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The Intelligent Client
Learning to Govern Through Numbers
At Heathrow

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I hereby declare that this thesis has not been submitted either in the same or different form to this or any other university for a degree

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Since my early 30s I wanted to do a PhD but it was difficult to find a spare handful of years. My PhD started fifteen years later sitting with Professor Trevor Hopper in his office talking about dialectics and the link between networks, trust, innovation and accounting in the summer of 2012. That was it and the procrastination stopped. I owe Professor Hopper a big formal thank you for his encouragement and wisdom which has kept me moving forwards. I have been very lucky to have such a supportive supervisory team at SPRU. I'm very grateful for the careful, patient, professional and kind advice from my supervisor Dr. Josh Siepel. Josh has helped me to navigate my way through some of the more serious and difficult decisions over the last few years. Finally, a major acknowledgement to Professor Paul Nightingale who has inspired me throughout the last 4 years; helping me to hone my topic and not "read history backwards". Professor Nightingale encouraged me to do Heathrow, think seriously about impact and read more Social Theory. I am very grateful for his support and intellect.

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“Dissonance is a musical metaphor. Some sounds or sound constellation violates the aesthetic expectations of the listeners. Within the musical field, it connotes a temporary state of misunderstanding. This state ends in one of three ways: the dissonant sound is resolved back into the old resonant order, the dissonance persists, unrecognised, as a form of noise, or the aesthetic expectations adjust to a new resolution. The new resolution may be the result of initial intentions by the producers or the outcome of a misunderstanding that had found a successful interpretation – in either case, it becomes part of social change”

(Antal, Hutter, Stark 2015, p6)

“All deliberate, all planned human conduct, personal and collective seems to be influenced, if not controlled, by estimates of value or worth of ends to be attained”

(Dewey 1939, p2)

For Charles, Jake, Max and Brenda and in memory of Tony Carr

Abstract

This thesis examines the call for reform¹ in the governance of risk and control within major construction programmes in the UK. Over the next 8 years, Construction 2025 describes aspirations for major improvements in productivity, cost efficiency and delivery lead times.² However, the pathway to reform remains unclear. Major infrastructure projects have a history of dissonance where competing value systems can create friction. However, the productive friction from multiple evaluative perspectives can also be a fundamental part of resolving emergent and perplexing problems. Construction 2025 highlights the need to develop stronger delivery relationships with an emphasis on the early engagement of suppliers and “fixing” the front-end of projects through more rigorous procurement strategies. It also notes that “much” of the waste in construction is fundamentally linked to the treatment of risk. Intelligent Clients, such as Heathrow, have been identified as exemplars in developing superior models of risk governance that work “with” suppliers to articulate the nature of value and evaluative purpose (CE, 2009). This thesis is a study of the composition and evolution of control in the construction of Terminal 5 (T5) and the more recent Terminal 2 (T2) at Heathrow.

Terminal 5 is considered a landmark case that challenged traditional self-seeking opportunism with a lean partnering philosophy delivered through integrated teams. A year later Terminal 2 moved away from the partnering with suppliers, engaging a 3rd party integrator managed through an intelligent control system. At the time this raised concerns that T2 represented a relinquishing of the project management capability developed on T5 and a weaker model of integration. However, T2 was a success. This thesis draws on extensive project-based technical data, interviews with industry experts and policy reports to build a comparative picture of the calculative infrastructures. Temporal bracketing is used to trace the patterns of development into “phases of control” as a sequence of evaluative orders. Both cases move the conception of control beyond directive forms of control “over” resources to consider the nature of social integration and the complexity of enrolling allied interests. The findings explore a variety of innovative calculative technologies that translated tensions into productive friction. In both cases Heathrow did not fix the front-end. Instead an adaptive calculative infrastructure mediated collective deliberation, critical inquiry and emergent learning. These findings suggest that the current reform discussion³ would benefit from more explicit consideration of the importance of architectures of control in making projects valuable, governing risk and shaping conduct towards enterprise and discovery.

¹ Construction 2025; Constructing Excellence, 2009; Egan, 1998; ICE, 2017

² Construction 2025 targets are 33% lower initial & whole life costs and 50% faster deliver from inception

³ Construction 2025; ICE, 2017

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Abbreviations and Acronyms

BAA	<i>British Airports Authority</i> acquired by the Ferrovial Group in 2006
CBI	<i>Complex Build Integrators</i> are the primary contractors responsible for the coordination and management of the supply network
CPI	<i>Cost Performance Index</i> (ratio of budgeted cost of work performed to actual cost)
EAC	<i>Estimate at Completion</i> (estimate to complete plus cost to date)
Heathrow	The Heathrow Airport asset owned by Heathrow Airport Holdings Limited (formerly the BAA). The Ferrovial Group is the majority owner
HETCo	Joint Venture between Laing O'Rourke and Ferrovial Agroman (part of the Ferrovial Group) appointed in 2008 to construct Terminal 2A
ICE	<i>Institute of Civil Engineers</i>
IBR	<i>Integrated Baseline Review</i> ⁴
MPR	<i>Monthly Performance Review</i>
NEC	<i>New Engineering Contract</i>
PMBOK	<i>Project Management Body of Knowledge</i> published by the Project Management Institute as a book of standards and concepts
QCRA	<i>Quantitative Cost Risk Analysis</i>
QSRA	<i>Quantitative Schedule Risk Analysis</i>
STORM	<i>Success Targeted Opportunity and Risk Management</i> ⁵
SPI	<i>Schedule Cost Index</i> (ratio of budgeted cost of work performed to planned schedule)
T5 Agreement	<i>T5 contract</i> accompanied by a procedural T5 Handbook of working practices
T2	<i>Terminal 2</i>
T5	<i>Terminal 5</i>
TCM	<i>Total Cost Management</i> ⁶

⁴ A cyclical review of the baseline plans at Heathrow

⁵ Used as a concept to underpin risk management on T5

⁶ A T5 initiative

Chapter 1

Introduction

1.1 The Broken Business Model

The primary aim of this thesis is to address the call for reform in the governance of risk and control by construction clients in major programmes in the UK (CS2025; CE, 2009; ICE, 2017). For more than 20 years the industry has highlighted the need for greater collaboration in construction to improve productivity, delivery cycles and client value (Latham, 1994; Egan, 1998). However, since the economic downturn in 2008, collaboration has suffered and a more “claims orientated” behaviour has been observed with construction clients “chasing work at unsustainable margins” and “jettisoning of quality and sustainability initiatives” (CE, 2009, p19). Over the next 8 years global construction is expected to dramatically grow by 70% (CS2025, p5). Construction 2025 outlines commitments to improve global competitiveness and efficiency through the reduction of costs by 33%, delivery times by 50%, lower greenhouse gas emissions by 50% and an improvement in the trade gap by 50% by 2025. In the Autumn of 2015 the construction industry gathered for a summit to debate strategies and plans over the next 10 years. In 2015 a vision for construction was described by the Chief Construction Advisor as:

“..a world where buildings and infrastructure are conceived and built much faster with greater whole life value and better carbon and energy performance. With construction driving growth across the whole economy with UK companies working in partnership at home and overseas.” (Hansford, 2015)

This strategic vision requires a radical transformation in productivity within construction. However, Hansford the Chief Construction Advisor noted progress has been slow because of the “Broken Business Model” in the UK with the largest contractors delivering a modest 1-2% margin⁷. Persistent commercial friction has frustrated attempts to improve quality and value. The Head of Business Models in the Construction Leadership Council commented that it is “not right to have projects delivered late” (Sow, 2015). In this sense, the broken business model is the outcome of an inability to overcome persistent practices that legitimise lateness and weak

⁷ The margin data discussed by Hansford was released in September 2015 based on the CN 100 index. This data recorded a 12 month fall in average operating margins from 2.5% (2014) to 1.2% (2015) for the largest 25 contractors in the industry.

margins a symptom of poor control and competing commercial interests that have frustrated attempts to improve efficiency.

The business model literature defines the “building blocks” of the business model as a value proposition, customer interface and the mechanisms of management or “infrastructure” where partner networks and competencies are brought together resulting in costs and revenues (Osterwalder et al, 2005). Traditional construction business models are client-led with contractors responding to initial specifications developed by the client. In turn, the client initiates the “supply chain” of contractors, subcontractors and consultants (Cox and Townsend, 1998). The “strategic procurement” (ibid) of the main contractors follows and at this later stage “mechanisms of management” organise the partner networks through a project organisation. If we consider Teece’s classic definition of a business model:

“...the design or architecture of the value creation, delivery, and capture mechanisms it employs. The essence of a business model is in defining the manner by which the enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit. It thus reflects management’s hypothesis about what customers want, how they want it, and how the enterprise can organize to best meet those needs, get paid for doing so, and make a profit.” (Teece, 2010, p172)

Teece distinguishes between the customer (client), enterprise (accountable for service delivery) and how the enterprise is organised to meet the needs of the client. In construction the creation, capture and delivery of value takes place through a “project” organisation. The client plays an active role in articulating their perception of how the value proposition will be delivered and ultimately this is captured in the contract and initial baseline plan⁸. Coordinating the joint efforts of the client and supply network involves complex organisation and sophisticated approaches to synchronise cooperation (Söderlund, 2012). Different business models reflect a varying appetite for pooling knowledge between partner networks and the client. Organising co-production through project organisations involves a degree of structural complexity⁹ and coordination mechanisms to balance the network of “cooperative agreements” focused on delivering the value proposition (Mokhlesian and Holmen, 2012; Cox and Townsend, 1998; Söderlund, 2012).

⁸ Baseline plans are the formally approved version of the budget used by major stakeholders when making comparisons (PMBOK 2015, p534)

⁹ Structural Complexity describes the arrangement of the component parts of a project (Brady and Davies 2014)

Teece notes that at the heart of a business model is the challenge of designing and sustaining a competitively viable model which not only delivers but also captures value. In this context, he notes that value capture requires business models that:

“yield value propositions that are compelling to customers, achieve advantageous cost and risk structures, and enables significant value capture by the business that generates and delivers products and services” (Teece, 2010, p174).

The construction client-contractor model described so far fails on a number of these points by delivering projects late and over budget to clients with excessive cost and risk structures that deliver punitive margins to contractors. The mechanisms of management and control are failing to engage partner networks and competing interests have frustrated attempts to improve quality and value.

1.1.1 Reform in Governing Risk

The management of change and risk across the supply network is a source of commercial tension in large-scale projects (CS2025). Knight’s classic work links both risk and uncertainty to the fact that knowledge of the future is “imperfect” due to the unknown and indeterminate nature of change (Knight, 1921). Knight distinguishes between risk and uncertainty by describing risk as “measurable” incertitude. Within projects this is conceptualised as a “variance” to plan caused by an “uncertain event or condition” that can have a positive or negative effect (PMBOK, 2015, p559). This variance refers specifically to the agreed plan where deviations in performance are viewed as a risk. Attempts to control variations in performance have resulted in more emphasis on the definition of scope within the initiation and planning of a project (Morris, 2003; 1994; Loch et al 2006). However, scope “lock-in” can result in lost opportunities for performance improvement as changes emerge. Lock into early stage commitments can be compounded by inflexible project management tools where supplier teams are penalised and “team member’s careers may suffer because they are evaluated against targets that have become irrelevant during the project” (De Meyer et al, 2006, p3). Although advances in risk technologies make it possible to explore alternative plans, risk aversion has frustrated attempts to actively manage risk (ibid).

Within construction there is a history of competitive tendering practices that can create intense price competition (Egan, 1998; CE, 2009). In turn, awarding contracts on the basis of lowest “fixed” tender price can result in suppliers aggressively defending their margins (Egan 1998). This can result in “risk-dumping” practices where the initial fixed price is protected by “dumping”

the accountability for scope variations onto others (Brady and Davies, 2011). Risk dumping can destabilise the performance of the supply network as suppliers build in false contingencies as “pseudo comfort” (Power, 2007) to protect against unforeseen additional costs. Construction 2025 notes that “much waste is driven through the approach to risk across the supply chain” (CS2025, p10) and although key industry reports recommend organising projects in a way that identifies who is “best placed” to manage risk (CE, 2009, p27), progress has been slow.

Early stage lock-in and risk dumping practices can combine to create resistance to attempts to generate efficiencies and cost savings. Construction projects involve the coordination of a complex “network of interfaces” between organisations which can create an array of hidden interdependencies (Gann and Salter, 2000; Brady and Davies, 2014). In this context, the client holds some oversight responsibility for balancing interactions and “know-how” between organisations. However, different types of risks require different management strategies. Although greater information can improve judgement when dealing with epistemic forms of “known unknowns”, hidden “know how” or “unknown knowns” can involve political motives (Winch, 2012). These motives can block the willingness to share risk management “know how”. Gann and Salter, 2000, p961 note that:

“the management of technical know-how has become a significant strategic consideration for suppliers and operators. There is a need for integrity of information between suppliers, designers, systems integrators, engineers, constructors, clients and end-users. Yet firms tend to manage risk by retaining information crucial to systems integration within their own sphere of control, rather than by transferring know-how between the temporary coalitions of firms with whom they collaborate”

This quote highlights trade-offs and tensions between openness and protecting strategically important “know how” that can frustrate the sharing of information. Gann and Salter highlight the fragile nature of relationships as temporary “coalitions” which create insufficient justification to transfer strategically valuable risk-based knowledge. These “political” motives block knowledge sharing necessary to resolve technical problems. In turn, this complicates the identification of “who” is best placed to manage risks between consultants, suppliers and construction clients.

Traditional risk-averse practices such as risk dumping and hiding strategic knowledge have been legitimised for many years, reflecting a deep concern for the commercially destabilising effects of uncertainty (CS2025; CE, 2009). These issues highlight a failure in the governance of risk. Power’s 2007 work on “organized uncertainty” is relevant here because it considers governing

risk as part of an institutional process. Power notes that risk only becomes an “empirical fact” when it is captured within the management system of representation, which defines the essence of “what” a risk is (Power, 2007, p3). Power suggests that governing “risk” is both an outcome and a process where risk management discourse emerges as a reflection of different appetites for risk. However, a major challenge for risk management is sustaining control in a way that effectively deals with complex problems rather than a rational “pretence” of control or even worse a mechanism to justify the building of contingencies in the form of “layers of pseudo comfort” (ibid, p201). Power describes a continuous and dynamic tension between “enterprise” as value-creating autonomy versus “auditability” and centralised regulation through checks to test due process (ibid, p197). In this context, governing risk involves a dynamic process of balancing trade-offs associated with themes that underpin enterprise vs auditability such as “enterprise versus discipline, of freedom versus accountability, and democracy versus managerialism, and of opportunity versus auditability” (ibid, p203).

Power describes the governance of risk as an ongoing and unstable process which involves steering and defining the nature of acceptable deviations despite the likelihood that the plans to deliver “ends-in-view” ¹⁰(Dewey, 1939, p52) will change. He suggests that “good” governance of risk moves away from purely emphasising quantitative predictions to a broader activity described by Power, 2007, p202 as:

“....alternative futures of the present, rather than quantitative ambitions to predict the future”

This quote highlights the view that superior forms of governance move away from prescriptive attempts to lock into detailed quantified risk metrics and instead seek to build, test and explore alternative future configurations. These ideas reflect the literature on organising for discovery (Dougherty, 2016) which recommends that in inherently complex settings, abductive learning routines¹¹ are more appropriate than deductive models based on testing fixed assumptions. In this context, governing risk would involve testing alternative hypotheses to understand possible deviations from plan rather than predicting a fixed pathway to the future. Dougherty’s work recommends abductive learning routines combined with collaborative practices described as “heedful interrelating” to shape joint action towards common purpose as a superior way of managing emergent change (Dougherty, 2016, p25). These themes recommend that managing complexity requires a degree of experimentation and acceptance that discovery ideally draws

¹⁰ Dewey’s “ends-in view” are expected outcomes based on “anticipated” ends (Dewey, 1939, p52)

¹¹ Abductive learning routines are described as patterns of practice that test novel hypothesis about what *might* be going on (Dougherty, 2016, p21)

on collaborative efforts and the pooling and sharing of knowledge. However, a more open and experimental approach to risk governance also requires what was described over 20 years ago as countering the strongly “in-grained” adversarial culture (Latham, 1994) which has persistently frustrated progress. The transformation of risk governance within construction requires a significant change in the traditional approaches to control to move away from early stage lock-in, hiding waste and strategic knowledge. The key themes in the need to reform governing risk in construction are synthesised below.

1.1.2 Reform: A Synthesis of Themes

Reform in governing risk rests on the transformation of a deep concern for the destabilising effects of uncertainty amongst clients and suppliers. Traditional risk management practices reflect close regulation of performance with upfront definition of expectations in the early stages of project initiation. However, although the committed outcomes of a project are agreed within the early stages of a programme, the pathways to achieve these outcomes will change because of the emergent nature of complexity. The literature on governing risk and innovation within complexity warns that an over-emphasis on prediction and regulation to predetermined targets could result in lost opportunities for value creation. Instead “good” governance should enable abduction and collective exploration toward imagined futures (Power, 2007; Dougherty, 2016). These recommendations require control approaches that transform the traditional hiding of “know-how”, working together to discover solutions rather than risk “dumping” on others. Sustaining discovery involves trade-offs and tensions between “enterprise” and “auditability” with modes of governance that enable learning rather than closing down opportunities for novelty. However, currently the standard instruments and technologies used to manage risk within projects remove deviations from committed plans rather than encouraging experimentation (De Meyer et al, 2006; Loch et al 2006). These points all combine to highlight a spiral of risk aversion and a need for more collective deliberation (CE, 2009; Egan, 1998; Dougherty, 2016). The next section considers the exemplars in the construction industry as “Intelligent Clients” identified as those who have overcome these incumbent practices by developing superior models of risk governance. Within this context, Heathrow is considered an exemplar Intelligent Client (CE, 2009; Davies et al, 2009; Brady and Davies, 2014) that successfully adopted innovative approaches to governing risk.

1.2 Intelligent Clients

After the economic downturn of 2008 the term Intelligent Client emerged to describe major infrastructure clients who could navigate the harsher economic climate (CE, 2009). Intelligent Clients were identified as being able to transform how they engaged “with” suppliers to deliver superior levels of productivity. In 2009 Wolstenholme’s report “Never Waste a Good Crisis” identified Intelligent Client success as being linked to the adoption of long-term commercial relationships and the adaptation of “business models” to reflect “Egan” principles¹²(ibid). Egan was the Chief Executive of the BAA¹³ and considered a significant figure within the industry¹⁴ but also a major force behind the innovative Terminal 5 partnering methodology. This methodology was derived from Egan’s experience in the car industry, combining lean principles of component standardisation, pre-assembly and state of the art logistics with the ongoing development of scope to take advantage of team learning (Davies et al, 2009; Brady and Davies, 2011). Much of the thinking behind T5 informed his influential 1998 report “Rethinking Construction” which described a pathway to transforming value within construction by partnering to drive up quality. The evaluative principles described in the report recommended moving away from short-term contractual relationships to long-term partnerships. Partnerships focused on delivering a vision of exceptional performance, pooling expert knowledge and rigorously monitoring quality improvements. The incentives underpinning this type of model would focus on performance improvement rather than a lock-in to pre-determined targets. Performance improvements would be sustained by developing a reward structure to incentivise team problem solving. Wolstenholme’s 2009 report revisited progress and reform across the industry since 1998 and noted the success of a few large Intelligent Clients:

“So, which sectors have shown improvement and how have they achieved it? Inevitably, it has tended to be the major clients with repeat construction business who have developed in-house intelligent client teams. Successful teams have consistently integrated their processes and achieved results through a sustained programme of change - many adopting Egan principles and adapting their business model to incentivise and promote best practice” (CE, 2009, p13)

This quote links improvement to “in-house” client teams, long-term relationships and Egan principles. However, success also required an engaged supply network willing to collaborate in order to sustain performance improvement (CE, 2009). Improving business model performance

¹² The Egan principles are examined in more depth in Chapter 4.

¹³ The BAA, British Airports Authority.

¹⁴ Brady and Davies, 2011; Constructing Excellence, 2009; Doherty, 2008; Nightingale and Brady, 2011

required consensus to balance competing aims and interests by “integrating processes” to achieve a common set of normative expectations. The Egan-style “best practices” promoted evaluative principles to encourage performance improvement. However, within the report there are no explicit references to the capabilities underpinning “best” practice, or indeed to the nature of integrating processes necessary to sustain change.

