted in three phases: a background research phase; an ethnographic research phase; and an analysis and documentation phase. The first phase deals with preparation. The objectives are: (a) create a project management structure and work schedule; (b) review the state of the art; (c) establish a theoretical framework; and (d) identify stakeholders. The second phase will be involved in fieldwork. The third phase, addresses analysis and documentation activities. The objectives are: (a) interpreting results drawn from both theoretical and empirical data collected; (b) finalising conclusions; and (c) finalising documentation and ethnographic research analyses including a planned dissemination schedule.

The various methods of analysis that will be used in the research are: Code and Retrieve, where themes are identified through the constant reading and re-reading of transcribed interviews; the use of Computer Assisted Qualitative Data Analysis Software (CAQDAS) to identify recurrent themes; and the use of constant comparative methods, a data analysis process whereby each interpretation and finding is compared with existing findings. Furthermore, cross checks on interpretations will be made across cases for example between workers, residents, tourists and policy makers, and across different registers for example comparing fieldnotes with interviews, and policy documents with practices and

Data Storage and anonymity

- ☒ Will the research involve administrative or secure data that requires permission from the appropriate data controllers and/or individuals before use?
- ☒ Will the research involve the sharing of data or confidential information beyond the initial consent given?
- ☒ Will the research involve respondents to the Internet or other visual/vocal methods where respondents may be identified?

Please describe how you will store your research data and for how long, and, if appropriate, how you will ensure anonymity of your data subjects: *max 250 words*.

The production of data will be ongoing throughout the period of the research. The intention is to make use of a simple data management application (e.g. eFileCabinet or M-Files) as a digital archive within.

The data produced relates to a number of separate categories:

Administrative data that reflect records of engagements, meetings and interviews. This includes work schedules and ongoing communications with supervisors, peers, experts, stakeholders, interviewees etc. The data are likely to be in MS Office format which will be converted to PDF format to prevent conversion or amendment once finalised. The PDF format documents will be archived and the original formats discarded.

Interview-related data includes interview notes; MP3 recordings of interviews; consent forms; and confidentiality statements. These are to be scanned and produced in PDF format. The PDF format documents will be archived and the original formats discarded.

Various data analysis reports are to be compiled. These are to be part of the research phase and lead to the findings that are to be included in the final report. The working format will be in MS Word. Furthermore, I will also be aware of any possible consequences on the dissemination of my research by ensuring that published data does not reveal the identification of the research participant without their explicit consent.

Aim of research project (*250 words*):

The scale and importance of Nationally Significant Infrastructure Projects (NSIPs) means that they continue to be shaped by changing political, economic and cultural experiences. The prioritization of energy NSIPs such as Hinkley Point C, highlights the disputed values of policy, developers and the local community. A logic of regional and national socio-economic benefits are assumed, yet these have not been decisively demonstrated (Richer, 2017, Devine-Wright et.al, 2010). This research will be situated at the intersection between policy, infrastructure development and community impact.

In the context of major infrastructure development, identity and the recognition of the role of place on identity are recurring themes (Devine-Wright, 2017). This reflects the role of social and cultural dimensions in shaping the individual's experience of the physical environment and thus shaping their values and belief systems. I will analyse the dimensions of potential impasse' while taking the broader social, political and economic context into account. An emphasis will be placed on the relationship between the construction industry, policy and local community, which given the localities economic dependence may involve analysis of the tourism sector in relation to the workforce and the impact of the NSIP.

The research provides a holistic understanding of a complex and multifaceted stakeholder project that is underpinned by current challenges including that of climate change. In such a way, the research examines NSIPs as an apparatus (Foucault, 1980), that is the focal point where a host of related concerns determine the impact of strategic demands on the environment, community, workforce, economy and locality.

Safety and Risk

- ☒ Has a risk assessment been completed?
- ☒ Is there a possibility that the safety of the researcher may be in question? (e.g. in international research: locally employed researchers)
- ☒ Will the research take place outside the UK where there may be issues of local practice and political or other sensitivities?
- ☒ Could the research impact negatively upon the reputation of the University, researcher(s), research participants, other stakeholders or any other party?

- ☒ Do any of the research team have an actual or potential conflict of interest?
- ☒ Are you aware of any other significant ethical risks or concerns associated with the research proposal? (If yes, please outline them in the space below)

Please describe the health and safety considerations in relation to both participants and researchers (250 words max): *If there are significant concerns an appropriate risk assessment and management plan must be attached.*

I will ensure that proper steps are taken in the following protocols: Research participants should take part voluntarily; respect to their rights and human dignity; minimising risk (appropriate methods of data storage); protected from harm, any potential risk and harm will be mitigated by precautionary measures; and the right to confidentiality and anonymity. Prior to the interview, participant information sheets will be made available together with informed consent forms. Consent will be ongoing and negotiated throughout the data collection period. The research participant will be provided with information about the purpose, methods and intended uses of research and also be made aware of his/her right to withdraw from the research at any time and without any negative consequences.