In 2013 the Intelligent Client concept was examined in more depth by the Institute of Civil Engineers (ICE) report which developed a capability framework and “check-list” of principles to rate the ability of a client in “being” intelligent. The Capability Framework provides a useful insight into the role expectations and normative values underpinning the Intelligent Client concept. In this context, it describes the role of the Intelligent Client as managing “relationships” to maximise value:

“Specifying the requirements to external participants and managing delivery outcomes. Fundamental to this is the selection of appropriate private sector participants and the management of those relationships to maximise value.” (ICE, 2013, p2)

The framework emphasises the client’s central importance in front-end planning to set up the initial business case, arrange funding, and translate stakeholder requirements into an organisational design for delivery (ibid, p5). The degree of involvement in managing delivery and co-production is described as adopting “appropriate” strategies and solutions to balance trade-offs between centralised control and flexibility. However, rather than elaborating upon the nature of different appetites for oversight the framework emphasises the importance of supporting delivery relationships with “effective” governance arrangements and appropriate “interface management” (ibid, p17). In this context, “effective” governance arrangements are described as visible authority structures that reflect and engender “integrity” with “open” and “honest” communication. Interface management is described as appropriate when it bridges or aligns diverse behaviours towards agreed outcomes and expectations (ibid, p19). In this context, the Intelligent Client’s role involves:

“communication, integration and incentivisation” in a way that “challenges adversarial behaviour and establishes a safe and collaborative culture”. (ICE, 2013, p20)

The Intelligent Client is seen as a mediator who stabilises tensions through “alignment” and interventions focused on “communication, integration and incentivisation”. Interactions at interfaces are perceived as potentially contested because of competing interests. In this context, the Intelligent Client’s role involves developing a collaborative culture to counter adversarial

behaviour by encouraging “openness” and principles of “integrity” as a superior form of engagement. The framework emphasises the importance of financial incentives and “communication” in supporting this alignment. However, there is no explicit discussion to clarify the types of incentives or the role of the client in improving communication to align evaluative perspectives. This framework describes a “wish-list” of outcomes linking terms such as “integration” and “incentives” with collaborative cultures and “effective management”. However, the Intelligent Client models of governance, degree of involvement in delivery and the treatment of risk are not directly addressed other than by recommending a controls design that is “appropriate” and “visible”.

Traditional mechanisms of management are failing to engage partner networks. Although Intelligent Clients are described as the minority of successful clients who have developed models of governance to enable collaborative deliver relationships, there is little specific detail about the composition of control. The ICE Capability Framework recommends normative principles of openness and honesty as important conditions to enable collaboration. However, there is little discussion about how openness is sustained when faced with incertitude and tensions over the project delivery cycle. The Heathrow cases therefore represent important sites to elaborate on these themes and examine the models of governance and control which were capable of governing risk.

1.2.1 Heathrow as an Exemplar “Intelligent Client”

Heathrow is an important client to the construction industry holding a key role in the “Construction Client Group” and acting as a representative to the government on a number of reform initiatives¹⁵. The construction of Heathrow 5 (T5) is celebrated as one of the most successful airport constructions in Europe delivering the construction of a £4.3bn Terminal on time and budget (Brady and Davies, 2014). It is also considered a landmark example because of its partnering philosophy which drew on the knowledge of the “best” in the industry combined with expertise from the oil, gas and the car industries (Brady and Davies, 2011). A long planning period informed significant “front-end” strategizing and the programme drew on successful commercial practices from other industries such as integrated¹⁶ teams and gain-sharing incentives (Brady and Davies, 2011;14; Davies et al, 2009; Nightingale and Brady, 2011). Much of this learning was captured in a bespoke umbrella contract, the T5 Agreement, which ascribed a normative code of conduct based on pooling knowledge and partnering for performance

¹⁵ Notably through Wolstenholme and Egan’s task forces and recently Project 13 examined in chapter 4

¹⁶ Integrated teams were multi-functional and inter-organisational project teams

improvement (ibid). Rather than early stage “lock-in” to scope, the control system was designed to support concurrent engineering and construction which resulted in a long period of design development. This enabled teams to engage in exploratory activities to develop superior solutions through an integrated team structure that supported decentralised decision-making (Brady and Davies, 2010). Throughout the programme change experts worked with suppliers to improve collaborative working practices and counter old “individualised” and adversarial behaviours (Davies et al, 2009; Brady and Davies, 2011).

Within 12 months of T5 opening, the construction of a £2.5bn Terminal 2 (T2) was commissioned through a commercial framework which moved away from partnering to engage 3rd party Complex Building Integrators (CBIs) to manage the supply network. A standardised “New Engineering Contract” (NEC3)¹⁷ clearly defined lines of accountability between the CBIs and the client. Rather than partnering with suppliers, the role of the client focused on oversight and “clearing away obstacles” (Morgan, 2009). This model of risk governance emphasised regulation where “intelligent” data provided the foundation for a more arms-length and virtual approach to control. Much of the existing T5 literature links the success of T5 to the creation of integrated teams, a bespoke contract and the client’s primary role as a “systems integrator” (Davies et al, 2009, Brady and Davies, 2011;2014; Brady et al, 2006)). These features were missing from T2 and instead the importance of the “numbers” and control technologies became a central feature for governance. In 2012, an article noted that in adopting this new approach on T2, Heathrow had effectively outsourced its “systems integration role” and relinquished its “project management capability” (Brady and Davies, 2011). However, in 2014 the construction of Terminal 2 was hailed a success with the state-of-the-art “Queens Terminal” opening to budget and on-time with a similar level of value for money to T5. There is currently no substantial research into T2 and therefore a major contribution of this thesis is to examine “how” Heathrow made this transition. This therefore frames the primary research question:

Q1 How did Heathrow learn to govern through numbers?

These points are relevant for the “Intelligent Client” discussion because the contrasting T2 and T5 approaches suggest a variety of successful models of governance. The intention of this thesis is to compare and contrast the control and risk governance approach on both Heathrow programmes to contribute to the industry-level reform debate. The next section examines in

¹⁷ The NEC3 is the post 2005 version of the NEC contracts (endorsed by the public sector).

more depth the existing Heathrow literature to understand the composition of the risk and control architecture developed for T5.

1.3 Risk and Control Innovation at Terminal 5

Existing literature highlights that the construction of T5 was an exemplar in client-supplier partnering and learning by engendering the sharing of knowledge across the whole construction team (Davies et al, 2009; Brady and Davies, 2011;2014; Gil, 2009; CE, 2009). The BAA adopted a client-led risk management framework underpinned by collaborative principles. Integrated supplier teams grouped together different organisations into a delivery team structure. Teams were recruited based on not only their technical knowledge but also willingness to pool knowledge, share targets and cost information in an open-book environment¹⁸ (Gil et al, 2012; Davies et al, 2009; Nicolini et al, 2000; Brady and Davies, 2011). For its time, T5 adopted a “radical” risk model moved away from traditional “risk dumping” (Brady and Davies, 2011) practices to fully reimburse in-scope costs. In-scope costs were reimbursed on a cost-plus basis which guaranteed payment plus a margin on all costs agreed to be “within” scope (Brady and Davies, 2011; Davies et al, 2009). Existing literature highlights the fundamental importance of this concept described as the “client bears the risk” as enabling the supply chain to focus on co-production rather than concerns for payment (ibid). Teams were engaged through tasks focused on collective problem solving to achieve levels of performance deemed as exceptional (T5 Handbook, 1998, Gil et al, 2012; Brady and Davies, 2011). The T5 Agreement was supported by a Handbook issued to all first-tier suppliers which outlined “how” teams were expected to manage risk and the incentive and reward processes (Brady and Davies, 2014; 2011; Doherty, 2008). The client’s role is described as a central coordinator or “systems integrator” organising operations in a way that enabled knowledge transfer (Davies et al, 2009; Brady and Davies, 2011; 2014). A value-based incentive structure was developed to co-incentivise teams to deliver superior levels of performance¹⁹.

The construction of T5 represents a remarkable model of collaboration that challenged traditional self-seeking behaviours. Transparency is also a major theme and the expectation of openly sharing performance information amongst a variety of organisations was a major innovation. The client-led strategy of “bearing” the risk and guaranteeing in-scope cost

¹⁸ Open-Book refers to the disclosure and sharing of performance data in order to improve transparency. Sharing may reflect a significant change from traditional practices when data is viewed as sensitive and/or part of competitive advantage (Mouritsen et al, 2001)

¹⁹ Value-based incentives monitored specific KPIs as a mix of cost, schedule, safety and quality targets (Handbook, 1998).

reimbursement to delivery teams created a degree of certainty for suppliers. However, it also provided an incentive for suppliers to over-estimate initial “in-scope” baseline costs. Concurrent engineering and design resulted in a protracted period of flexible planning and “fluid” scope. Traditionally suppliers would resist shared accountability combined with fluid scope and yet on T5 this combination was accepted. The existing literature touches on some of these points and can be divided into 2 schools. The first set of papers ²⁰emphasises the centralised role of the client as the “systems integrator” offering leadership oversight to enable the transformation to a new lean model for performance improvement. The second set²¹ emphasises a variety of actors and technologies that combined to enable progress through the adaptation of plans, incentives and risk management approaches. The next section examines the systems integrator model in more depth.

1.3.1 The Systems Integrator

Brady and Davies’ 2011 paper examines the emergence of capabilities and learning emphasising the long 7-year period of up-front planning and strategising to prepare for construction. This paper describes the central role of the client in steering and shaping the programme by brokering knowledge and integrating interests towards cooperation. The transformation of traditional practices is linked to the creation of integrated teams for co-production where the client’s risk bearing role created an environment conducive to innovation. The client bearing the risk switched attention away from risk averse practices which enabled suppliers to bring their “best” capabilities to the programme. The gradual building of team capability to innovate was linked to performance rewards and the encouragement of cooperative practices. Although this paper recognises the importance of control in the co-evolution of learning between teams and the client, there is little discussion of the control architecture that shaped progress.

The systems integrator as a controller and coordinator of knowledge was examined in more depth in Davies et al, 2009. This paper develops the concepts underpinning organising for lean performance improvement where the client held strategic vision and operational oversight to enable efficiency through replication. In this context integration is conceived as an operational and engineering challenge where the systems integrator oversees the “functioning” of the system.

²⁰ Davies et al, 2009; Brady and Davies, 2011;2014

²¹ Gil, 2009; Gil et al, 2012; Gil and Tether, 2011; Nightingale and Brady, 2011

This is described as:

“System integrators outsource portions of design, production and construction whilst keeping some in-house capabilities to integrate components and deliver a fully functioning system against time, cost and quality targets” (Davies et al, 2009, p111)

This perspective views a project as a “systems” with “subsystems” and component parts which are brought together by an integrator who coordinates progress towards agreed performance targets. The paper suggests that the integrator’s challenge is an engineering one; ensuring operational integration by enabling a coherent and functioning system with synchronised components. The systems integrator is conceptualised as a leader encouraging continued performance and “bearing” rather than “sharing” risk. This lean model emphasised the oversight of risks and standardised processes to engineer performance improvement by incrementally removing waste. Project management tools are described as supporting architecture to enable the systems integrator to manage and work with teams in “reducing costs, minimising waste, improving safety in design and construction” (ibid, p112). Although the paper describes the importance of project management processes and performance principles there is no discussion of the composition of evaluative frameworks necessary to sustain co-production. Security for suppliers through long-term partnership agreements and full cost reimbursement is viewed as a sufficient condition to enable sustained efforts towards performance improvement. Although governing conduct in this setting infers a complex control architecture to oversee progress and balance the dynamics of continuous improvement, there is no discussion about the complexity of management control.

The Brady and Davies, 2014 paper explores some of these concepts, recognising the existence of “dynamic” complexity in projects and emergent relationships described as relations “between components within the system and environment”, which change over time (Brady and Davies, p24). This paper draws on Sayles and Chandler’s 1971 classic view of a systems integrator (Söderlund, 2012; Brady and Davies, 2014) as a baseline concept composed of:

“contractual agreements, shared goals, planning and persuasion to encourage close cooperation of multiple organizations involved in addressing the messy interdependencies between them to achieve the systems-wide goals” (Brady and Davies, 2014, p22)

This quote demonstrates the importance of a control architecture to balance cooperation across a variety of organisations to deliver purposive goals. Later the paper highlights the dynamic nature of complex coordination noting the importance of incentives in shaping behaviour.

However, the client is seen as the primary integrator rewarding collaborative behaviours and exploration. Although there is discussion about the success of adaptive planning and the ongoing focus of driving performance outcomes, there is no explicit discussion about the composition of management control. The paper concludes by recommending a lifecycle focus in future studies to consider how management practices can align complexities over the delivery cycle (ibid, p36). This point highlights the need for extended research into the mechanisms of performance management and control used over the programme life to manage “risk” complexities. These points combine to highlight a major gap in the existing literature, and although there is explicit discussion of the client governing conduct through control technologies which developed cooperation, defined lean processes, mitigated complexities; there is no explicit discussion of the control architecture that shaped these outcomes.

The literature examined so far addresses themes of coordination and control with an emphasis on the client as an integrator rather than the performance management frameworks developed to enable control. There is an important gap and opportunity for research to examine “how” the design and delivery of the T5 control architecture sustained this complex partnering model. In turn, the findings could provide a basis to develop a broader understanding of the performance improvement approach that enabled control.

1.3.2 Complexity and Integration

Within major construction programmes the concept of complexity is important because it creates a means-end indeterminacy that can frustrate planning, coordination and control (Scranton, 2015). Project complexity is linked to the interdependence of tasks, but also to the variety of diverse relations amongst stakeholders (De Meyer et al, 2006; Söderlund, 2012; 2010; Clegg et al, 2012). The Latin derivation of the word “complex” brings the two parts “com” meaning *together* and “plex” meaning *woven*. Within major programmes the existence of interwoven interdependences and shared accountabilities create major tensions (Scott et al, 2011; Clegg et al, 2012; Bresnan and Marshall, 2012). Dynamic complexity means that external change can destabilise plans resulting in social misalignments, cultural differences and political conflicts which can disrupt progress (Scott et al, 2011; Brady and Davies, 2014; Clegg et al, 2012). So far, the literature highlights “intelligent” clients as navigating this complexity by developing mechanisms of management through integrated teams and incentives to reward common purpose. On T5, the systems integrator governed conduct by encouraging teams to accept a degree of uncertainty and variability in plans knowing that the “client bears the risk” (Brady and Davies, 2011; Davies et al, 2009). The T5 literature focuses on systems integration through

functional techniques of production and control as material and physical control “over” the project (Lockwood, 1964; Clegg, 1989). The emphasis is on design and control outcomes where different forms of incentives are assumed to facilitate and empower resource allocation. However, “governing” and the reproduction of control practices can be more fully understood if the focus moves away from functional design features and the assumption that placing incentives automatically shapes derivative control outcomes (Miller and O’Leary, 2007). Instead it is important to examine “how” control technologies such as incentives mobilise social practices within their institutional context and setting (Hopwood and Miller, 1994; Miller and O’Leary, 1994; Power, 2007; 2015; Miller and Power, 2013).

Lockwood’s 1964 study into “integration” is relevant here because it distinguishes between “systems integration” and “social integration”. Systems integration is considered to be the material and physical means of control over an institution to stabilise order. These means of control include disciplinary rules and regulations intended to facilitate and empower resource allocation and action (Lockwood, 1964; Clegg, 1989; Mouzelis, 1997). However, in contrast, social integration refers to the nature of agency and the shaping of values to reproduce or challenge meaning where the dynamics of agency inter-play with institutional structures (ibid). The literature examined so far refers to material forms of control and the role of a centralised systems “integrator” in organising and configuring knowledge transfer across project settings. The emphasis is on different arrangements of technologies (single model design environments, incentives, partnership frameworks) to facilitate coordination. However, there is limited discussion of the complexity of control reproduction and resistance or the interactions necessary to shape meaning and agreement. Returning to Sayles and Chandler’s 1971 systems integrator concept, this describes technologies of control and the need for persuasion and cooperation to deliver strategic goals. Projects are organisational forms developed to resolve unique problems by engaging various experts to develop complex solutions (Söderlund and Tell, 2012; Scranton, 2015). Project delivery is dependent on engaging the cooperation of a variety of experts (Söderlund, 2012; Grabher, 2004). Control technologies provide the mechanisms of management for delivery by shaping conduct, defining standards of delivery and assigning accountability for performance success and failure. These points are central to the broken business model debate and a lack of social integration can be a primary source of resistance, blocking the development of common purpose above self-seeking opportunism. Some of these issues of social integration and control reproduction are discussed in second set of Heathrow T5 papers below.

1.3.3 Social Integration “through” Mediatory Technologies

Within the Heathrow literature there are a second set of papers highlighting social integration themes. The first is Gil and Tether’s (2011) study of the relationship between design flexibility at Heathrow and risk management practices. This work is important because it highlights a reflexive interplay between design and risk technologies that shaped meaning whilst developing relationships. The paper highlights that within T5, the willingness to develop flexible designs (safeguards and adaptive designs) by developers was moderated by cooperative relations with the (project) customer. However, when designs became inflexible, risk management (change control²²) technologies mediated interactions to prevent tensions and overruns. This paper highlights a reflexivity between technologies and relationships where modifications helped to sustain the engagement of a progressive dialogue that balanced potentially destabilising episodes between the developers and customers.

Articles by Gil’s et al, 2012 and Gil, 2009 examine the nature of relational partnering approach adopted on T5 and how cooperation amongst suppliers was sustained (Gil, 2009; Gil et al, 2012). These papers highlight persistent tensions within the supply network engaged on T5 where incentives regulated conduct. Complex interdependencies between sub-projects were combined with design fluidity to create “scope gaps” and ambiguity. This created tensions where suppliers were “like a number of ant nests, not quite at war with each other but all wrestling over the same territory” (ibid, p162). These instances demonstrated points where over-lapping accountability created ambiguity resulting in a “clash” of values between a commitment to partnering and an individualised “opportunistic silo mentality”. The modification of evaluation principles built into incentives helped to stabilise tensions. Over time, this learning became embodied within the reward structures creating a “repository of knowledge” on how to govern (Gil, 2009, p163). These points echo some concepts of social integration where control technologies shaped allied interests through a recursive negotiation to settle and stabilise tensions. In turn, learning was captured and embodied within new evaluative assumptions and rewards structures. This paper highlights a mediatory role for incentives in adapting to balance tensions thereby enabling learning and control.

Nightingale and Brady’s 2011 paper on projects and predictability emphasises the emergence of learning on T5. The paper describes a gradual adaptation and accumulation of knowledge captured and embodied within plans.

²² Change control is a process of approval or rejection of requested modifications to the baseline plan (PMBOK 2015, p530)

Nightingale and Brady, 2011, p106:

“The knowledge required to change the world to match the plan is not a “mirror of nature” and instead involves implementing plans that are realistic rather than true or false. They become increasingly factual over time as they adjust to the world and the world adjusts to them”

These ideas describe a process of building a deeper level of knowledge where reflexive learning was embodied within more realistic plans. In this context, planning and plans were conceived as “scaffolding” to coordinate distributed behaviour of (systematically) connected people. This paper describes the shaping of behaviour over time through a process akin to the mediatory role of other planning technologies described by Miller and O’Leary, 2007 as “envisioning” a future whilst connecting action across domains towards an envisioned outcome. On T5 the process of mediation consummated action and in this context plans were central to creating not only knowledge but also agreement. Nightingale and Brady, 2011, p96:

“realistic plans can be critically engaged with and can provide the basis for structured disagreement as well as shared confidence about future courses of action”

This description highlights that realistic plans acted as “mediating” technologies, ordering disagreements and compromises to shape behaviour towards intended future outcomes. Rather than implementing pre-determined plans, the adaptation of plans enabled structured agreements underpinned by refined evaluative assumptions.

These 4 papers highlight the social complexity of control and the reflexive and mediatory role of plans, incentives and risk management technologies in shaping behaviour. Rather than describing control technologies as tools to assemble pre-determined assumptions they recognise the conjoined process of representing and intervening to steer and shape conduct (Miller and O’Leary, 2007; Miller and Power, 2013; Hacking, 1983). In turn, shaping behaviour and conduct emerged “through” a process of control and social integration steered by control technologies. In this context control technologies can act as “calculative” technologies when they make “calculations” ²³enabling comparison and measurement of conduct (Jeacle, 2012; Miller and O’Leary, 2007; Miller and Power, 2013; Callon and Muniesa, 2005). As agents accept responsibilities and reproduce calculative practices, they became “calculable” by animating the financial standards and norms captured within the calculative technologies (Miller and Power, 2013; Miller, 2001). These points start to introduce the concept of social control, animating

²³ Drawing from Callon and Muniesa “calculations” involve objectification and comparison over 3 main steps 1. Detachment to a space where an object is manipulated 2. Sorting 3. The result is extracted so that it can circulate elsewhere (Callon and Muniesa 2005)

action and the mediatory role of technologies where mediation involves drawing together people and ideas (Miller and O’Leary, 2007; Miller and Power, 2013). These concepts are elaborated in the next chapter.