A continuous assessment of the research by the university and supervisors will ensure that recognised standards of integrity are met, including research quality and transparency.

Most of my ethnographic research will be conducted in and around the local towns of Bridgwater, Minehead and Taunton and at the workforce campus sites, of Bridgwater and Cannington.

However, my direct engagement at the construction site will be pre-arranged with stakeholder organisations, for example Laing O'Rourke. I will be largely shadowing senior managers, therefore exposure to risk will be minimal. While on site, I will also ensure that I am equipped with the correct standard safety clothing such as the high visibility vest, steel toe boots and hard hat that should be provided for while there. Furthermore, any necessary site induction requirements will be followed through.

Other significant ethical issues or concerns: (If None, then please state 'None')

None

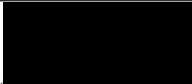
*If any answer to the questions above is **YES**, then a **Second Stage (Full) Ethical Review** MAY be required.*

*If the project involves **none of the above**, complete the **Declaration**, send this form and a **copy of the proposal** to **Amy Jones the School of Management Research Support Officer**: [REDACTED] Research may only commence once approval has been given.*

Declaration: *The project will be conducted in compliance with the University's Research Integrity Framework (P1415-956). This includes securing appropriate consent from participants, minimizing the potential for harm, and compliance with data-protection, safety & other legal obligations. Any significant change in the purpose, design or conduct of the research will be reported to the SOM-REC Chair, and, if appropriate, a new request for ethical approval will be made to the SOM-REC.*

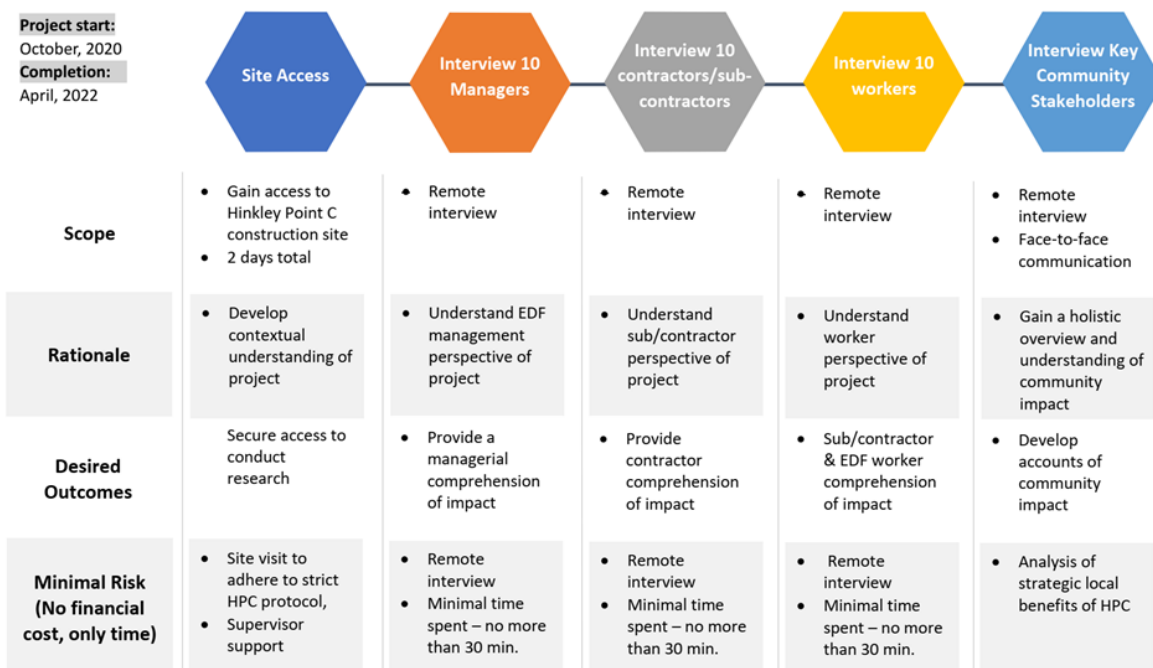
Signature of PI or PGR Student

Maria Teresa Borraz-Doubell

Signature of first supervisor (if appropriate)		Paul White	
Decision of SOM-REC		Approved	
Ethical Risk Assessment	Green <input checked="" type="checkbox"/>	Yellow <input type="checkbox"/>	Red <input type="checkbox"/>
Signature of SOM-REC Chair or SOM-REC deputy Chair			
Date		3/02/2020	
SOM-REC Reference number (office use only)		SOM-REC PGR 051	

APPENDIX E: THESIS EXPLANATION

Examining the impacts of Nationally Significant Infrastructure Projects (NSIP) among multiple stakeholders



Explanatory Summary

This research examines the social impact of Nationally Significant Infrastructure Projects (NSIPs) on both the local receiving community and the developer's management and construction workforce. The ethnographic study considers the multiple voices of different stakeholders who have different interests in the project and as such divergent understandings of the kinds of impact for community life. Therefore, by conducting such a study of those involved directly in its delivery; and those affected by it, would provide a unique, insight, a deeper understanding, and more of a holistic perspective to already known economic benefits. The study is concerned with issues of who benefits, why, when and under what conditions are these benefits felt.