1.4 Sustaining Control

Sustaining control is a fundamental principle to the progressive nature of projects which are temporary organisational forms that achieve success by delivering goals within a specified timeframe (Söderlund and Tell, 2012; Söderlund, 2012). The concept of “pace”²⁴ has been highlighted as a key driver in determining the urgency and momentum built into the organisation of projects and the scheduling of project time (Shenhar and Dvir, 2007; Ylijoki, 2003). Sustaining productivity involves a continuous process of control due to the interrelated nature of time-critical tasks within a supply network. However, sustaining control is complicated by emergent and perplexing problems (Dewey, 1910) which can destabilise the fragile and temporary alliances (Gann and Salter, 2000) that form the basis of many major projects. Contested periods can cause deviations and lateness to schedules agreed within the project. So far, the T5 literature has identified an important role for calculative technologies such as incentives, plans and change controls in sustaining engagement and preventing lateness. Rather than being viewed as static instruments for sporadic measurement and readjustment towards fixed goals, prior literature describes a mediatory role for calculative technologies. Reflexive learning emerged over time linked to the capture and modification of new assumptions which embodied compromises to provide stability (Nightingale and Brady, 2011; Gil and Tether, 2011; Gil et al, 2012). The idea of calculative technologies as mediators to enrol social practice moves the debate beyond control as a derivative outcome of monitoring and measurement to consider “how” calculative technologies sustained control. This provides the second research question for this thesis:

Q2: How did the calculative infrastructure mediate and sustain control?

This question uses the infrastructure of “calculative” technologies as the object of study. The term calculative infrastructures draw together some of the earlier concepts of plans as project scaffolding²⁵ (as both a process and outcome of planning) with work by accounting academics who conceptualise the combination of calculative technologies as creating a “vast calculative infrastructures” (Miller and Power, 2013). Infrastructures are conceptualised as emergent and accumulated structures of calculative technologies that shape social practices in a conjoined

²⁴ Shenhar and Dvir, 2007 describe pace as the degree of urgency (normal, fast, critical)

²⁵ Nightingale and Brady, 2011

process of representing and intervening (Power, 2015). The prior T5 literature refers to a combination of plans, incentives and change controls as mediatory technologies and these ideas are extended to understand “how” they intertwined and evolved to sustain control. However, rather than contrasting the design principles for governance between T2 and T5 in a static comparison, the studies trace the co-evolution of the different calculative infrastructures. By examining the changing composition of the infrastructures, the studies examine “how” control was sustained and the models of governance that emerged to shape and guide conduct.

1.5 Making a Contribution

The overarching intention of this thesis is to address the need for reform in the governance of risk and control within major construction programmes by using Heathrow as an exemplar Intelligent Client. The broken business model debate highlights the need for transformation in contractor margins and more efficient delivery cycles. There is a need for improved mechanisms of management to sustain networks of cooperation across the supply network. However, despite over 20 years of reform discussion describing the need for more collaborative working practices, progress has been slow. There is a deep concern at the client and industry level of the destabilising effects of emergent change and this has resulted in an aversion to risk with early stage lock-in to plans and commercial frameworks that dump the accountability for risk on to others. Within construction, project risk is defined as a variance from plans and it is this deviation from agreed commitments that requires calculative infrastructures able to shape and steer performance in a way that proactively manages change.

Power’s (2007; 2015) work highlights how governing risk is shaped by an appetite for aversity. This appetite is captured in the management system through calculative technologies which define when performance deviations become risks and therefore “when” and “how” they are managed. Rather than governing risk through audit and surveillance, in complex settings, a learning approach is recommended (Power, 2007). Engaging abductive routines tempered by heedfulness of others’ actions is recommended as a “better” approach, enabling adaptation of plans and evaluative principles (Dougherty, 2016). This point brings us to Heathrow as a site for risk innovation with T5 celebrated for its client-led risk model, encouraging supplier enterprise and the contrasting intelligent system developed for T2. The Heathrow cases provide an important opportunity to examine in depth the development of an infrastructure which shaped innovative approaches for risk governance. It is the intention of this thesis to contribute to the reform debate by providing an insight into “how” Heathrow successfully navigated complexity and risk during the construction of both terminals.

The policy literature highlights the progress of “Intelligent Clients” in driving through improvements in the quality and delivery of major projects (CE, 2009). The 2009 Constructing Excellence report attributed some of this success to the capabilities of Intelligent Client teams in sustaining progress by integrating processes and sanctioning best practice through incentives. The ICE’s 2013 Capability Framework elaborates some themes highlighting the importance of the client’s role in developing mechanisms to support more open communication. In this context, the client plays an oversight role encouraging normative values of sharing and working together to counter adversarial tensions. This oversight role is sustained through authority structures and governance arrangements to support a collaborative culture based on honesty and integrity (ICE, 2013). Oversight is supported by incentive structures designed to “align” and integrate delivery goals. These points suggest a major role for Intelligent Clients in sustaining productive relationships by building an evaluative order to sustain co-production. This order is perceived as stable once divergent perspectives are “bridged”, aligned and integrated (ibid). However, the ICE report does not elaborate on “how” integration would be achieved or how far deviations are acceptable as a normal process of discovery and exploration. Although there is recognition that Intelligent Clients have specific controls capabilities to support oversight, mitigate tensions and balance divergent interests, the calculative infrastructures necessary to sustain these activities are not explicitly addressed.

Themes of integration, alignment and oversight are covered in the Heathrow T5 literature. The “systems integrator” literature emphasises the client as a leader, overseeing integrated teams engaged in shared problem solving. In this context, the client holds primary responsibility for coordinating efficient processes and knowledge transfer between integrated teams. Incentives and the bespoke contract are highlighted as important in ascribing a code of conduct to sustain partnering and performance improvement. However, there is little detail of how these technologies shaped engagement as the programme progressed. The second set ²⁶ of T5 papers address some of these points by highlighting a dynamic and mediatory role for plans, incentives and risk management technologies. In this context, calculative technologies sustained progress by shaping interests and adapting to capture new assumptions. These papers highlight the emergence of situations on T5 that tested plans and reward structures resulting in adaptation to sustain agreement. These findings expand the concept of integration beyond systems integration as “control over” resource allocation resulting in a derivative form of material control. Instead, they introduce ideas of social integration and the shaping of a disposition

²⁶ Gil and Tether, 2011; Gil, 2009; Gil et al, 2012; Nightingale and Brady, 2011

towards common purpose and the persuasion and negotiation of agreement and allied interests (Clegg, 1989; Lockwood, 1964; Mouzelis, 1997). Rather than focusing purely on systems integration by economic incentives, social integration emphasises the importance of fixing meaning and purpose in order to sustain the reproduction of control. This moves the debate beyond making assumptions about the relationship between incentives nudging a desired outcome, to studying the process of deliberation and agreement necessary to enrol suppliers. However, although the second set of papers acknowledge the important role of mediatory technologies in sustaining a shared sense of common purpose, there is little discussion of “how” or indeed “when” contested situations tested the calculative infrastructure.

1.5.1 Gaps in the Existing Literature

The existing T5 literature describes T5 as an exemplar case and an important site for innovation in the governance of risk. However, there is a major gap in the study of the process of control and the composition of control technologies that provided the scaffolding for progress and delivery to be sustained. Although some of the literature describes social integration through evaluation to mediate progress, they do not describe the principles that were modified to sustain delivery. This gap in the literature provides an opportunity to revisit the T5 case and examine in depth the composition of control technologies and the generative processes that governed conduct and sustained control.

For T2 there is no substantive literature examining the construction of the terminal or the project delivery and management. However, T2 is an important comparative case to T5 because it represented a departure from the partnering model considered central to the success of T5. Instead the adoption of a standard New Engineering Contract, the appointment of Complex Build Integrators and risk sharing arrangements stepped away from the functional features of T5 which were attributed to T5’s success. Instead, the client invested in a sophisticated “intelligent” system to monitor progress and hold suppliers to account. This approach is more standard across modern construction programmes and so it provides an important case for comparison. From an Intelligent Client perspective, the ICE framework recommends governing normative values that encourage “integrity”, “honesty” and moral constraint as a powerful way of countering adversarialism (ICE, 2013). On T2, the arms-length approach to control moved away from ascribing a code of conduct. The absence of a handbook outlining acceptable standards of conduct raises questions about “how” social integration was managed and how “accountability” could be sustained through a virtual system of control. These points highlight

the importance of building a comparative case to consider “How did Heathrow Learn to Govern Through the Numbers”?

1.5.2 Integration, Evaluation and Delivery

A large body of the existing project management literature focuses on planning and the failure to accurately predict delivery outcomes in large-scale projects (Flyvberg, 2012; Flyvberg and Cowi, 2004). This can lead to an emphasis on early-stage data gathering and subsequent monitoring to implement more precise forecasting routines (De Meyer et al, 2006; Loch et al, 2006). However, the policy discussion explored in this chapter has revealed a social complexity within delivery and a need to improve cooperative delivery relationships as a pathway to reform. The controls architecture plays a central role in shaping cooperation and conduct towards a common sense of evaluative purpose. However, large-scale projects are complex settings where conflicting evaluative priorities also require careful oversight to “align” agreement towards intended outcomes. This leads to the second research question which focuses on the performative nature of calculative infrastructures to pose the question: “How did the calculative infrastructures mediate and sustain control? “. This question considers “how” suppliers were enrolled in order to sustain control. Although the existing T5 literature highlights a mediatory role for individual technologies, there is little detail about “how” or “when” mediation took place or the evaluative principles which were modified to govern conduct. This thesis extends these ideas to examine the evolution of the calculative infrastructures that enabled and sustained control. These ideas are examined over the following seven chapters and the chapter summaries are described in the next section.

1.6 The Chapter Outlines

The structure of this thesis follows with chapter 2 which is a literature review which leads to the development of a conceptual framework. This is followed by the methodological chapter describing and explaining the data collection and analysis approaches. Chapter 4 is an empirical chapter which examines the industry level reform discussion linking the themes for reform to the Heathrow cases. Chapters 5 and 6 are the empirical case chapters describing the Terminal 5 “Doing Risk Differently” case and the Terminal 2 “Intelligent Foresight”. Chapter 7 develops the comparative analysis and discussion which is followed by a final policy conclusion chapter. The chapter summaries are elaborated in the following pages.

1.6.1 Chapter 2: Literature Review

Chapter 2 draws initially on Miller's 2001 work on "Governing by Numbers" and Miller and Power's 2013 paper to examine the mediatory role of calculative technologies in governing conduct in complex settings. Miller and Power's 2013 paper is used to develop a conceptual framework that examines the way in which control is sustained by governing conduct through the assignment (territorializing) and acceptance of accountability (subjectivizing) through calculable spaces. Concepts such as "controversies" and the machinations of "enrolment" of allied interests to settle intense debates are examined as a way of understanding the unstable processes of control. These ideas are combined into a conceptual framework that traces the development of the programme through successive phases of control to build a picture of the evolution of the calculative infrastructure. Further literature is examined to explore the link between an appetite for risk and the nature of stability and sustained control. Initially the literature explores the inherent indeterminacy of control in project settings and the importance of reflexive learning in navigating the complexity of projects. Dougherty's 2016 work on innovation in complex settings introduces the concepts of "abductive routines" and "heedful interrelating" as ways of animating discovery. Stark's 2009 work examines the concept of organising dissonance in a way to balance tensions into productive friction. These ideas lead to a discussion of the complexity of governing risk in projects which considers different appetites for risk, discovery and ambiguity. The chapter concludes with a discussion about the use of the conceptual framework to trace the emergence of spaces, evaluative principles and technologies to understand "how" control was actually sustained over the delivery cycle.

1.6.2 Chapter 3: Methodology

Chapter 3 describes how the empirical materials were collected and the process methodology adopted to analyse the development of the calculative infrastructures between 1996-2014. Data was collected over an intense 14-month period creating an archive of project-based data (interviews, observations and reports), industry level reports and technical controls documents. Initially, unstructured exploratory interviews ²⁷were recorded and transcribed and over time they became more focused on specific events, technologies and control themes. Temporal bracketing provided a method to break the data into blocks of time called "phases of control" which were punctuated by periods of controversy. Thematic analysis was used as a way of identifying the dominant themes within each "phase of control" and the groupings of sub-themes. Gradually a narrative "plot" was developed of the generative interactions through

²⁷ In total 62 hours of interviews were conducted amongst 20 key interviewees.

calculable spaces within each phase of control and the “dominant” evaluative principles. This led to an analysis of the changing composition of calculable spaces and the machinations of enrolment to settle tensions. By tracing the progression “across” the phases of control; a holistic picture of the evolution of the different calculative infrastructures was developed. The final sections of this chapter reflect on the way in which process thinking requires a careful tracing of the emergence of control but also substantial access to the field and care in dealing with business-sensitive issues.

1.6.3 Chapter 4: The Broken Business Model?

This chapter examines the contextual setting for construction which formed the background for the Heathrow cases. Initially it explores the concepts of the underbidding game and persistent trade-offs and dissonance that prevents performance improvement. The broken business model debate is then framed within the current policy context for Intelligent Clients. The second section examines persistent gaps between policy aspirations and practice by considering the main evaluative principles and models of governance recommended in key industry reports. Egan’s 1998 *Rethinking Construction* is re-visited to compare the emerging debate between a lean model for performance improvement and the Built Environment model captured in Wolstenholme’s 2009 report “Never Waste a Good Crisis”. This discussion provides a historical context for the more recent Construction 2025 report and the current Intelligent Client debate. A comparison of the different normative themes underpinning the Egan, Wolstenholme and Construction 2025 business models is developed to contrast the evaluative orders and assumptions underpinning how value is conceived and captured. This creates a framework of emerging themes associated with how improved risk governance is conceptualised and the industry perspective on the role of technologies in improving delivery. In the final section these themes provide a basis to consider specific principles underpinning early stage enrolment on both T2 and T5 and the development of models of governance intended to balance risk and discovery.

1.6.4 Chapter 5: Terminal 5 “Doing Risk Differently”

Chapter 5 initially explores the T5 timeline and control methodology developed to enable performance improvement. Key principles and procedures underpinning fluid territories of accountability are examined alongside the need for collective evaluation through performance reports as a way to integrate thinking. The next section develops a narrative of the sequence of events within each control phase and the evolution of evaluative principles underpinning each phase. The three phases are described as “the client holds the risk”, “one version of the truth”

and “foresight”. Within each phase, key technologies such as specific monthly reports, cyclical reviews²⁸ and initiatives²⁹ are described to identify evaluative priorities and principles. In the next section, the way in which technologies enrolled suppliers is discussed in more depth within each control phase. The settlement of specific tensions associated with fluid scope versus lock-in and safe versus realistic forecasts are examined. This leads to a discussion of how controversies were settled and the gradual development of the calculative infrastructure across the control phases. The final section returns to the “learning to govern through numbers” discussion and describes the co-evolution of the emergent learning approach with the development of a calculative infrastructure. This last section reflects on the willingness of Heathrow to learn from controversy by investing in an adaptive infrastructure to sustain collective evaluation.

1.6.5 Chapter 6: Intelligent Foresight in Terminal 2

Chapter 6 initially examines the T2 timeline and the move away from partnering to a more regulated approach. The principles underpinning the control framework are developed with a focus on risk management strategies, approaches to develop a sense of common purpose through the “right” kind of incentives and priorities such as safety. The next section develops the sequence of events into three phases of control: “single version of the truth”, the “dashboard” and the “golden thread”. In each of the phases the evaluative principles, technologies and their role in mediating enrolment are examined. Key technologies such as monthly performance reports, the dashboard and fortnightly reviews are examined to develop a baseline of evaluative principles. The following section, examines how key technologies enrolled different groups and the gradual development of the golden thread of control. In the final section the debate returns to “learning to govern” describing how the intelligent system sustained regulatory oversight by adapting accountabilities in response to performance risks. The ongoing adaptation of calculative technologies enabled Heathrow to take advantage of emergence.

1.6.6 Chapter 7: Discussion: Making Projects Valuable

Initially this chapter revisits the need for reform in governing risk and the contrasting appetites for discovery and risk described in the T2 and T5 cases. Similarities are observed in the role that evaluation plays in steering the programme towards a common sense of meaning and purpose. However, different patterns of fabrication and learning were observed between Terminal 5’s

²⁸ The Integrated Baseline Review

²⁹ Total Cost Management

emphasis on collective evaluation versus the more client directed approach on T2. The next section returns to the progression through the phases of control on Terminal 5 to describe an initial unsettled phase, to mediating an “order” to encourage credible forecasts. Sustained control is linked to the replication of monthly reporting rituals and the fixing of risk citizenship principles into an infrastructure of rewards and targets. The following section focuses on the phases of control on T2 and progression from an initial period of testing the integrity of data, to a period of development of the client’s diagnostic capability and finally a recovery phase. Sustained control is linked to the dashboard and sophisticated risk management strategies which organised dissonant tensions. By the final phase, a lengthy process of “translation” was observed that gradually enrolled the 2nd tier into accepting accountability for new recovery plans. The final section of the chapter develops a comparative discussion of the T5 infrastructure for performance improvement versus the T2 regulatory model of governance. This leads to a final discussion of an “intelligent” emergent learning approach as a way of sustaining control within major projects.

1.6.7 Chapter 8: Conclusion: The Intelligent Client

This conclusion chapter returns to the discussion about the need for clients to develop adaptive approaches to governing risk and the success of both Heathrow programmes in gradually mobilising a common sense of evaluative purpose. The following section summarises how the T5 calculative infrastructure sustained and mediated control by describing the recursive process of testing and contesting that led to the legitimisation of lean principles and risk citizenship. This leads to a discussion of T2 and the development of an adaptive calculative infrastructure that shaped client intelligence whilst gradually enrolling the wider supply network towards delivering the critical path³⁰. The following section returns to Egan and Wolstenholme and the complexity of developing calculative infrastructures to challenge a traditional aversion to scope change. The potential for reform in delivery relationships is considered and the importance of recognising the role of controls architectures in integrating evaluative purpose. Construction 2025 is re-examined and the concept of learning and sustaining critical inquiry by fabricating risks. The final section suggests further areas for research including more research into the broken business model and models of virtual control, control innovations in governing risk and the benefit of process research for further studies of projects.

³⁰ Critical path refers to the sequence of activities which must be completed to deliver the project “on time” (PMBOK, 2015)

1.7 Summary

This chapter has outlined the main questions and themes underpinning this thesis. So far, the discussion has identified a failure in large-scale construction projects to develop mechanisms of management capable of sustaining cooperation across the supply network. In this context, large-scale projects involve plural tensions and emergent risks which can destabilise progress. Traditional approaches to control reflect an aversion to risk with early stage lock-in to plans and commercial frameworks that transfer risk to others rather than proactively managing change. The Heathrow cases provide an important opportunity to examine two contrasting models of governance which successfully navigated emergence and complexity. The research questions outlined in this chapter focus on tracing the transition between the two different models of governance. The questions focus on the evolution of the calculative infrastructures and the generative nature of calculative technologies in mediating and steering both programmes towards completion. The discussion so far has highlighted theoretical concepts such as “social integration” and the role of technologies and infrastructures in enrolling a common sense of meaning and purpose. The next chapter reviews the literature to develop these concepts further in order to examine issues associated with the reproduction of control in complex settings and the different ways in which calculative technologies can govern conduct.

Chapter 2

Literature Review

2.1 Introduction

This literature review is problem-focused with an intention of drawing together literature primarily from accounting, organization and innovation studies to consider the main themes associated with the complexity of governing conduct and sustaining control within large-scale projects. In this context, governance is considered as a dynamic process of shaping and steering action, from the Latin term of “gubernare” or “to guide”. Governance takes place through an architecture of project control practices and technologies designed to steer conduct towards a defined “value system, responsibilities, process and policies” (Mueller, 2012, p306). However, steering conduct in major projects is complicated because the “ends-in-view” (Dewey, 1939) can change. Construction projects have a history of adversarialism and commercial friction which can create an unstable control environment (CE, 2009). To deter adversarial behaviours, rigorous “checks and balances” are often adopted to discourage this (Flyvberg, 2012). Although models of risk governance are recommended to encourage openness (ICE, 2013), this can be viewed as surveillance and met with resistance resulting in hiding inconvenient knowledge. The innovation and organizational literature recommends that in complex settings collective deliberation is needed to resolve perplexing problems as they emerge (Dougherty, 2016; Stark, 2009; Weick, 1995). However, traditional project management approaches favour front-end planning and early stage lock-in (De Meyer et al, 2006). Governing conduct in this environment requires a calculative infrastructure capable of sustaining control by balancing competing interests whilst encouraging openness and a “spirit of enterprise” in adversity (Power, 2007). A calculative infrastructure to steer projects towards a common sense of evaluative purpose and away from lateness, waste and poor value.

The previous chapter characterised Heathrow as an important empirical site for risk-control innovation. The construction of Terminal 5 seems to represent a spirit of enterprise with a lean partnering model adopted to encourage performance improvement (Davies et al, 2009; Brady and Davies, 2011). Rather than early stage lock-in, engineering plans and designs evolved over time. Calculative technologies, such as flexible budgets, a reimbursable guarantee and value-based gain-sharing incentives, played a mediatory role in sanctioning an appetite for discovery (Gil, 2009; Nightingale and Brady, 2011). Within a year of completion, Terminal 2 moved to a more arms-length model defined through a standard New Engineering Contract. This regulatory approach focused on client oversight through an intelligent system which held suppliers “to

account” against planned commitments. Prior literature links delivery success at Terminal 5 to co-located integrated teams, gain sharing incentives and rigorous client oversight in managing risks (Davies et al, 2009; Brady and Davies, 2011; 2014). However, the Terminal 2 approach seemed to move away from these features to “action at a distance” (Rose and Miller, 1992; Robson, 1992) managed through a performance management system that shared accountability for risk. These two different models of governance raise a number of questions about “how” control was sustained given the very different appetites for centralised regulation versus partnering for performance improvement.

Learning to govern through numbers at Heathrow involved two different models of control: participatory versus centralised planning; client-led risk management versus shared accountability; and co-located versus distributed teams. However, over time both programmes delivered successful outcomes and similar levels of value for money. The following sections examine the relevant literature on governing conduct in complex settings and the potentially powerful role of evaluation in shaping common purpose. The next section examines the management control literature to understand different aspects of the social reproduction of control and the role of calculations, technologies and spaces in mobilising action at a distance.

2.1.1 Governing by Numbers?

Miller’s 2001 paper “Governing by Numbers” considers the role of the numbers as a technology of government. Miller describes how governing conduct takes place through the assembly of ideas and responsibilities into calculable practices. Practices are shaped by technologies such as budgets and reports that define responsibilities. This work moves away from viewing calculative practices as an objective and technical form of measurement to consider social control and its reproduction. In this context, governing involves shaping attention towards being responsible within specified parameters “rather than confront individuals daily over the allocation of resources, why not provide funds who have both the responsibility and the freedom to spend the money as they see fit” (Miller, 2001, p381). These concepts are linked to “governmentality” from Foucault’s work on power where governing involves an “ensemble of institutions” but also calculations and tactics to sustain disciplinary power (Foucault, 1979; Rose and Miller, 1992). In this context governing “by” the numbers involves social control where “the manager can be represented as an object, evaluated and acted upon by others as a result of visibility, calculability, and comparability that accounting provides” (Miller 2001, p387). This body of literature has been used to understand “action at distance” (Rose and Miller 1992) and the steering of conduct by calculative technologies that confer responsibility towards normative

standards of conduct (Miller, 1992). Action is mobilised and sustained when accountability is assigned but also accepted by responsible actors. The concept of being “calculable” involves the setting of financial targets and norms that confer budgetary responsibility and also an acceptance of responsibilities (ibid). In this sense people become calculable when they respond to reports that show a variance to expected plans by intervening to make corrections.

This branch of literature emphasises regulatory control by “normalising” deviations amongst peripheral actors towards “what ought to happen” (Macintosh and Scapens, 1991, p460; Hoskins and Macve, 1988; Hopwood, 1990). This suggests a hierarchical form of disciplinary power over individuals. This power can be latent by building expectations of “invisible supervision” which has a dispositional power in terms of creating an “internalized self-discipline” where workers anticipate scrutiny and surveillance (Hoskins and Macve, 1988). However, rather than this disciplinary power being linked to the “will of the boss”, it can also be part of a wider architecture of “norms and standards” (Miller and O’Leary, 1987). In a later 2007 paper Miller and O’Leary moved away from focusing on organisational relationships to the mediatory role of accounting “instruments” that control by connecting ideas and people across organisations in a common vision. These points are important for the study of major projects because control spaces extend beyond a dyadic relationship between one client and the major supplier. Instead, projects involve a lateral network or “project ecology” made up of different relational layers from personal to institutional which encompass a wide epistemic community of experts (Grabher and Ibert, 2012). When project networks are conceptualised in this way it highlights the importance of enrolling and sustaining engagement across a complex portfolio of relationships. Several studies have focused on the mediatory role of accounting in guiding network partners towards common goals and priorities (Carlsson-Wall et al, 2009; Hakansson and Lind, 2004). The heterogeneous and unstable nature of network relationships has highlighted the importance of closely observing the performativity of control within its context (Hakansson et al, 2010; Hakansson and Lind, 2004). Rather than assuming fixed “loci” of control, scholars suggest that:

“It is more pertinent to trace continual changes in loci of control rather than trying to identify a specific centre that exerts action at a distance” which assume “linear and uniform time and space” (Quattrone and Hopper, 2005, p760)

This quote warns against making assumptions about action at a distance and the loci of control and instead studying the settlement of ongoing tensions and ties associated with sustaining control. Management control scholars note that control can take many heterogeneous forms

which are fundamentally embedded within its social context which makes “understanding multiple attempts to create order, spaces and times” an “uneasy task” (Quattrone and Hopper, 2005, p. 761). These points lead to a body of research focused on “mediation” and the role of different forms of calculative technologies in linking together actors, ideas and organisations into collective endeavours.

2.1.2 Mediation: Instability and Enrolment

A large body of research³¹ has emphasised the mediatory role of different forms of management control technologies as actors or inscriptions in governing and shaping action by mobilising alliances. Many of the accounting studies focus on different aspects of accounting mediation from “affect” and an emotive “edge” as a way of sustaining network relations (Boedker and Chua, 2013) or the visual power of different forms of report (Busco and Quattrone, 2015; Quattrone 2017; Justesen and Mouritsen, 2009) or settlements of controversy associated with change (Preston et al, 1992; Quattrone 2017; Chua 1995). Several of Mouritsen’s studies focus on specific calculations such as the functional analysis within target costing as a way of creating a narrative (Mouritsen et al, 2001) or cost calculations that steered technology organisations towards new product and sourcing strategies (Mouritsen et al, 2009) or calculations to structure network complementarities between organisations (Mouritsen and Thrane, 2006). Some studies focus on a single technology, such as Busco and Quattrone’s 2015 study of the visual power of the balance scorecard in discovering strategic vision. This case considers a balance scorecard report as a visual “performable space”³² to discover future strategies. The scorecard mediated discovery by interrogating, ordering and motivating inquiry captured in KPIs and plans as an “ecology of signs”. Over time inquiry was “sustained” by a sequence of cyclical reviews where the visualisation motivated interrogation into relationships “between objects, spaces, images, words, and texts resulting in a continuous enactment of knowledge and beliefs” (Busco and Quattrone, 2015, p1256). This concept of sustained inquiry in complex and “ambiguous” settings is also examined in Quattrone’s 2017³³ paper which considers the semiotic power of specific visualisations, such as the Terminal 2A Dashboard. These studies move away from emphasising disciplinary control as a way of sustaining action at a distance. Instead the focus moves to the

³¹ Notably; Preston et al, 1992; Robson, 1992; Chua, 1995; Quattrone and Hopper, 2005; Chua and Mahama, 2007; Mouritsen and Thrane, 2006; Mouritsen et al, 2001; 2009; Boedecker and Chua, 2013; Busco and Quattrone, 2015; Quattrone 2017; Jutesen and Mouritsen, 2009.

³² This space became performable by reflection and exploration into strategies - not alignment, but a “translation” which reflected a continual “ordering” of strategic vision (Busco and Quattrone, 2015)

³³ This paper is discussed in more depth in chapter 6 - but it considers how the Terminal 2A Dashboard acted as a tool for visual rhetoric to 1. Mediate ambiguities 2. Sustain inquiry described as “in-divisions”, “in-tensions” and “in-difference”

mediatory role for technologies in persuading and negotiating network relations where the outcome is some form of stability and control.

The study of governing conduct at Heathrow focuses on a unit of analysis broader than a single calculation or visual tool. Instead, the Heathrow cases consider the notion of “sustained” control by considering mediation through a variety of “key” technologies and spaces that settled progress over the delivery cycle. The study of controversies is a useful way of observing the machinations and modifications of different technologies necessary for control by settling agreements (Power, 2015; Chua, 1995; Preston et al, 1992). Drawing on STS concepts, the study of “controversies” involves focusing on unforeseen events and the emergence of contested interpretations and different knowledge claims that challenge the existing order (Latour, 1987; Callon, 1986; Pinch and Bijker, 1987). Tracing gradual enrolments within controversies can identify underlying hidden agendas and competing interests associated with change (Hopwood, 1973; Preston et al 1992).

2.1.3 Fabrication

Callon’s 1986 study of the enrolment of support for a conservation strategy at St. Brieuc Bay provides a useful framework to break the “sociology of translations” down into four progressive stages. In this context, a translation is considered as a process of stabilising identities and the basis for interactions within a network of relations (Callon, 1986). The sociology of translations can be used to examine the role of calculations in settling diverse interests. The four stages³⁴ involve moving from an initial perceptible solution (problematization) through to framing values (Interessement) and enrolling (Enrolment) others into a common meaning legitimately sustained (mobilization) through technologies. The term fabrication refers to the movement through all four phases from problematisation through to settlement after enrolment. This is significant because it represents the point of settlement when new evaluative principles or technologies became acceptable and stable in terms of form and use (Latour, 1987). The concept of fabrication has been used to trace the stabilisation of enrolment associated with new accounting systems (Preston et al, 1992; Chua, 1995).

³⁴ Please note that the terms “problematization” will become problematisation, enrolment and mobilisation but retaining interessement for the remainder of the thesis

Preston et al's 1992 study of the implementation of a new budgeting system notes that:

"the process of fabrication also includes individuals' interpretations of, and responses to, the proposed or implemented system. In this respect both intentional and unintentional consequences" (Preston et al, 1992, p567)

Studies of fabrication consider unintended controversies associated with change. They also trace the modifications and debates necessary to move from controversy in problematisation debates through to order and mobilisation. Breaking translations into stages of enrolment can reveal the debates and themes that shaped relationships into productive compromises. It is also a useful way of examining the nature of modifications in technologies that led to new "ties" linking people, organisations and objectives together (Miller and O'Leary, 2007). The length and pace of the translation also gives an indication of instability and depth of change. Mouritsen et al's 2009 paper distinguishes between different types of translation based on the significance of the change. In this context, the pace and impact of translations were described as "short" and simple routine translations versus more complex "long" translations. Long translations involved longer periods of controversy and contested strategic debates from competing calculations. These concepts are useful ways of considering the length of a controversy and the specific role of certain calculations and technologies in stabilising order.

Concepts of translation and fabrication offer a useful way of conceptualising progressive change by tracing the modifications and debates necessary to stabilise network relations. However, when the methods adopt a performative³⁵ case study approach, the focus is purely on tracing the interactions and ties as they emerge. The aim here is to focus on observable practice to understand "which" actors contribute to the calculative phenomena's significance. Performative methods recommend keeping the "social flat" to avoid making *a priori* assumptions (Jutesen and Mouritsen, 2011; Mouritsen et al, 2010). Keeping the social flat is seen as a way of accepting relational heterogeneity³⁶ and therefore focusing on practice and performativity as it unfolds (Hansen, 2011; Mouritsen et al, 2010). However, by de-emphasising the historical context, drivers for change may be hidden within the observed case. This can lead to misinterpretation and overlooking important explanations of "why" action takes place (Greenhalgh and Stones,

³⁵ Performative case studies focus on "following the actor" and the creation of new network ties through the enactment of representations (Mouritsen et al 2010; Hansen 2011)

³⁶ Latour notes that "...in principle (it) is possible to discover properties which are typical of life in society, and could explain the social link and its evolution, though in practice they might be difficult to detect" (Latour, 1986, p.272)

2010, p1288). Miller and Power's most recent paper addresses some of these issues by broadening the conception of control beyond specific "loci" or individual "actors" to focus on "infrastructure". In this context, infrastructure is conceptualised as an entangled "complex" of calculative technologies, people and practices that accumulate over time (Power, 2015; Miller and Power, 2013). This infrastructure is described as a vast "calculative" infrastructure and it is examined in more depth in the following section.

2.1.4 Calculative Infrastructures

Miller and Power's 2013 paper brings together concepts of governing through the assembly of calculative technologies into calculable spaces where mediation takes place. This work synthesises a huge body of literature from organization and accounting studies to create a baseline of concepts that describe "how" accounting enables governance. Rather than focusing on a single locus of control or calculative activity, it describes a "complex" of entangled roles described as 1. Territorializing 2. Mediating 3. Adjudicating 4. Subjectivizing. These roles combine to create a dynamic and emergent phenomenon described as a vast calculative infrastructure". The multiple roles are described as:

"We identify four key roles of accounting; first territorializing, the recursive construction of the calculable spaces that actors inhabit within organizations and society; second mediating, that much of what accounting instruments and ideas do is link up distinct actors, aspirations and arenas; third adjudicating that accounting plays an decisive role in evaluating the performance of individuals and organizations, also in determining failing and failures; and fourth, that accounting is a subjectivizing practice par excellence, that it both subjects individuals to control or regulation by another, while entailing the presumption of an individual free to choose"

(Miller and Power, 2013, p557)

These roles take place in "calculable" spaces where calculations associated with costs and revenues are captured and responsibility is assigned to individuals, teams or other forms of institutional unit (Miller, 1992; Miller and Power, 2013). In this context "cost centres" and other forms of budget become calculable spaces when they capture and assign calculations intended to steer conduct towards specific performance standards and targets. This process is described as a recursive process of "territorializing" where calculative technologies capture, assign, compare and "adjudicate" performance within calculable spaces. In this context, Miller and Power 2013 introduce the concept of mediation where ideas travel and evaluative principles are mobilized through deliberation and discursive forums. This mediatory role of accounting is also explained in terms of building a "common narrative" and purpose amongst "subjects" where

evaluation plays a key role in steering action towards acceptable standards of conduct. Miller and Power note that the four “roles” combine in different ways within their contextual setting. However, control is sustained by “subjectivization” and regulation involves two “aspects”:

1. Being subject to control by another
2. Freedom of choice with reference to defined financial standards and norms.

The combination of these aspects is important as subjectivization moves beyond just disciplinary control to freedom of choice within defined parameters of “attention”. In this context, they stress that the concept of subjectivizing moves beyond describing passive organizational dupes to active agents with economic freedom to fulfil roles and priorities. This final point stresses the heart of control lies in the acceptance of being “calculable” and fulfilling accountabilities that are assigned. In short, being calculable involves the acceptance of governance and being “held to account”.

Miller and Power’s 2013 paper describes calculable spaces as a heterogenous and emergent phenomena recursively constructed over time. The outcome and processes of mediation are captured and embodied within a calculative infrastructure which evolves through an entangled combination of mediatory technologies and practices. The concept of an emergent calculative infrastructure is examined in more depth in Power’s 2015 paper “How accounting begins: Object formation and the accretion of infrastructure”. In this paper Power examines the gradual acceptance and diffusion of accounting for impact through Impact Case Studies within UK Universities. This paper develops a framework to trace “how” performance principles move from an orchestration of ideas to stabilized practices through an infrastructure. Drawing heavily on Star’s 2010 work, the concept of an infrastructure is examined as an “invisible”³⁷ organisation of people and artefacts that gradually organises performance values. However, when controversies challenge the composition of the infrastructure critical elements become visible. Power applies these concepts to examine “problematization” themes and tensions associated with the impact agenda. The case then traces the stabilisation of order through an unfolding suite of governing roles, evaluative rules and collective routines conceptualised as the organisational infrastructure.

Power’s case utilises several concepts to inform further studies of infrastructure. Firstly, it identifies an important link between the establishment of accounting and time whereby the

³⁷ Star (2010) highlights the invisible nature of infrastructure because of its “embedded” transparency borne out of the fact that it does not require “reinvention” each time it is assembled and used.

legitimation of performance apparatus is gradual. In Power's case, the infrastructure that supported implementation accumulated over time and this "accretion" involved changing priorities and performance tensions. Secondly, the case highlights the importance of situated and in-depth studies of control and the recognition that social control may be both fragile and unstable. These two points combine to suggest that studies of calculative infrastructures require methods sensitive to the importance of the situated context and the effects of controversy on the emergence of control.

Miller and Power's 2013 framework links control to dynamic processes that emerge over time "through" calculative technologies and spaces. The framework draws on literature that recognises the social complexity of control beyond a hierarchical view of disciplinary control over others. Instead, control is linked to the recursive construction of territories of accountability and a mediatory role for technologies in stabilising network relations. However, mediation is closely linked to adjudication where "action at a distance" involves an order of evaluative priorities that define the nature of success or failure. Miller and Power describe adjudication through accounting that "classifies, counts, enumerates, summarizes, and compares" (Miller and Power, 2013, p584). The outcome of adjudication and mediation is a dominant evaluative "order" captured within the infrastructure. However, in Miller and Power's paper there is little discussion about the processes of adjudication in shaping and steering evaluative purpose. In the next section, further literature is examined that is focused on the "making of value" and order.

2.1.5 Evaluative Order

Although Miller and Power's framework describes an important adjudicatory role for technologies and spaces in subjectivizing individuals, there is little discussion about the nature of judgement, comparison and justifications. Many of these principles are examined within the valuation³⁸ studies literature. Dewey's 1939 *The Theory of Valuation* is important here:

"Speaking literally, there are no such things as values. ... There are things, all sorts of things, having the unique, the experienced, but undefinable, quality of value. Values in the plural, or value in the singular, is merely a convenient abbreviation for an object, event, situation, possessing the quality" (Dewey, 1939, p2)

³⁸ For example: Antal et al, 2015; Doganova and Eyquem-Renault, 2009; Kornberger et al, 2015; Dewey, 1939; Lamont, 2012; Espeland and Stevens, 2008; Espeland and Lom, 2015

In this context, evaluation involves an “object” and evaluative judgement about the possession of a quality or standard (Lamont, 2012). Commensurability involves “checks and balances” against these principles to test for proof of “worthiness” by comparing performance against standards (Espeland and Stevens, 2008; Boltanski and Thévenot, 2006; Kornberger et al, 2015). The act of judgement confers value on an object by defining “what counts” as valuable (Espeland and Stevens, 2008; Kornberger et al, 2015). In turn, judgement involves sanctioning past decisions as a proof of the legitimacy of choices previously made. Dewey’s 1939 quote describes the key role of evaluation and “estimates of worth” on collective action and planned conduct:

“All deliberate, all planned human conduct, personal and collective seems to be influenced, if not controlled, by estimates of value or worth of ends to be attained” (Dewey, 1939, p2)

In this context judgement involves making comparisons against an order of priorities that reflect “worthiness” based on a schema of performance principles (Lamont, 2012; Espeland and Stevens, 2008). For projects this can involve an assessment of “ends to be attained” (Dewey, 1939) which can alter and change as new pathways emerge. These ideas describe how the process of evaluation and estimation of worth can shape action towards an evaluative order.

The concept of different forms of “moral order” is examined in Boltanski and Thévenot’s 2006 work: “On Justification: economies of worth”. Their work draws on political philosophy to develop an abstract analysis of different social worlds underpinned by a contrasting framework of values to govern relationships. The nature of worth is considered as 6 different common types of social model³⁹ or “polity” underpinned by patterns of beliefs to govern over relationships. Rather than being a static state, each “polity” can evolve over time and move through “states of worthiness”. Technologies act as “objects” which reflect the orders that they “reside in”. However, “objects” can also be instrumental in social change by testing the evaluative principles that assign worth. This testing and contesting involves “acts of justification” which are attempts to compete in order to legitimise views.

Boltanski and Thévenot’s “On Justification” focuses on moral economies and the objectification of evaluative principles within a moral order of worth. This work is considered important because it introduced the notion of “worth” as a fusion of values and value (Stark, 2009). Moral orders of worth reflect a schema of “the good, the just and the fair” based on different criteria for judgement (Antal et al, 2015). These ideas describe different appetites or dominant themes

³⁹ Which are Civic; Market; Industrial; Domestic; Inspiration and Fame

described as “higher order” or lower order principles. Stability or social change involves a testing and contesting of the worthiness of these principles through justified acts. Boltanski and Thévenot describe forms of settlement and compromise other than justified acts such as “pardoning”, where past justified acts are waived to settle contested disputes in order to enable progression. However, although Boltanski and Thévenot discuss social change there is little explicit detail about the drivers for progression. This last point is examined in depth by Antal, Hutter and Stark in their 2015 book “Moments of Valuation” which extends some of the concepts from Boltanski and Thévenot’s work to consider controversy and change. Moments of valuation are considered as situated “sites” where “dissonant tensions” between different value systems can lead to novelty:

“in order to become something new, for a while, a variegated process of social interaction takes place: the deviant, the tenuous, the rough is recognised in specific situations, and it is estimated in terms of established value scales” (Antal, Hutter, Stark, 2015, p6)

This quote describes an initial period of instability and gradual acceptance of novelty by comparing the “new” against existing “value scales” to decide if the new is acceptable. This work recommends that studies of evaluation and evaluative orders should focus on situated “sites” of valuation and controversies challenging evaluative orders. In this context, the study of contested moments is intended to raise the visibility of the underlying “values attributed, the controversies and interpretations expressed” (Antal et al, 2015, p6). This work suggests that studies of evaluative orders would ideally be situated with an emphasis on tracing change. This tracing focuses on modifications in evaluative principles but also the technologies used to attribute and assign value. These points highlight the importance of studying calculative technologies and how they “make things valuable” by attributing and assigning value through acts of evaluation (Kornberger et al, 2015; Antal et al, 2015).

2.1.6 Synthesis of Themes

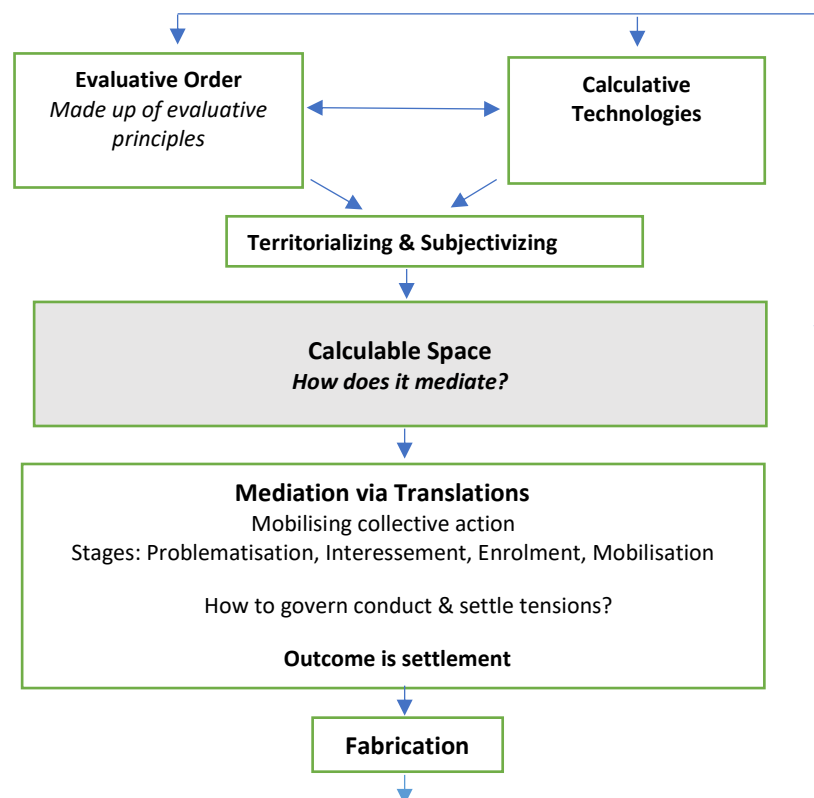
The introduction to this chapter described a tension between the need to develop controls infrastructures capable of dealing with emergent change and the tendency for traditional project control approaches to closely regulate change by locking into initial plans. Underlying this are issues associated with regulating conduct and controlling the nature of action at a distance. Miller’s “Governing by numbers” introduced the concepts of “being calculable”, i.e. an acceptance of different forms of control to shape action towards normative standards of conduct. These ideas were extended in Miller and Power’s 2013 paper to cover the role of

calculable spaces in assigning accountability. Their paper stresses that at the heart of control is an acceptance by “subjects” or subjectivization where calculative technologies shape conduct towards an acceptable level of freedom and regulation. Miller and Power’s framework describes a mediatory role for accounting where evaluative judgements can animate and steer ideas towards a common narrative (Miller and Power, 2013, p581). These concepts suggest a dynamic environment where the outcome of control emerges over time. Power’s 2015 paper highlights a gradual accretion of ideas shaped “by” and captured “in” an infrastructure of technologies, evaluative principles and practices. Power’s paper is important here because it suggests that studies of calculative infrastructures need to be sensitive to both emergence and instability. Rather than assuming that control is “implemented”, the study of controversy can highlight the critical features of technologies that serve to stabilise order. Focusing on the debates around problematisation and the settling of tensions can highlight the nature of modifications necessary to sustain control. These ideas are combined to create a conceptual framework.

2.2 The Conceptual Framework

This framework, figure 2.1, draws from Miller and Power’s 2013 publication to consider “how” control was sustained on both Heathrow programmes. It breaks down the composition of control into calculable spaces as the central unit of analysis. The framework will be used to trace how calculable spaces evolved over time into a wider “calculative infrastructure”.

Figure 2.1: The Conceptual Framework for Sustaining Control



In the framework, governing conduct is conceptualised as a recursive process of territorializing (assigning) calculable spaces and subjectivization through calculative technologies. Calculative technologies are the key reports and cyclical reviews used to attribute and assign accountability for the delivery of value. These technologies represent an order of principles and priorities that shape acts of justification as well as a basis for evaluative judgement. Controversies provide the setting to consider how specific calculable spaces evolved and the machinations of enrolling different interests and the modifications necessary to engage agreement. The concept of fabrication provides a point in time to assess stability and progress, and the nature of compromises necessary to sustain “order”. The conceptual framework distinguishes between calculative technologies and calculable spaces. Calculative technologies perform calculations that objectify, compare, manipulate and extract results (Callon and Muniesa, 2005; Jeacle, 2012; Rose and Miller, 1992). Calculative technologies adjudicate performance by testing for worth against a schema of performance principles. However, calculable spaces are sites where calculative technologies perform by shaping conduct where subjects accept responsibilities (Miller, 1992). Calculable spaces are spaces where actors respond to reports and budgets that show a variance by intervening to make corrections. In short, the “able” at the end of “calculable” implies assignment, acceptance and reproduction.

The upper part of the framework describes the creation of an evaluative order through the construction of calculable spaces. The lower part describes the machinations necessary to settle problematisation tensions. At the point of fabrication, order is sustained and a new set of evaluative principles and technologies are re-assembled. The final arrow represents a loop and cycle of control where controversies are settled and progress is sustained. This framework provides a basis to trace progress through successive phases of control over the delivery cycle to build a picture of the evolution of the calculative infrastructure. The intention here is to understand how progress was sustained and the nature of adaptations necessary to settle performance tensions. This is intended to build a picture of patterns of development and uncover the nature of the dominant evaluative orders captured in the infrastructure that resulted in the governance of the programmes.

So far, the accounting control literature has highlighted the importance of understanding the situated context for control. The conceptual framework has been created to trace the recursive development of calculable spaces and evaluative principles which settled tensions. However, the last chapter described plural tensions within large-scale projects which create a dynamic control environment. In turn an array of interdependencies can create instability when emergent change challenges existing plans. The innovation literature recommends organising

for complexity by adopting abductive learning routines and heedful ways of interrelating to encourage ongoing collective problem solving (Dougherty, 2016). However, traditionally construction projects are marked by an in-grained “adversarial culture” (Latham, 1994), a tendency towards lock-in rather than learning and self-seeking opportunism above sharing knowledge. These factors can create persistent tensions and competing evaluative priorities. In response to this, an appetite for risk and discovery is developed and a strategy to govern conduct which reflects an “order of worth” (Boltanski and Thévenot, 2006) which may favour autonomy and “enterprise” or perhaps a more cautious appetite for regulation and “auditability” (Power, 2007). As newness emerges this can result in an intolerance for change and a removal of deviations or perhaps an acceptance and adaptation. An appetite for risk and discovery are important factors that influence how control is sustained and the nature of settlements. The following section considers literature linked to these themes of sustaining the reproduction of control in complex settings. This draws from innovation literature, organization theory and accounting literature to consider different approaches to organising for discovery and learning within unstable and messy large-scale projects. Themes associated with trade-offs and tensions associated with competing value systems are considered as well as the literature on governing risk. This literature then provides a background and contextual setting for the reform discussion and control agenda that underpins the Heathrow cases. The following section starts with Scranton’s 2015 paper on large-scale projects, learning and the indeterminacy of control.

2.3 Navigating Complexity in Projects

Scranton’s 2015 paper on the history of projects highlights how projects can be viewed as an organisational form specifically set up as an instrument to resolve a complex problem identified at the beginning of the temporary organisation. Project scholars have indicated that the bespoke design of a project offers a more flexible way of organising knowledge and learning than more rigid functional forms of organisation (Söderlund and Tell, 2012; Hobday, 1998, 2000; Söderlund 2012). However, project flexibility requires approaches to control capable of adaptation in order to capture emergent learning whilst sustaining an acceptable level of control. This involves a complex balancing of a networks of cooperative relationships in a way that can sustain progress and the pace necessary to deliver projects on time and to budgets (Söderlund, 2012; Shenhar and Dvir, 2007). However, the nature of dynamic complexity of projects can mean that emergent change can destabilise plans resulting in a misalignment of goals (Brady and Davies, 2014).

Scranton quotes Bauman (below) in a glorious description of some fundamental problems that challenge control within major projects:

“A project is not a reality. It is ‘under-determined’; there is no certainty that your aims will be fulfilled. There is always a risk that a mistake could be made, that a wrong turn could be taken and then, instead of implementing the project, you will actually make its implementation more difficult. So, there is a risk of many, many people whose work should be coordinated but might not be. And there is also the problem of trust. Could you actually trust them, that left to their own resources, without instruction, without attention paid to them, without correcting their false moves, they will actually work towards implementation of the project?”

(Scranton, 2015, p7)

This quote describes the control challenge where a project is used as an instrument for resolution but the pathway to success is unclear and indeterminate. Although projects are set up to “make things different”, the nature of complexity can mean that the pathway to progression can be non-linear and complex (Plowman et al, 2007). Scranton’s quote describes the perils of path-dependent lock-in when the pathway chosen becomes inappropriate. This can be further frustrated by unpredictable forms of emergent action and knowledge, as unruly distributed interactions create an incompatibility when the control model seeks to regulate conditions which no longer exist (Nightingale, 2004; Dougherty, 2016; Seo and Creed, 2002). The need for coordination is amplified because of task and team interdependencies but also shared accountabilities. Scranton’s quote also introduces the complex issue of coordinating collective action on a large scale of “many many people” (Scranton, 2015, p7). This reveals specific tensions between the need for predictability (can you trust them?) and the need to support autonomy in localised decision making. This point illustrates a dichotomy in control design between surveillance and regulation, and more autonomous approaches to enable devolved decision-making. These points emphasise the challenges of organising project control in a way that balances concerns for the regulation of performance whilst still encouraging the emergence of novel ideas and local knowledge.

Scranton’s work describes the gradual emergence of an established project over time into a mature organisation of people, targets, information and rewards. This infrastructure enables the temporary organisation to “morph” into a project enterprise. However, this development involves “capable teams” and the pooling of knowledge to navigate incertitude.

Scranton, 2015, p4 notes that:

“..because the means to the goals are not obvious or are complex, if understood, teamwork (not task assignment) is crucial, with feedback from multiple investigators, experiments, trials, or design-in-use providing invaluable, critical reflexivity”.

This quote highlights how experimentation, the capturing of feedback and reflexive learning play a key role in sustaining progress within major projects. These points resonate with ideas from Nightingale and Brady’s 2011 paper that describes reflexive learning on Terminal 5. This paper describes how people became a “source of predictable behaviour”, pooling knowledge captured in plans enabling the project to move towards the overall desired outcome. However, organising multiple investigators can be complex. Scranton highlights the fundamental importance of a “team orientation” shaped by “who’s on the team, how they were chosen and by whom and what are their responsibilities.” (Scranton, 2015, p4). These points emphasise the importance of organising common purpose towards a “team orientation” that encourages collective learning.

The organisation of inter-disciplinary learning is complicated and organisational theorists have, for many years, noted that it requires a complex institutional design to frame different “thought worlds” (Dougherty, 1992). In turn, certain types of tacit knowledge can be constrained to “local settings” or “different perspectives” and “meaning systems” that frustrate collective problem solving (Dougherty, 1992; Tyre and Von Hippel, 1997; Bechky, 2003). Carlile’s 2002 work in particular, stresses the difference between simple “knowledge transfer” and more complex forms of learning that require the transformation of both meaning and competing interests. When faced with these pragmatic boundaries, Carlile 2002 describes a need for greater effort and iterative tools that provide visibility of dependencies to translate political interests. However, change and ambiguity can frustrate attempts to organise learning. Although organising routines may temporarily stabilise divergent perspectives, this can be displaced when new problems emerge (Dougherty, 1992; Dougherty, 2016; Bechky, 2003; Carlile, 2004). Weick’s 1995 work on “sensemaking” is relevant here as it shows how the organisation of ambiguity requires a combination of interlocking routines and regulated control able to synthesise different perspectives. Weick contends that sensemaking required interlocking spaces for “inter-subjectivity” tempered by control accountabilities which combine to provide “unity”⁴⁰ (Weick, 1995).

⁴⁰ “How to accept the diversity and mutation of the world while retaining the mind’s power of analogy and unity so that this changing world shall not become meaningless”. (Weick, 1995, p171)

The discussion so far has revealed the indeterminate nature of control in project settings and the difficulty in navigating complexity because the pathway to success is unclear. Although pooling knowledge and collective learning is recommended to resolve perplexing problems, harnessing the collective intelligence of a variety of diverse experts can be complicated. Weick's 1995 work is important because it details the need to balance inter-subjective tensions and common understanding and purpose. Carlile's 2002 work reveals the need for iterative routines and visible infrastructures to enable learning and control in diverse and complex settings. These themes of iterative learning and common purpose are brought together in Dougherty's 2016 book on organising for discovery in complex settings.

2.3.1 Taking Advantage of Emergence

Dougherty's latest 2016 book "Taking Advantage of Emergence" starts with a discussion about innovative problem solving in emergent and complex settings. Dougherty notes that complex innovation systems are marked by emergence, where solutions are likely to evolve from circumstances. In this context, she examines how self-organising systems underpinned by purposeful pursuit and continuous adaptation can lead to superior forms of stability without the need for centralised intervention. Dougherty highlights 3 features of organising for discovery:

- A Division of Labour into 4 subsystems of discovery to address specific innovation perspectives that frame problem solving
- Abductive learning routines that animate discovery across the four subsystems
- Organizing infrastructure that keeps knowing sustained within doing

2.3.1.1 Subsystems of Discovery

Dougherty developed the concept of four "subsystems" to frame problem solving and the mobilisation of resources. The subsystems are described as a "division of labour" of values to organise and address the key problems which interplay and combine to create the overall innovation system. The four subsystems are:

1. The Project – developing the functional elements
2. Knowledge management
3. Strategic management - marshalling knowledge resources
4. Institutional complex innovation - orchestrating and reconfiguring relational goals

The subsystems deal with the need to strategically organise innovation problems by considering the interplay between the project, knowledge and strategic management for value creation when orchestrating the institutional complex. The last perspective of institutional complex

innovation focuses on the orchestration of governance through configuring relational goals into a “collaborative commons” for value creation and knowledge management. Dougherty notes that the institutional complexity of innovation can result in getting stuck in a rigid “block-buster business model” where the infrastructure “does not generate enough value-creating opportunities to use all the innovations that can emerge” (Dougherty, 2016, p17). These points resonate issues of rigidity when organising “territories” for accountability within major projects that can inhibit the visibility of emergent opportunities. In this context, Dougherty claims that rigidity can be overcome when routines that support abductive learning widen the search space.

2.3.1.2 Abductive Learning Routines for Heedful Interrelating

Dougherty’s model describes the animation of governance through abductive learning routines, which are described as addressing problems where “knowledge is limited, incomplete and fragmented” (ibid p28). This involves testing for a “novel hypothesis about what *might* be going on” by drawing together diverse insights (ibid p21). Dougherty describes how abductive practices become recognisable learning routines as they develop into patterns of interdependent action to combine and recombine knowledge across the different subsystems. They are considered performative as they bring “problems forth” to create new routines that emerge “through the application of symbols, categories, labels and assumptions contained in the tools” (ibid p19). Over time these routines organise diverse perspectives into collective interaction and “doing”.

Sustaining abduction involves “heedful interrelating” as a form of subordinating action towards a common purpose. Dougherty quotes Weick and Roberts 1993 on the collective mind, where heedful refers to reflective mental processes that consider the whole (ibid p146). In this context, heedful interrelating is defined as when people construct their own actions (contributing) whilst “envisioning” a system of joint action (representing) and interrelating (subordinating) their action with the group (ibid p25). Interaction and images create interconnections which help balance diverse perspectives. Pooling action can lead to novelty and “the emergence of a representation of a world that none of those involved individually could possess” (ibid p25). Drawing on Weick’s 2005 work on sensemaking, Dougherty warns that if attention is on the local situation and individualism, then shared situations may be neglected, thereby pulling the system apart. She notes that community and collective solidarity is fundamental to avoid “*heedlessness*” where there is a “failure to see and take note” (ibid p27).

Although Dougherty's work emphasises the importance of organising problem-solving in the subsystems, it also notes that "rigid" institutional templates can be overcome by abductive routines. These are part of a wider infrastructure which acts by framing reflexive learning between diverse groups and locations. In turn technologies are performative as they structure and enact knowledge. Activities are sustained through problem solving in the form of experimentation, testing and fine-tuning. Different forms of experimentation are described as "elaboration" - a broader form of exploration of possible interdependencies versus a "narrowing" to examine the depth of a situation (ibid p45). These activities are made visible through "overlapping knowledge" that enables people to take responsibility for the parts of the process that they contribute to. In this context, the important role of a central "leader" is seen as a way of sanctioning collective learning by visibly rewarding heed and preserving stories of discovery and success.

2.3.1.3 Sustaining Discovery?

Dougherty's work highlights key themes relevant for managing complex projects. Firstly, the importance of visibility of the "whole", the need for "heed" and awareness of dependencies when coordinating collective action. In this context, a failure to sustain networks of cooperative partnerships across the supply network is a major issue⁴¹ for construction business models. Secondly, a model of discovery that encourages distributed forms of collective action organised towards a common search for improved performance, resonates some themes underpinning the T5 lean partnering model. In this context, Dougherty emphasises the key role of a mediating infrastructure⁴² of "tools" that embody assumptions and categories to sustain "knowing within doing". Dougherty's work describes the emergence of a heterarchical form of organisation that can draw together multiple perspectives through an infrastructure of routines and tools that support lateral forms of distributed learning. However, heterarchies represent a significant control challenge as they tend to diverge as competing values and interests redistribute or "drift" as time passes (Stark, 2009; Antal et al, 2015; Quattrone and Hopper, 2005). Much of Dougherty's work is based on studies of pharmaceutical research teams searching for new viable products rather than the difficult and dissonant setting of a construction project. Although Dougherty notes that "power" and "politics" play a role in sustaining collective contribution, the processes behind these ideas are not explored in depth. However, issues of enrolment and

⁴¹ This is discussed in chapter 1 and examined in more depth in chapter 4

⁴² On this point, Dougherty cites Nightingale (2004) on the importance of an infrastructure to support the co-evolution of knowledge and innovation and Yaqub and Nightingale (2012) on the discovery of vaccines to capture and coordinate accumulated and emergent knowledge.

balancing divergent interests and tensions are important themes for construction projects. In chapter 1 the discussion revealed how fragile and temporary delivery relationships fail to enrol a willingness to pool valuable “know-how”. Dissonant and competing tensions can frustrate and destabilise attempts to encourage heed and discovery. The next section considers the literature on dissonance and the balancing of tensions through evaluation.

2.3.2 Organising Dissonance

Stark’s (2009) work is underpinned by an assumption that organisations are plural and socially complex settings marked by competing tensions. Stark’s 2009 book “A Sense of Dissonance” describes the persistence of dissonance as competing value systems that require organisation in complex settings. Stark contends that the careful organisation of dissonant values can balance friction and translate negative tensions into “productive friction” (Stark, 2009, p18). Productive friction is linked to the creative generation of knowledge and novel forms of recombination that challenge taken for granted assumptions. However, Stark notes that balancing friction and tensions requires a framework to guide evaluation in a “principled and ordered” way (ibid p23). Stark describes how frameworks of evaluation with over-lapping performance criteria can support “reflexive cognition” (ibid, p4) within diverse groups. In turn, issues located at interface points are sites where tensions can arise because of overlapping values. At this interface, Stark describes how justification and the “giving of accounts” by people and the “keeping” of accounts can force collective reflection and dialogue to test performance principles (ibid, p25) and testing and exploration can take inquiry outside the “search space that is already known” (ibid p212). In this space, performance frameworks play a fundamental role in balancing contending evaluative principles and creating conditions for novelty to be viewed as acceptable rather than a form of deviance (Antal et al, 2015). Stark’s work is important because it reveals the productive nature of incertitude when organised to balance dissonance whilst fostering diverse perspectives into a collective “ah ha” (Antal et al, 2015, p5) to resolve perplexing problems. However, overlapping performance criteria require careful governance and set-up of conditions to encourage acceptance of novel forms of discovery.

Although Stark’s work identifies the importance of organisation to sustain discovery he does not comment on the properties or composition of performance frameworks to sustain productive friction. This point is, however, explored in Chenhall et al (2013) which examines “how” the organisation of a performance management system can “sustain” productive friction. The paper examines changes in a quality reporting system in a geographically dispersed voluntary services organisation where reporting played a key role in organising complexity. The paper explores

“how” and “when” different modes of evaluation inspired either productive or destructive forms of compromise and the role of reports in providing a space for the negotiation of different evaluative principles. The paper reveals the importance of “concurrent visibility” of attributes that represented priorities and important values for some actors within performance reporting. This helped to sustain compromise and temporary settlement by representing these attributes in a visible format⁴³. However, balanced tensions were threatened when reports gave precedence to a single perspective described as “stuckness” - a mode of evaluation that prevented a broader representation of values. The paper claims that reporting can become unproductive when open debate is inhibited or when the discussions move away from fundamental principles to the repetitive “mechanics” of accounting. This paper extends the importance that Stark places “on giving accounts” as a way of balancing tensions between multiple evaluative priorities.

2.3.3 Synthesis of Themes

Scranton’s 2015 description of a project as an instrument to resolve complex and indeterminate problems through the organisation of teams, provides a useful basis to consider the difficulty of controlling projects. Managing diverse perspectives into critical and reflexive learning presents a significant challenge when pathways to success are indeterminate. This challenge is amplified when teams of experts are from different “thought worlds” but also different organisations with competing political interests (Dougherty, 1992; Carlile, 2002). Dougherty’s 2016 book demonstrates that dynamic and complex settings can provide a control challenge. However, if organisations focus on encouraging abductive reasoning and heedful interrelating it is possible to navigate complexity. Stark’s 2009 book indicates that although dissonant tensions can stifle progress, if friction is organised through evaluation, then productive compromises can be achieved to sustain discovery. Dougherty 2016, Stark 2009 and Weick’s 1995 work recommends collaborative forms of collective evaluation that create intersubjectivity and shared accountability. Chenhall et al’s 2013 paper identifies a role here for reporting to enrol productive compromises by giving concurrent visibility of strategic priorities and higher order values. However, in construction there is a long history of adversarialism and “heedlessness” (Dougherty, 2016) which can be linked to a deep concern for the management of change and the financial effects of risk. This has dampened an appetite for collective discovery and enterprise in adversity (CE, 2009). The governance of risk within construction⁴⁴ is a

⁴³ The paper describes how a report enabled concurrent visibility of specific standards but also an acceptable degree of uniqueness through narratives and regional reporting.

⁴⁴ Constructing Excellence, 2009; Egan, 1998; Construction 2025; ICE, 2013

fundamentally important theme and central to any comparison of different approaches to governing conduct at Heathrow. In the next section, literature on the management and governance of risk is considered.

2.4 Governing Risk within Projects

Knight's classic work distinguishes between uncertainty and risk based on measurable incertitude (Knight, 1921). In this sense, risk is an "identified danger" manifest in describable events with probabilities linked to possible future states. But in contrast, uncertainty involves unknowns as in "we know what we do not know, but that is all that we know" (Callon et al, 2011, p11). Power's 2007 work on "Organized Uncertainty" focuses on the organisation of risk within different institutions noting that risk can be viewed as an "empirical fact" (Power, 2007, p3) that can manifest in many different perspectives - from hazards and dangers to volatility of financial returns in financial markets. Power notes that these different conceptions of risk become managed when they enter an institutional "system of representation" (ibid, p4) where technologies act as instruments or framing objects for action and intervention. In this context, uncertainty is transformed into a risk when it becomes an object of management, regardless of the information about probability (ibid, p6). Quoting Elwald, Power notes that:

"Nothing is a risk in itself; there is no risk in reality. But on the other hand, anything can be a risk; it all depends on how one analyses the danger, considers the event"

(Power, 2007, p4)

In project management, the generally accepted definition of risk is a variance from plan described as "an uncertain event or condition that if it occurs, has a positive or negative effect on a project's objectives" (PMBOK, p559). In this context, project practitioners model and evaluate risk as events not captured in planned objectives which could manifest in changes in scope, schedule or cost. This focus on "variance" as a measure of risk has resulted in more emphasis on the front-end strategizing and rigorous planning (Winch, 2012; Morris, 2003; Gil and Tether, 2011). De Meyer et al (2006) detail how traditional risk management evaluates performance to planned targets in an approach that is "instructionalist" in the sense that the plan becomes the objective rather than a "means" to explore alternative ways of achieving the objectives. They note that when risks are defined as deviations from plan, the project mind-set assumes a "known terrain" of events, outcomes and a solution space. In turn, project risk technologies, such as the "risk register", monitor progress in terms of deviations from plan as a form of management by exception.

Morris (2003) emphasises that priorities within risk management are shaped by contextual factors making it difficult to predict how to plan and manage a project. Instead, risk management is conceptualised as an ongoing iterative management “process” to measure, capture and analyse to develop mitigation strategies. Winch’s 2012 paper recommends improving the management of risk by tailoring the relevant information based on different states of unknown. Winch describes how collecting information can increase a confident cognitive “state of mind” to enable judgement because there is a clearer conception of potential threats and opportunities (Winch, 2012). Winch’s model describes different states of the “unknown” where the most common form “known unknowns” is dealt with by quantified risk analysis. In contrast, “unknown knowns” are political. Threats and opportunities are “deliberately” hidden and misrepresented to protect interests. In this context, Winch notes that opportunism can damage a project and more effort is required to build confidence and information. Finally, a deep level of uncertainty is identified as “unknown unknowns” where a state of ignorance exists.

Winch’s cognitive model is a useful starting point to conceptualise different types of incertitude that may require different risk management strategies. It describes an inverse relationship between information confidence and the unknown. However, in complex settings increased information may increase awareness that the situation is more complex than initially thought. More information may result in less confidence and a cycle of more incertitude. Winch’s model also simplifies the indeterminacy within even the “known” and the political nature of inconvenient knowledge. In contrast, Stirling (2010; 2009) explores the complexity of knowledge and warns against taking an over simplistic view in the assessment and regulation of risk. Stirling notes that the nature of knowledge is intrinsically complex and in some instances incommensurable “not amenable to simple aggregation” (Stirling, 2009, p36). When attempting to regulate risk it may be too simplistic to assume an independence between “facts” and values. This point highlights the value-laden nature of what may be presented as a “fact”. Stirling’s work highlights the need for more methodological care in considering responses to knowledge problems. In his 2010 article Stirling describes how certain forms of evaluation can act as a catalyst for deliberation where plural (with a variety of interpretations) and conditional (explicit exploration of alternatives) approaches move away from simply closing down justifications into single definitive responses.

This work identifies important themes for the management of risk in projects. Firstly, it highlights a complex relational dynamic where political interests can influence how risk is defined, analysed and regulated. Within a policy setting, risk is closely linked to danger and harm, creating a tense environment for potential controversies and uncertainty. The legitimacy

of decision making can be contested and the regulation of risk influenced by power and politics where more democratic forms of governance can act as a panacea to avoid the perils of hiding risks and danger (Stirling 2010, 2009). This indicates a need to examine in more depth the contextual setting of controversies at Heathrow in order to understand how these tensions could influence the governance of risk. Secondly, it stresses issues of domination in defining which types of risk “count” as being worth more deliberation and visibility. These themes echo earlier discussions on conferring more legitimacy to specific dominant narratives (Miller and Power, 2013; Boltanski and Thévenot, 2006). Stirling reveals the silencing effects of power and potential bite-back when controversies amplify the effects of harm. This raises the question of how the invisibility of risk can amplify the effect of danger and how progressive dialogues may reduce potential harm.

In a policy setting, more open dialogue and the exploration of multiple perspectives can mitigate against harm and the danger of technological lock-in. Issues of “lock-in” are also relevant to managing projects because project risk is referred to as an unforeseen variance. In this context, participation and exploration into evaluating alternative solutions may be shared. However, the appetite for “how” risk issues are resolved involves institutional problem solving which reflects an appetite for varying levels of autonomy and participation in risk management. The next section examines Power’s 2007 work on the factors that can shape the institutional appetite.

2.4.1 An Appetite for Risk

Power 2007 notes that within organisations “uncertainty management” is more about organising complexity and stabilising knowledge networks than efforts to define and measure the probability of outcomes. Power’s work acknowledges and accepts the existence of value-laden assumptions within risk management and that these beliefs form the building blocks for risk governance. Power describes how incertitude means that organisational decision-making is fundamentally a messy process shaped by variety of relationships, political motivations, personal experiences and “rules of thumb” (Power, 2007, p14). Stability can be achieved through a risk management infrastructure embodying material standards and guidelines with experts to guide the organisation of uncertainty. Risk technologies or instruments play an important role in shaping how risk is conceived, analysed and regulated.

Power 2007 describes how governing risk involves both a process and outcome shaped by instruments where risk management reflects an appetite for risk. Governing risk involves a tension and dialectic between concepts of enterprise versus managerialism and auditability. One side represents traditional approaches to risk management that focus on the reduction of

harm by checking routines against predetermined standards. This is described as “auditability”, where governing involves precision, checking and compliance processes to identify variances to plan. However, Power highlights a newer model of risk governance, “Enterprise Risk Management” (ERM), where the management of risk involves checking routines but also value creation strategies. In this context, ERM is defined as a popular discourse based on making risk “everyone’s business” within an organisational setting (Power, 2007, p94). Power describes ERM as a new “risk appetite” which extends risk management beyond mitigation to consider risk as a variance in value expectations. In turn, risk management is conceived as managing value “at risk” and this concern is devolved through the enterprise as the dominant “rationality of governing”. This ERM rationality is describes as a style of “standard” making which typically has four key features (ibid, p80):

- Recognising harm but also opportunity where the focus is on control variances to mitigate risk but also to enhance value
- An emphasis on risk communication with a wide range of stakeholders drawing together a variety of different perspectives
- Where responsibility and authority is assigned and allocated across the enterprise
- The emphasis is on risk identification through visualizations and mapping using overview instruments rather than risk calculations.

Power elaborates how these features are underpinned by a new “moral economy” (ibid, p95) where corporate citizens act in a way that is self-governing with a capacity to innovate. However, he notes that the freedom to innovate is underpinned by an organisation built on “proof” and “precision” and conceptions of accountability (ibid, p197). Leadership plays a central role in organising accountability but this requires visibility. Risk maps that highlight the impact and likelihood of risks and other overview “instruments” make the organisation “readable” to senior management (ibid, p81). Power describes how they create auditable evidence of risk management and a visual form that articulates the nature of risk. In some instances, they become centrally important in mobilising organisational consensus of the nature of risks.

Within ERM, principles of governance represent a mix of the self-governing as “enterprise” with “auditability” based on precision, proof and control compliance (ibid, p197). Power notes that ERM involves autonomous common coalitions that reflect principles similar to “heedful interrelating” (Weick and Roberts, 1993; Dougherty, 2016) although responsibilities and performance expectations are more prescriptive and standardized. In this sense, ERM seeks to

develop citizens that act responsibly and heedfully within an evaluative framework. This encourages collective action but through a prescribed set of responsibilities.

2.4.2 Synthesis of Themes

Power (2007) and Stirling (2009; 2010) describe the value-laden nature of knowledge and the complexity of engaging with controversy and uncertainty. These ideas move the traditional project management focus away from conceptualising risk as an “unknown” to be discovered through the provision of more information, to a socially complex concept. Stirling’s work highlights a complex relational dynamic where political interests can influence how risk is evaluated and justified. Power’s work links these themes to an institutional “appetite” for risk which shapes how it is conceived and who is held to account for mitigating risk. Some of these themes tie back to the concepts of an “evaluative order” and “acts” of justification in shaping an organisational dialogue (Boltanski and Thévenot, 2006; Miller and Power, 2013; Antal et al, 2015; Kornberger et al, 2015). However, what counts as being worth more deliberation is defined within a complex infrastructure of institutional standards and guidelines. In this context, traditional approaches to project risk management involve compliance to procedures that emphasise the diligent recording of “proof” of risk events. However, in an ERM setting, subjectivization is more closely linked to corporate citizens accepting accountability for risk and entering a dialogue to justify improving value “at risk”. Power (2007) reveals the complexity of these different risk appetites and an ongoing trade-off between a desire for regulation and a need for discovery and enterprise in complex situations. Rather than viewing a risk appetite as a static concept, Power describes it as the emergence of a dominant institutional appetite governed through different styles of standard making. This final point is important because it emphasises the dynamic and heterogenous nature of risk shaped by its institutional context.

2.5 Learning to Govern Through Numbers?

This chapter has examined themes associated with management control, complexity and the governance of risk. The organisational and innovation literature has revealed important themes that complicate the reproduction of control within major projects. Navigating complexity through projects involves resolving indeterminate problems where the pathway to resolution is unclear. Scranton’s 2015 paper highlights the challenges of organising project control in a way that balances a desire for regulation with freedom to enable critical reflection amongst a diverse team of investigators. Dougherty’s 2016 work on organising for complexity highlights the benefits of distributed forms of organisation united towards a common goal of discovery through collective problem solving. Abductive learning routines play a key role in bringing

problems forth whilst organising diverse perspectives into collective discovery. However, sustained inquiry requires heedfulness and subordination when envisioning joint action. This point is important because Dougherty's model is based on "collaborative commons" and acceptance of overlapping accountability for discovery. However, within construction, shared accountability and collective discovery are two main areas of concern and tension. Stark's 2009 work on dissonance describes productive friction and tensions in learning. Stark recommends organising search "spaces" and overlapping performance criteria that can balance multiple perspectives into a common sense of evaluative purpose. Chenhall et al's 2013 paper extends these ideas into the importance of concurrent visibility of evaluative priorities to avoid "stuckness". These ideas combine to describe how sustaining emergent learning in complexity requires common purpose, and material and abstract forms of governance that balance friction and tensions. However, controversies can destabilise progress when they challenge a sense of common purpose potentially leading to heedlessness. These points lead to issues of governing risk where incertitude can create a spiral of tensions associated with "hiding" knowledge to protect political interests.

The review of the literature on risk within projects shows traditional views of risk as a variance from plan which can result in an overemphasis on fixing early-stage plans. The literature on the process of risk management recommends more sophisticated modelling to build confident judgement. However, Power and Stirling's work describes complex social dynamics and tensions when institutions attempt to govern risk. Political interests and an institutional appetite for risk can shape not only how it is conceived and regulated but also who is held to account for risk. Power's 2007 work on organising uncertainty describes governing risk as a process of stabilising networks of knowledge. This suggests that uncertainty management is more about shaping "order" than measuring probability outcomes. However, this shaping of order can involve an ongoing and dynamic process of balancing an appetite for enterprise with a need for regulation. This process takes place through an infrastructure of standards and guidelines which shape an acceptable appetite for risk.

In summary, much of the literature on navigating the complexity of major projects recommends the benefits of collective learning. Dougherty's 2016 and Stark's 2009 work suggests a powerful role for collective evaluation and shared accountability in balancing competing interests. However, organising a shared sense of evaluative purpose requires an infrastructure to sustain control. In the opening section of this chapter some of the key features of the control approaches adopted on T2 and T5 were compared. The contrasting models of control described

features of participatory versus centralised planning, client-led risk management versus shared accountability and distributed versus co-located teams. However, the accounting literature warns against an overemphasis of functional traits of specific loci of control. Instead, it recommends accepting the unstable, intertwined and emergent nature of control (Power 2015; Miller and Power 2013). Therefore, the Heathrow cases will trace the “actual” development of the calculative infrastructures as they evolved over time. The conceptual framework provides a basis to break down the composition of the calculative infrastructures into a sequence of calculable spaces developed to mediate order. This framework is intended to support an analysis of “how” control was sustained despite controversy and change. The next chapter draws these points together by describing the “process” methodology that was adopted to trace the development of the infrastructures over time.

Chapter 3

Methodology

3.1 A Process Approach

This chapter describes and explains the methods used to collect data and analyse the two comparative approaches to governance and control on T2 and T5. So far, the discussion has highlighted the unstable nature of the controls environment within major construction programmes and the emergence of controversies which can destabilise progress. This chapter describes the use of a process approach within this thesis in order to acknowledge the importance of complexity and the indeterminate nature of control within large-scale projects. Rather than making a static comparison between certain functional traits of the control architecture, the research design focused on tracing the evolution of the calculative infrastructures. In turn, the research questions are underpinned by an assumption⁴⁵ that the controls environment at Heathrow was dynamic and calculative technologies played a mediatory role in settling order. In the last chapter the literature review addressed different aspects of governing risk in complexity. The review introduced the concept of fabrication and the usefulness of studying progression by focusing on controversy and the process of negotiation and the modifications necessary to stabilise agreement. These points have methodological implications because they highlight the importance of recognising temporality and the need to take time seriously (Burns, 2014) when examining the nature of control. This involves being sensitive to evolution whilst considering in some depth how periods of controversy effected the development of the calculative infrastructure. Within this thesis the central importance of emergence and controversy led to the adoption of a process approach as an underlying method that was sympathetic to the link between temporal progression and control (Langley, 1999; 2009a; 2009b; Langley et al, 2013; Burns, 2014).

Process studies track the development of phenomenon through phases or states which enables a study of “actual” emergence and the generative drivers underpinning progression. The focus here is on creating a longitudinal chronology of events by tracing diachronic ⁴⁶patterns of interactions into “what happened and who did what – when” (Langley, 1999, p692). This approach is sympathetic to the indeterminacy of control in projects. Langley notes that process studies avoid making static assumptions that are unsuitable for studies in complexity because “action under complexity interacts with its context to generate reactions, with unexpected ramifications that are absent from static models” (Langley, 1999, p412). This final point is

⁴⁵ Based on claims made by the existing Heathrow literature

⁴⁶ Diachronic is “dealing with phenomena as they occur or change over time” (Webster’s 2007)

important because it acknowledges how this approach is focused on the study of “actual” interactions and practices rather than making claims about the strategic “mission” of control ⁴⁷ (Hopwood, 1979; Power and Gendron, 2015). Rather than oversimplifying assumptions about the linear progression in control, a process approach focuses on the actual sequence of events. Burns (2014) notes that this supports the analysis of “how” type questions:

“process research incorporates notions of causality as constituted by sequences of interconnected events rather than through abstract correlations. Thus, such an approach promises to extend “know-how” theorising”

(Burns, 2014, p74)

Burn’s quote describes how this approach is more suited to “know-how” theorising because it moves away⁴⁸ from making assumptions about how complex control moves from an initial orchestration to implementation. These points are important because the indeterminacy of control and the unforeseen effects of emergent change are significant problems for major construction projects.

3.1.1 Temporal Bracketing

Traditionally much of the project management literature has attempted to understand project phenomena by adopting a contingency approach that seeks to connect key functional traits⁴⁹ to the contextual setting. Many of the existing Heathrow Terminal 5 studies⁵⁰ focus on developing a link between the design traits of the programme and the innovative outcomes of this exemplar case to develop a picture of best practice. However, the danger of this approach is that functional attributes are wrongly assigned to successful outcomes because key events, interactions or choices that emerged “during” the programme can be overlooked. In this context, oversimplifying the relationship between outcomes, attributes and “time” could result in missing important progressive relationships that enabled success. In contrast, process approaches pay attention to time by tracing the sequence and movement between different states to understand important triggers and “drivers”. However, a longitudinal process study of

⁴⁷ Hopwood’s classic quote about accounting mission: “Without [research oriented towards describing and understanding accounting systems in action], I feel, the behavioural and organizational study of accounting will increasingly exist in a void, within a world grounded on the myths of the accounting mission rather than the achievements of accounting in practice” (Hopwood, 1979, p147)

⁴⁸ Burns notes that a process orientation focuses on how and why organisational phenomena emerge, settle, change and unfold over time. This contrasts to variance questioning to identify co-variation among dependant and independent variables for “know-what” modelling of best organisational practice (Burns, 2014, p74)

⁴⁹ For example; Hobday, 2000; Soderlund and Tell, 2012.

⁵⁰ Davies et al, 2009; Brady and Davies, 2011;2014.

the Heathrow control infrastructure over an 18-year period required a data analysis strategy to structure the research. Temporal bracketing (Langley, 1999; 2009a; Langley et al, 2013; Cacciatori, 2012) provided a technique to sort and convert the data into phases creating a structure to guide the analysis.

3.1.2 Phases of Control

Process approaches focus on the sequences and patterns of events, activities and choices rather than testing specific variable-based relationships (Burns, 2014; Langley, 1999). Temporal bracketing techniques break the data down into “blocks” of time creating comparative units of analysis to chart the progression of events and activities. These blocks or phases can provide a basis to analyse concepts “within each phase” whilst being sensitive to the importance of evolution, time and situated context. Langley notes that breaking the data into phases enables the analysis of “how” actions in one period lead to changes in subsequent periods (Langley, 2009b). Central to the use of temporal bracketing is a clear definition of what constitutes the beginning and end of a phase. New phases represent new “states” where there is a discontinuity which stalls the accumulation and reoccurrence of the temporal flow (Langley, 1999; 2009b). In the Heathrow analysis, discontinuities are defined by “problematisation” where patterns of debate became intense because of a need to resolve a control-related controversy and tensions emerged that challenged the underlying evaluative order. In turn a sequence of “phases of control” were identified linking changing dominant control themes with modification and changes in the composition of calculable spaces. The intention of this analysis was to uncover the mediatory role of key calculative technologies by tracking the process of acceptance of new accountabilities and evaluative priorities.

3.1.3 Research Design

The discussion in the first chapter positioned the main research questions against the existing Heathrow literature. The “systems integrator” work⁵¹ emphasised the importance of client oversight and the client’s role in bearing commercial risk and orchestrating the pooling of knowledge. The second set of papers⁵² highlighted an important role for flexible plans and incentives in mediating a common sense of meaning and evaluative purpose. Although both sets of literature described an adaptive controls approach, neither contained descriptions of the

⁵¹ Davies et al, 2009; Brady and Davies, 2011; 2014

⁵² Nightingale and Brady, 2011; Gil, 2009; Gil et al, 2012

composition or process of control. For Terminal 2, there were no studies of the control approach. These “gaps” provided a basis to start to develop the comparative cases.

Power and Gendron (2015) describe some of the formative design and collection challenges for research as striking a balance between density (depth) whilst developing sufficient richness (breadth) to enable the research to clearly establish the phenomena within its context. Locating “how” Heathrow learned to govern through the numbers required an appreciation of the broader contextual debates associated with the industry over the last 20 years, as well as a depth and density of knowledge about project controls. In the early stages, this involved collecting and studying documents associated with the current Industrial Strategy for Construction (CS2025) and key reports framing the “Intelligent Client” capability debate (ICE, 2013, 2017; CE, 2009). It was also important to develop an understanding of the background to the industry at the time of both programmes. For Terminal 5 (T5) this involved studying a range of influential industry reports from the mid-1990s and the relevant academic literature. For Terminal 2 (T2), the project controls frameworks reflected more standard industry technologies and principles. This made it easier to work outside of the case site. However, becoming familiar with the terminology and language of controls required practitioner training. Four levels of analysis were developed from a variety of sources:

- Broken Business Model: This involved developing a picture of the control concerns within the industry by studying influential reports, attending an industry conference and a variety of interviews and workshops. This was necessary to be able to sufficiently engage with the reform discussion and avoid what Langley warns against as generating “banal” process insights⁵³.
- Calculable spaces: calculable spaces were the central “object” of the plot made up of calculative technologies which intervened to shape evaluative priorities and principles. These technologies included performance reports, procedural manuals, handbooks and guidelines. How accountabilities were assigned and the standards and targets built into these reports were scrutinised to understand the nature of adjudication within these spaces.

⁵³ Langley’s “banal” process insights comment served as a significant warning. She describes the danger of vague discussions; such as “organisational processes involve opposing forces, non-linear relationship and feedback loops” (Langley, 1999, p694)

- Phases of control: The Heathrow cases were broken down into a timeline of control phases. These phases were initially analysed to build a picture of a sequence of key events and mediatory technologies that stabilised progress within each phase. Specific attention was paid to dominant themes which described the order of evaluative principles within each phase. In turn emergent patterns of contested “tensions” were considered to understand the generative movement between the phases.
- Calculative infrastructure: A picture of the calculative infrastructure that evolved to mediate and sustain control was developed by analysing the progression within and between the phases of control. The conceptual model was used to break down the composition of the calculable spaces within each phase. The nature of fabrication and the settlement of tensions was analysed to consider how the programme progressed from one phase to another.

These four levels of analysis were gradually developed. Initially, data gathering started at the broad industry level and then efforts focused on creating a timeline of events and technologies that made up the calculable spaces. The next stage of analysis brought together the empirical data and theory underpinning the conceptual framework to describe the evaluative order and generative patterns of development within the control phases. The final stage of the analysis involved considering the movement between phases to develop a picture of the calculative infrastructure that evolved over time. Although an initial intense period of data collection took place over 14 months, the triangulation of the findings was more gradual because it involved an ongoing dialogue with industry contacts in the field.

3.2 Data Collection

Initially exploratory fieldwork focused on understanding the construction industry debates which shaped the context for each programme. For Terminal 5, the study covered the period from 1996 until 2006 with greater focus on the post procurement and pre-handover stage (1999-2005)⁵⁴. For Terminal 2, the study covers from 2009 until 2014 when Terminal 2 opened. The Terminal 2 construction had 2 elements, the T2B construction⁵⁵ for the satellite pier stands

⁵⁴ The T5 study ends in 2005 because the programme was handed over to the operations readiness organisation in 2006.

⁵⁵ The T2B £0.6bn satellite pier was constructed by Balfour Beatty with phase 1 completed in November 2009 and the final phase dovetailed into June 2014. Balfour Beatty used Logikal Projects for control and project management support. The control methodology described in the thesis doesn't include this element of the Terminal 2 programme.

and the main Terminal, T2A. The Terminal 2 study mainly focuses on T2A because this represented the majority of the programme which was centrally managed through the Intelligent Client approach. The studies required access to project-based data to build a picture of the composition and evolution of the calculable spaces as the programmes moved through the phases of control. A wide variety of data was collected through 24 interviews, direct observations, project-based data, industry and policy documents. The data collected broadly fell into three levels:

Industry Level: Key policy documents from 1996-2017 were collected and analysed to identify the trends in the debate about the need for reform in governing risk in construction. Background discussions, unstructured interviews and observations from trade-press, 1 conference and central government hosted working groups helped to identify the major “themes” influencing the Broken Business Models and Intelligent Client debate.

Project-Based: Observations and unstructured interviews ⁵⁶were undertaken over a 14- month period from the winter of 2014. Analysis was performed on “key” soft and hard copy documents which reflected the controls principles. Cyclical performance reports based on 6 monthly, quarterly and monthly reporting cycles were studied and “key” events were identified from a combination of primary and secondary sources. A large data base of knowledge was constructed of 170 main documents including procedural descriptions, process flows, checklists, PowerPoints and spreadsheets.

Controls technologies: The study of controls required an understanding of the “language” and technical terminology at a project level but also from a policy perspective. Building this knowledge involved training in controls software and ongoing discussions with control practitioners, a variety of consultants and contacts within construction and central government. Keeping up with the evolving discussion was a fundamental feature of the research design to enhance the relevance of the conclusions in a way that could meaningfully inform the reform discussion.

3.2.1. A Phased Approach

Twenty-four interviews totalling 62 hours took place over 14 months with 20 different interviewees. The time taken in each interview, the generic professional background of the interviewees and their connection with the T2 and T5 programmes are detailed on page 62. Although sampling strategies and interview design is discussed in detail in section 3.2.4, the

⁵⁶ See the table on page 62

general pattern of the research involved deeper but less formal engagement and access as the research progressed. In the later stages, interviews were no longer recorded but a diary and notes were kept in draft form (promptly after each session). All participants have anonymised identities but 52% agreed to be recorded and the recordings were transcribed. The table below summarises the key features of the interviews:

Phases:	Role	Hrs	Interview Style
Exploratory Fieldwork (2014)	1. Industry Expert 1	8	Unstructured/not taped
	2. Major programme expert	4	Unstructured/not taped
	3. Director T5 and T2	2	Unstructured/taped
	4. Partner/Consultant 1	2	Unstructured/taped
	5. Project Manager T5	2	Unstructured/taped
	6. Controller 1	3	Unstructured/taped
Phase 1 (spring 2015) Building a comparative case	1. Industry Expert 1	3	Semi-structured/taped
	4. Partner/Consultant 1	3	Semi-structured/taped
	6. Controller 1	2.5	Semi-structured/taped
	3. Director T5/T2	1.5	Semi-structured/taped
	7. Controller 2	3.5	Semi-structured/taped
	8. Partner/consultant 2	1.5	Semi-structured/taped
Phase 2 (summer 2015) Joining the Project Eco-system	9. Industry Leader 2	1	Semi-structured/taped
	2. Major Programme expert	1	Semi-structured/taped
	10. Industry Leader 1	3	Semi-structured/taped
	11. T5 Controller 1	3	Semi-structured/taped
	12. T2 project controller	1	Semi-structured
	13. T5 Controller 2	1.5	Semi-structured
	14. Project manager T5 (2)	1.5	Semi-structured
	15. Manager T2	2	Semi-structured
Phase 3 (autumn 2015) Policy Reform	10. Industry Leader 1	1.5	Semi-structured
	16. Industry Leader 3	1.5	Semi-structured
	17. Government advisor 1	1	Semi-structured
	18. Consultant 3	4	Semi-structured
	19. Industry Expert 2	2	Semi-structured
	20. Consultant 4	2	Semi-structured

Table 3.1: Key Features of Interviews

3.2.2 Exploratory Fieldwork

Initially exploratory fieldwork collected information on project histories mainly from secondary sources and an initial timetable of events on T5 was drafted. Extensive data was already in place for T5 and several academics acted as sponsors by supporting preliminary questions and snowballing to other research groups and industry experts who might identify potential gaps in the research and suggest possible areas for further research. A strong cross-institutional collaboration was set up which sponsored initial access to key Heathrow project management and controls experts. By the end of 2014, an initial project was created to gather information about the contrasting approaches to governance on T2 and T5. An initial comparative case was built to highlight the key visual “spaces” and technologies for engagement on both programmes. At the end of 2014, a set of unstructured interviews were arranged to engage a small group of senior executives in a discussion about the different approaches to programme control and governance on T2 and T5. These interviews were taped and promptly transcribed. During this initial stage more access was granted and handbooks, manuals, PowerPoint charts and cyclical review data were gathered.

3.2.3 From Pilot to Full Fieldwork

3.2.3.1 Phase 1: Building a Comparative Case

Collecting an initial timeline of data on the evaluative principles, reports, reviews and periods of controversies for T2 was relatively straightforward once access was agreed. However, building a comparative case for T5 was more of a challenge because of the project’s lengthy lifecycle, size and complexity. Although archives of interviews existed for T5, little research had focused on controls technologies and their emergence over time. For T5, themes associated with client risk, common purpose and lean approaches to performance improvement provided an initial basis for more in-depth fieldwork. Once the T5 programme controls handbooks were located this opened up a series of questions about the nature of calculable spaces, risk governance, and especially issues associated with “fluid” accountabilities and tensions associated with accountability for risk. This inspired a bank of semi-structured interviews which discussed and scrutinised various performance review and procedural documents. The focus of the discussion shifted between specific events and evaluative themes that seemed to link to enrolment and controversy during contested periods. These interviews involved people with a range of expertise from industry leaders who had worked on T5, ex-controllers and project managers.

3.2.3.2 Phase 2: Joining the Project Eco-System

Until phase 2 there were several gaps, particularly around how the T5 dashboards and reports evolved and the composition of cyclical reporting forums. An industry and programme expert “tutor” (Cacciatori 2012) advised on a sampling strategy of key reports and helped to arrange a set of interviews with ex-managers and controllers to explore key events and themes. This snowballing was granted on the proviso that interviews were anonymised and all project reports containing live financial “data” remained confidential.

Project management literature on project-based learning emphasises the importance of “project ecologies.” These benefit from economies of repetition by transferring learning from one project to another embodied within organisational “tools” and cultures which can be recombined in subsequent projects (Davies and Brady, 2000; Grabher and Ibert, 2012). This phenomenon helped the search for specific dashboards, reports and controls methods as the community of professionals shared best practices in a way that enabled key technologies to be traced, despite the almost 10-year gap between their original use. Over time, more informal access to this community helped to close conceptual gaps in the T5 case and by the end of 2016 the 2 comparative cases emerged.

3.2.3.3 Phase 3 Policy Reform

In this final phase, meetings with key industry representatives revealed a specific issue linked to diverse perspectives, poor risk disbursement (dumping) and a lack of shared (common) purpose in construction. A key construction conference underscored these themes highlighting the weaknesses associated with trends in client and “complex build integrator” business models. Interviews snowballed into a set of meetings within central government and several working theme groups developed. I remain on the periphery of this work. Involvement with these groups helped to triangulate some research findings by identifying persistent conceptual themes but also resolving conceptual discrepancies.

3.2.4 Sources, Sampling Approaches and Interview Design

Gaining access to the appropriate organisations and people with the right kind of expertise was difficult. This made the data collection period longer than anticipated. The data collection strategy was constrained by the sensitive nature of the topic which required access to performance management reports and commercial frameworks. Also, the level of experience needed for the interviews required respondents with deep knowledge of the comparative risk, controls and commercial approaches. This required access to industry experts with sufficient experience to critically address complex controls issues rather than project-level managers with

routine knowledge. The sampling strategy was purposive in this sense, because interviewees were selected that had either strategic or in-depth expert knowledge. I also studied the industry to improve the likelihood of “being invited back” or being able to “snowball” to other contacts. This required credible conduct⁵⁷ and an ability to demonstrate sufficient industry knowledge to engage with respondents. However, in the exploratory stages, there was an initial “intense” period of training and research to develop a potential list of contacts. This required persistence and acceptance that building a pipeline of potential interviewees would be time consuming but also “tricky” because of pre-existing relationships with other academic institutions which took precedence. Serendipity played a role and over time some significant industry figures contributed. However, initial access would not have been possible without the kindness of a few key academics and industry contacts.

3.2.4.1 Phase 1 The Comparative Case

As the research moved from a pilot to full fieldwork, it became clear that although the development of the T2 case was rapid, T5 proved more complex. Archives of documents and transcripts existed and it was hoped that they would provide some background for the comparative case. Unfortunately, it became apparent that they lacked the detail necessary and so, rather than negotiating access, building a separate archive became a priority. Gathering a bank of T5 documents took time but gradually cyclical performance reports, project documents and handbooks were collected which enabled the move into full fieldwork. The bank of documents was used to build a timeline of events, technologies and periods of change. This timeline underpinned the design of semi-structured interviews and key respondents were selected based on the depth of their working knowledge of the controls architecture. Interviews were “structured” around general themes but “unstructured” in terms of what the person chose to emphasise (Dougherty, 1992; Cacciatori, 2012). Triangulation between interview transcripts, technical controls documents and cyclical performance reports continued to reflect dominant themes and conceptual and timeline “gaps” (Eisenhardt, 1989). Further interviews were arranged to address persistent themes and the conceptual framework was used to organise questions about the evaluative principles and the use of specific technologies to assign accountability and shape conduct. The findings formed the start of the construction of the “phases of control” thematic analysis on T5. This analysis was already complete for T2.

⁵⁷ My commercial background and experience of business networking helped.

3.2.4.2 Phase 2 the Eco-System

By the summer of 2015 inconsistencies in the T5 plot remained, particularly regarding the evolution of T5 reporting forums, dashboards and accountability for risk. An industry “tutor” played a central role in helping to guide sampling and sourcing strategies to close the gap. At this point, the research became more immersed in the context, with more informal access to data on the proviso that confidentiality was paramount. Direct observation of “state of-the-art” controls and risk tools on other projects, and access to archives which referenced the T5 risk methodology uncovered the central themes underpinning risk management on both programmes. During this phase, interviews with senior industry figures opened up a dialogue which helped broaden my appreciation of the industry level debate and to connect the Heathrow findings to the broken business model risk management debate.

3.2.4.3 Phase 3 Policy Reform

This final stage involved unstructured meetings, a conference and working groups which yielded a list of potential sources. The level of expertise and richness of the participants and their contacts helped to improve my base knowledge of the relevant themes for reform and the link between “projects”, the construction industry and the role of the government. Working group sessions were not recorded and Chatham House rules applied. During this phase, a small number of semi-structured interviews were conducted and written up. They focused on connecting the Heathrow cases to wider industry level issues, and they helped to reconcile the empirical Heathrow story with the conceptual assumptions that underpinned the policy debate and the language used. This last stage helped shape the Intelligent Client conclusions to be more relevant to policy and the current reform debate.

3.3 Data Analysis

Data analysis involved three broad stages; exploratory stage, full fieldwork and a final phase of analysis which led to tracing the patterns of development of the different calculative infrastructures. These are described below.

3.3.1 Exploratory Stages

This initial stage involved going back and forth between the data, the research questions and the prior Heathrow literature to identify gaps that required more scrutiny and data gathering. Early stage unstructured interviews described familiar themes from the existing T5 literature of integrated teams focused on driving through high standards of performance. They also described an important role for the T5 Handbook in documenting the lean partnering philosophy. A philosophy that required teams to accept opening book practices and cost

“transparency” in return for rewards which were described as “fair”. However, there was also discussion about situated controversies and tensions linked to the challenge of controlling a reimbursable cost contract, as plans continued to develop and change. Themes of adaptability and the “emergence” of control were mentioned and several interviewees stressed how the development of “being in control” involved moving from an initial state of “ambiguity” to a workable “culture”. This contrasted to T2A which was described as having a rapid initial set-up stage, where scope and accountabilities were fixed and agreed up-front. However, over time, plans were refined as the programme fell behind schedule. For T2, this raised questions about “how” the plans were modified and the role of calculative technologies in achieving a productive compromise.

Breaking the data down into control phases was important at this stage to bracket-off key events into a sequence. This was important because common control themes emerged across the cases, such as “one version of the truth” but their meaning differed because the context reflected different patterns of accountability. For example, on T2, a “single version of the truth” involved the establishment of a robust baseline forecast by holding suppliers to account and testing the integrity of cost and schedule forecasts. In contrast, on T5, “one version of the truth” referred to the establishment of diagnostic routines and collective performance rituals which helped capture more realistic performance forecasts and standards. On T5, evaluation was a collective process whereas on T2 accountabilities were assigned and centrally directed. This demonstrated that although similar terms such as one “version of the truth” were being used, the nature of the calculable spaces was fundamentally different. On T2, this involved strictly defined territories of accountability and subjectivization through an expectation of suppliers being held to account. In contrast, on T5, territories were more fluid and subjectivization encouraged collective search for the benefit of the programme. In both instances the order of evaluative priorities and “worth” and the use of technologies in building calculable spaces differed.

Once a timeline of technologies and critical events was developed, distinct themes emerged within each phase. The naming of these phases and their progression was more straightforward for T2 than T5. For T2, the interviews described a clear “plot” from a “single version of the truth” followed by an innovative “dashboard” and finally more visible supplier control through what was initially⁵⁸ described as the “Programme for Success”. For T5, phase 1 involved enrolling suppliers into the philosophy of the “client holds the risk” to settle concerns about accountability for changing scope. However, the development of the controls methodology emerged during

⁵⁸ Later this was renamed the “Golden Thread” and this is described in Chapter 6

the middle phase described as “one version of the truth”. The final phase was a distinct phenomenon called the “Total Cost Management”⁵⁹ initiative. Once this initial sequence of phases was identified, the conceptual framework was used to breakdown each phase into an architecture of calculable spaces. Then the project level documents and transcripts were analysed in more depth to scrutinise the main calculative technologies. This led to the study of patterns of enrolment, order and controversies within each phase described in the next section.

3.3.2 Full Fieldwork: Operationalising the Conceptual Framework

The conceptual framework was developed to trace progression through successive phases of control. It was described in the previous chapter as a diagnostic tool to breakdown the phases of control into distinct parts for more scrutiny (see figure 2.1 on page 39). The upper part of the framework describes the calculable spaces and the creation of an evaluative order shaped by “key” calculative technologies. The lower part breaks the process of enrolment down into stages, starting with the emergence of intense problematisation debates through to the negotiation and mobilisation of agreement. The intention of the conceptual framework was to identify “key” technologies that shaped “order” within each phase and then trace the nature of modifications necessary for sustained control.

Callon’s (1986) four stages of the Sociology of Translations were initially used to create a “plot” that traced enrolment from: 1. Problematization - as intense debates emerged; 2. Interessement - initial agreement of tentative principles captured in technologies to engage allied interests; 3. Enrolment - an unsettled period of negotiation and persuasion leading to new responsibilities and compromises; 4. Mobilization - the settlement of evaluative principles which enabled progress. However, because the analysis was based on past events it was difficult to distinguish between the early stage establishment of tentative principles (interessement), and processes of negotiation and persuasion that led to enrolment. For this reason, the 2 stages, “interessement” and “enrolment” were collapsed into one major heading of “enrolment”.

Gradually an initial plot was developed which described the evaluative principles and order within each phase and the key technologies designed to enrolled progress. However, this analysis took several months of note-taking, re-reading of data and scrutinising the transcripts. It also involved a dialogue of questions with contacts in the field to place specific calculative technologies within the timeline. Conceptualising the analysis of process data as the development of a “plot” was particularly useful (Langley, 1999; Pentland, 1999). Pentland

⁵⁹ This was later renamed the “Foresight” phase described in Chapter 5

describes a plot”⁶⁰ as a sequence of events, with focal actors (client and suppliers), with an evaluative frame and possible antagonists (tensions) and protagonists (calculative enablers of progress). This initial plot was written up into a narrative which was used as a “sensemaking” document (Langley, 1999) to develop dominant themes that underpinned the “evaluative order” within each phase. This “narrative strategy” was a particularly useful way of synthesising the different data sources to get “on top of the data”, and to clarify sequences and early analytical themes (Pettigrew, 1990). The narrative was then used to generate discussions about problematisation issues and contestations that challenged the evaluative order. The overall intention was to understand the role of calculative technologies and calculable spaces in sustaining progress despite unsettling and contentious tensions. During this stage NVIVO was used to develop a “thematic analysis” (Braun and Clarke, 2006; 2012).

3.3.3 Thematic Analysis “within” Control Phases

Thematic analysis is a method to identify and analyse “themes” that represent patterns within the data (Braun and Clarke 2006; 2012). Braun and Clarke’s work details a staged process for analysing central themes in psychology research. It is intended to add rigour to research that involves significant levels of interpretative analysis. It usually starts with a bank of transcribed interviews. It was most useful for tracing the analytical progression from the more surface descriptions described as “semantic” analysis, to a later stage of uncovering deeper and more “latent” themes. At this stage within the Heathrow cases there was a need to move from a detailed narrative description of phases of control to a more in-depth analysis of the assumptions, meanings and contentions underpinning the evaluative order. The narratives brought together the data from a variety of documents with the transcripts. As an initial exploratory step both the narratives and T5 transcripts were openly coded with an intention of searching for the “dominant” themes and a hierarchy of sub-themes within each control phase. This process started with T5, because it appeared more complex than T2.

⁶⁰ “A clear sequence of beginning, middle, and end in time, 2. Focal actors who play the protagonist or antagonist 3. An identifiable voice reflecting some of the actor’s viewpoints 4. An evaluative frame of reference of what is right or wrong, appropriate or inappropriate, and 5. Other indicators of context over time and place” (Pentland 1999, p712)

The extract below describes the early stage searching for a theme structure based on the phase 1 on T5, initially named the “client holds the risk”:

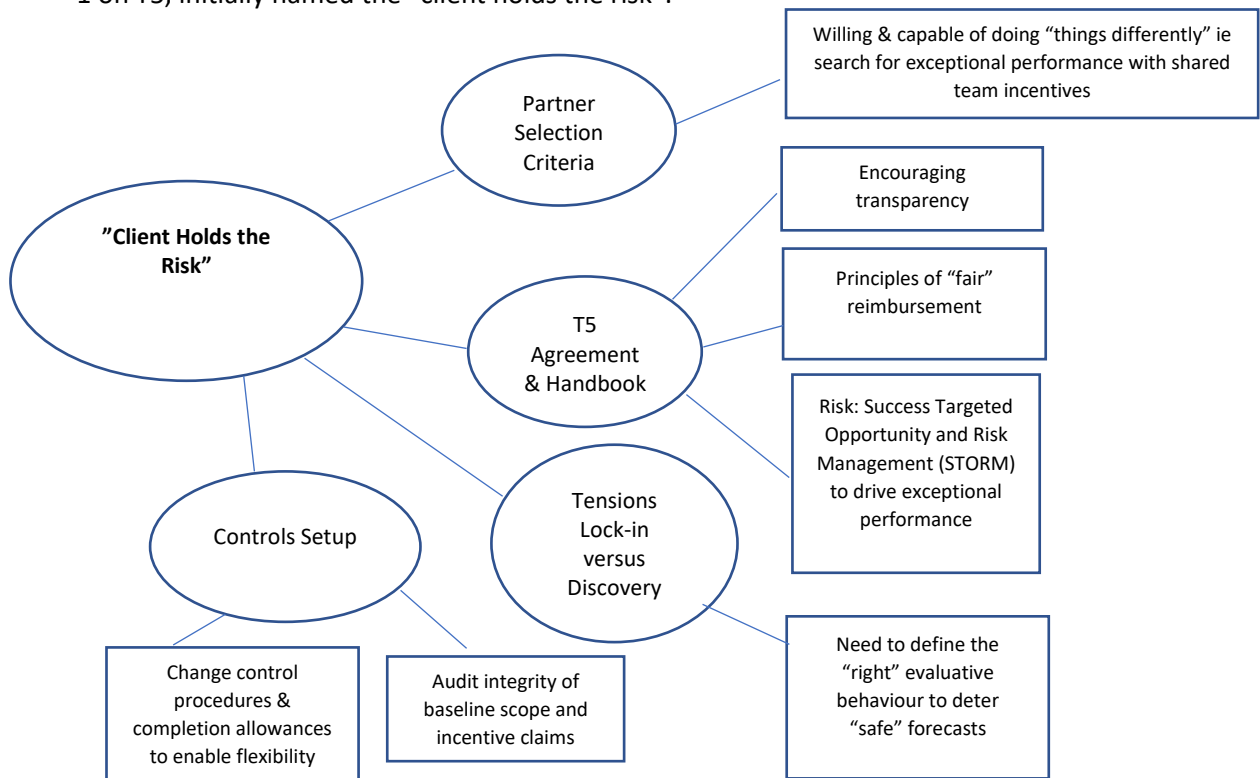


Figure 3.1: Early Stage Searching in Thematic Analysis

At this (very) early stage of the analysis one parent node was established for control phase 1 the “client holds the risk”. Bottom-up coding resulted in 4 main sub-nodes “Partner Selection Criteria”, “T5 Agreement and Handbook”, “Tensions” and the underpinning early stage “Control Set-up”. The “searching for themes” (Braun and Clarke, 2006) stage helped to gain a sense of the significance of each individual theme and its constituent parts. However, a review of these early stage themes prompted the need for a more coherent approach that could be replicated across the data-set. The coding was restructured to reflect the conceptual framework. This moved the analysis from focusing on a chronological description of events to examining the generative drivers that mediated and sustained control within the control phase. More reading and discussion led to re-grouping the sub-nodes into the headings, “technologies”, the principles underpinning “enrolment”, and “controversy” for each phase of control. The description and meaning of the parent theme, the “client holds the risk” was gradually refined over time through an iterative process of writing the control narrative “plot” whilst scrutinising the existing data and engaging with project experts. Gradually “higher” order principles describing each phase were rationalised and refined. This led to a clearer definition of the description of the phase of

control and its underpinning dominant themes described in terms of “scope and content of each theme in a couple of sentences” (ibid, p92).

The table below describes the scope and content of the “client holds the risk” - the setup stage for the programme where the meaning of “lean” was captured in key technologies. The latter were the Handbook and STORM which played a central role in ascribing the evaluative principles fundamental for knowledge sharing and active risk management. Enrolment involved settling concerns for risk through the incentive structure combined with control procedures to assure confidence, assign accountability and reward discovery. The structure of the table is based on one parent as the dominant theme “client holds the risk” and six sub-nodes grouped into the 3 headings. This pattern of one parent and a variety of sub-nodes grouped under the same three headings was replicated for each phase of control. Because the headings used to group the sub-nodes came from the conceptual framework this helped to build a consistent plot. Grouping the sub-nodes also linked the analysis to the theory underpinning the conceptual framework.

Dates	Phases of Control	Key Technologies	Enrolment	Controversies
1999-2001	<p><i>“Client Holds the Risk”</i></p> <p>Dominant Theme:</p> <p>1. <i>The contract, T5 Agreement enrolled teams into a lean partnering arrangement accepting a common identity and agreeing to search for exceptional performance.</i></p> <p>2. <i>The client held the risk to settle uncertainty & encourage discovery</i></p>	<p>1. The Handbook; described a normative framework of values for more transparent knowledge sharing.</p> <p>2. STORM: ascribed “Active risk management” to encourage heedfulness and acceptance of responsibility to manage-out risk</p>	<p>3. Incentives: Remove supplier’s commercial risk, distribute rewards through milestone & value incentives.</p> <p>4. Territorialized team accountability: enabling adaptive search for “better value”.</p> <p>5. Change control: to interrogate trade-offs between regulation and discovery</p>	<p>6. Needed more oversight of “right” behaviours to;</p> <p>a. Prevent inertia and lock-in</p> <p>b. Develop robust forecasts to capture progress and emergence</p> <p>c. Stop teams hiding contingencies in safe forecasts</p>

Table 3.2 Extract from Terminal 5 Phases of Control

The final column “controversies” reflected situated tensions where divergent priorities or competing interests unsettled the existing “order”. For most phases, issues described as a controversy inspired change within the calculative infrastructure leading to the following phase. For the extract above controversy was linked to a lack of clarity in “how” the lean partnering model would be mobilised.

Lean partnering reflected a major departure from traditional practices and this period of “ambiguity” was elaborated in a problematisation description:

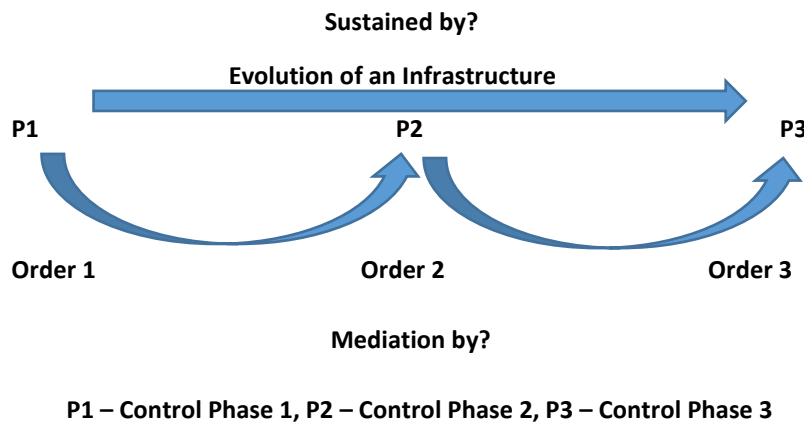
“Who would be held to account for changing scope and how would they be evaluated?”.

These analytical steps were replicated for each phase, which were labelled in a way that represented the “dominant order” (such as ambiguity for phase 1 on T5). The main problematisation description elaborated the nature of the tensions. This provided a basis to structure the analysis of mediation, enrolment and modifications which took place to settle tensions.

3.3.4 Tracing the Emergence of the Calculative Infrastructure

For each phase of control, the changing composition of the calculable spaces and the machinations of enrolment to settle tensions were analysed. However, there was a need to consolidate the phases of control into a holistic picture of the actual progression across the data-set. The model below was developed to compare the T2 and T5 calculative infrastructures that evolved.

Figure 3.2: Tracing the Emergence of the Calculative Infrastructure



The model was used to describe the progression on T5 from phase 1 the “client holds the risk” to phase 2 “one version of the truth”. The monthly reports were identified as a key technology which mediated tensions associated with risk whilst capturing a collective version of the truth. Mediation enabled progression from a period of “ambiguity” (order 1) to a risk management order (order 2). The model and conceptual framework were used to explain how this happened and the nature of modifications to calculative technologies and calculable spaces that enabled progress. The model also summarised “how” control was sustained. For example, on T5, “sustained” control was linked to the gradual legitimization of lean principles and the

subjectivization of risk “citizens”. This analysis then led to a comparison between the two infrastructures detailing the main differences but also similarities.

This approach resulted in a comparative discussion of different infrastructures for performance improvement versus a more regulatory model of governance. In the conclusion, these observations were used to extend some of the industry-level discussion about intelligent client capabilities. The findings also addressed specific gaps within the existing Heathrow literature by identifying the wider calculative infrastructures, and the composition and role of certain control innovations, which were previously hidden. The final conclusions also addressed specific points within the industrial strategy making suggestions on how different approaches to control could contribute to the reform debate.

3.4 Reflections

The intention of this thesis was to contribute to the reform discussion by examining “how” Heathrow, as an exemplar intelligent client, learned to govern through the numbers. Simultaneously, the research addressed gaps in the prior Heathrow literature by examining the composition and mediatory role of the calculative infrastructures on both programmes. Concepts such as the phases of control and controversies were examined to compare patterns of development across both projects. However, this breadth of analysis meant there were fewer opportunities to focus on specific periods of contested change or to extend the control phases into more detailed states or “sub-plots”. Concepts such as “fabrication” and Callon’s 4 stages of the Sociology of Translations were useful for exploring how the different technologies shaped patterns of development. However, it was not possible to observe the detailed “inner workings” of fabrication “in action” during the resolution of controversies (Preston et al, 1992). This level of detailed analysis is an area for further research that could consider the gradual construction of some of the innovative calculative technologies described within this thesis.

The adoption of process thinking was an essential part of acknowledging the complexity and indeterminacy of project control. Burns describes how at the heart of “process thinking” is a recognition of the continuous “flow” of unpredictability and ongoing change (Burns, 2014). However, operationalising these ideas required careful tracing of the emergence of control using the conceptual framework and other analytical strategies. Certain techniques were very useful. In particular, writing and re-writing the case as a narrative (Langley, 1999) helped to develop a plot of changing evaluative principles and suites of technologies that sustained control. The flexibility of the conceptual framework and thematic analysis also helped to generate new insights (certainly for the T5 case). However, triangulation also involved lengthy periods of

discussion with contacts in the field. Rather than discussing deep interpretive themes, these discussions usually involved the technical details of control or the dates of specific events. These points highlight how being a researcher in this type of setting requires not only a grasp of the technical concepts of control but also access to control documents and reports.

Several analytical techniques helped with the process of doing the research. NVIVO is a potentially powerful tool and it was heavily used in the early stages to experiment with themes as an abductive reasoning tool. However, eventually it became an important tool in refining the thematic analysis as described on page 70. PowerPoint was also useful for summarising complicated early stage thoughts into a constrained space. However, possibly the most useful techniques involved writing, editing, re-writing, and reading and re-reading to compare the data with the literature. Engaging more fully in the field helped me to keep the study problem-focused.

In summary, this chapter has described how the empirical materials for the Heathrow case were collected and analysed. As a final reflection, it is important to recognise that undertaking this type of research is particularly difficult because of the commercial sensitivity of the information and the need to preserve anonymity. In writing the empirical chapters, I have taken care to present the information in a way that respects the sensitive nature of the data. The three empirical chapters that follow focus on developing the Heathrow case within its contextual setting. The next chapter, examines the evolution of the broken business model reform discussion which provides a background to the Heathrow cases.

Chapter 4

The Broken Business Model?

4.1 The Game

“But you have to play the industry game. We end up in this game, the dance we know we do in the industry, which is very similar to banking, which is we all dance the same thing because we're worried that, if we don't, we won't get the rewards. And we're in the same thing. So, we know the game. We know we underbid. We underbid, hoping the client will change its mind. The client changes its mind, you put the price up. Once you've won the contract then now the power has moved from the client to the person who's got the contract and then we don't manage the contract very well”

(Senior Industry Executive, 2015)

The intention of this chapter is to explore the contextual setting for the construction industry in the UK which formed the background for the Heathrow cases. The construction industry has a history of dissonance ⁶¹where a variety of experts and professions come together through project organisations to deliver complex and often unique solutions. However, tensions between competing value systems can lead to situated and contested “moments” of controversy that challenge incumbent value systems (Antal et al, 2015; Dewey, 1939). The opening quote describes “underbidding” as a rule-based game where contracts are won at the lowest tender price but once operational control is transferred to the supplier they intentionally seek to create incremental margin. However, gaming can be hidden because of a need for suppliers to protect their reputation and hide an intention of manipulating the contract. For over 20 years task forces and industry reports have commented on the need for reform to “counter a strongly ingrained adversarial culture” (Latham, 1994). Although professional codes of conduct advise against intentional underestimation⁶² many academics have highlighted a persistent “misrepresentation” of initial business cases and plans in major programmes (notably Flyvberg, 1996; 2012; Winch, 2010; Flyvberg and Cowi, 2004; Clegg, et al 2012). Flyvberg’s work (1996; 2012) identifies misrepresentation and underbidding as a strategic choice to intentionally hide information in order to win new business. Flyvberg recommends the introduction of checks and balances and institutionalised control to create transparency and accountability in order to

⁶¹ In this context dissonance refers to contending values and beliefs that can result in different justifications of worth rooted in different interests & evaluative priorities (Stark, 2009; Antal et al, 2015, Kornberger et al, 2015)

⁶² The Project Management Institute outlines that managers should provide accurate and timely information & not “engage in or condone behaviour that is designed to deceive others” (PMI 2006, p5).

counter political misrepresentation (Flyvberg, 2012). However, attempts to create greater transparency through audit and surveillance practices can result in resistance. The concept of project level “unknowns” that are “known” but not shared with others is important when considering strategies for reform in the governance of risk and control (Winch, 2012; Flyvberg, 2012; Clegg et al, 2012).

Construction 2025 describes an important role for the client in developing stronger delivery relationships by fixing the front-end of the project to create a “route-map” for improved working practices. It recommends the orchestration of common purpose at the procurement stage by adopting an open-book environment, profit sharing incentives and integrated interdisciplinary teams (CS2025). These approaches are portrayed as a way of encouraging co-production whilst aligning commercial interests. However, construction supply chains involve a network of “complex interfaces” where performance is based “not only on a single firm, but on the efficient functioning of the entire network” (Gann and Salter 2000, p959). In this context the network reflects a traditional aversion to uncertainty and a deep concern about being held to account for uncontrollable risks. Chapter 1 described a tendency towards hiding “know-how” and withholding strategically important knowledge when faced with uncertainty (Gann and Salter, 2000). Although Construction 2025 recommends the adoption of various approaches such as open-book to encourage collaboration, this assumes a willingness to openly share financial information. However, in the risk-averse setting of a major construction project, open-book practices may lead to resistance. Rather than building deeper relationships, they can result in contingency building to protect fragile margins. In turn, incentives designed to encourage profit sharing may also be manipulated by developing “safe” initial plans packed with buffers and contingencies (Clegg et al, 2012). Power’s 2007 work describes the complexity of organising uncertainty and the role that different calculative technologies can play in shaping an appetite for risk. This work is important because it describes how risk instruments or calculative technologies (such as open-book) can unlock networks of knowledge by balancing trade-off tensions. However, the institutional setting for the governance of risk needs to be more fully understood. This chapter examines the dissonant nature of construction and the historical context for these underbidding and risk-averse gaming strategies. In the next section the discussion returns to an examination of the current policy debate. This is followed by a more detailed review of the persistent gaps between industry aspirations for reform and actual practices from Egan in the late 1990s to the current day. The final section links industry themes and recommendations to the governance models designed to control T2 and T5.

4.2 Transforming a Broken Business Model?

Construction 2025 highlights major opportunities for construction with projected global growth of 70% by 2025. The vision for transformation in the industry has five key components:

1. Better whole life value⁶³ for construction assets 2. More efficient and sustainable approaches to delivering low carbon assets 3. Clear leadership and enduring government-industry relationships 4. The development of leading digital design, advanced material and digital construction technologies 5. Attracting and retaining talent (CS2025, p18)

These 5 pillars combine to create an image of construction driving productivity growth across the economy. However, despite these aspirations, the Construction 2025 strategy describes the construction industry's current broken business model as reflecting persistent problems with "late delivery, cost overruns, commercial friction, late payment and accidents" (CS2025, p18). The reform discussion amongst the industry representatives (Hansford, 2015; ICE, 2017) focuses on the fundamental need for stronger delivery relationships to counter persistent lateness and overruns. In turn "fracture" in the execution and delivery of projects is linked to weak collaboration (CS2025, p23).

At the heart of business models is the concept of "value" as a proposition about what customers want and an architecture for delivery (Teece, 2010; Amit and Zott, 2012; Zott et al, 2011; Mokhlesian and Holmen, 2012). Teece (2010) describes a business model as a "hypothesis" but also a methodology of principles about how to deliver value through an architecture for value creation and capture. In construction, the notion of value is initially defined by the client and key stakeholders in terms of a specification of important dates, key milestones and specific operational and financial targets. The procurement of the main suppliers by the client is a fundamental milestone because once commissioned, responsibility for orchestrating the network of activities amongst the supply chain of engineers, architects and consultants passes between the client and suppliers (Cox and Townsend, 1998). Coordinating and organising co-production between the client and suppliers involves a complex infrastructure where the degree of client involvement in overseeing progress varies (Mokhlesian and Holmen, 2012). However, sustaining value "capture" in a network of cooperative relationships is key to enable a "viable" business model (Teece, 2010; Amitt and Zott, 2012; Söderlund, 2012). Value capture involves retaining but also extracting value at a level that is acceptable to suppliers and the client (Amitt and Zott, 2012; Teece, 2010). Teece describes an acceptable level of value as a "compelling"

⁶³Whole Life Value incorporates the "relevant" costs and revenues over the useful economic life as well as the initial CAPEX (ISO 15686-3)

value proposition because it captures sufficient value for the business (supplier) and client in terms of acceptable cost and risk structures (Teece, 2010). However, in construction the standard business model is currently failing to deliver acceptable levels of cost and risk.

In 1994 