In order to achieve this, I will interview managers, contractors, subcontractors and local communities that takes into account the tangible experiences of all the stakeholders working and living within the NSIP. The reason for conducting such an in-depth ethnographic study is that each experience is different and unique depending on who you are on the stakeholder map. As shown on the diagram above, managers insights would be different to workers or those of contractors or subcontractors, including local benefactors. Each one with their own set of challenges and benefits, but more importantly the research aim is to focus on the processes that are involved in the successful delivery of such a dynamic project, and not on the judgement of individuals or interrelations as such. As Paul mentioned critical research is neither valued or welcomed.

As this research is funded by the SURES (Swansea University Research Excellence Scholarship) programme, not only strict ethical guidelines are ensured but a strict timeline is enforced, i.e., 12 to 18 months of fieldwork (with academic supervisory support), comprising of remote interviews and if and when possible, a site-visit or two. The risk factor is therefore regarded as minimal as there is no cost involved or a prolonged research period. The only requirement is access and time. The ECA have kindly offered their support by way of introductions to some members of the organisation which include contractors and subcontractors. At the end of the research project a summary report of findings will be provided to both EDF and the ECA.

APPENDIX F: CODING STRUCTURE

NVivo Sample of Codes and Subcodes

1. Accent
2. Benefits of HP
 - 2.1. Unapproachable
3. Commuting
4. Employees HP
5. Environmental Planning
 - 5.1. Sustainability
6. HP Challenges
 - 6.1. Covid and materials
 - 6.2. Economic
 - 6.3. Environment
 - 6.4. Fair play
 - 6.5. Logistics
 - 6.6. Nuclear site
 - 6.7. Paperwork
 - 6.8. Poaching
 - 6.9. Safety standards
 - 6.9.1. Education
 - 6.10. Skills shortages
7. HP Local Economy
8. HP Making an Impression
 - 8.1. Economic
 - 8.2. Politics
9. HPC Accommodation
10. Industry Challenges
 - 10.1. Changing times

- 10.2. Competition
- 10.3. Covid
- 10.4. Fragmentation
- 10.5. Maintenance
- 10.6. Profit Margin
 - 10.6.1. Bankruptcy
- 10.7. Training
- 11. Internet Connection
- 12. Pandemic General
- 13. Participant Responsibilities
- 14. Policy Procedures
 - 14.1. Schemes
- 15. Professional Background
- 16. Security
 - 16.1. Stringent regulations
 - 16.1.1. Health and safety
 - 16.1.2. Qualification requirements
 - 16.2. Belonging
 - 16.3. Hierarchy
 - 16.4. Community Obligations
 - 16.5. Family
 - 16.5.1. Mobility
 - 16.6. Financial
 - 16.6.1. Social
 - 16.6.2. Policy
 - 16.6.3. Audit
 - 16.6.4. Supply Chain
 - 16.7. Future projects
 - 16.7.1. Job Security

- 16.8. Living accommodation
- 16.9. Sustainability
- 16.10. Workforce
- 17. Supply Chain
- 18. Training
- 19. Types of Services and Contracts
 - 19.1. HP contract
 - 19.1.1. Contract length
 - 19.1.2. Workday
 - 19.2. Tier contractors
 - 19.2.1. Unionisation
 - 19.3. Places
 - 19.4. Regional – country difference
 - 19.5. Nuclear versus other
 - 19.5.1. NSIP versus other
 - 19.6. Social upliftment and corporate responsibility
- 20. Worker Locations

APPENDIX G: DATA PROTECTION BRIEFING CERTIFICATE OF COMPLETION



Swansea University
Prifysgol Abertawe

This is to certify that

MARIA TERESA BORRAZ DOUBELL

successfully completed the

Data Protection Briefing: GDPR edition

course with a score of

100%

on

22nd February 2020



APPENDIX H: SITE VISIT

View from holiday bed and breakfast accommodating contractors working on the power station:



A view of the nuclear power station construction site from beyond the security cordon:



A local village store:



Village accommodation regularly used by contractors working on the nuclear power station construction site.



Illustration of the rural countryside setting within which the nuclear power station is being constructed:



Juxtaposition of the rural countryside and the nuclear power station construction site:

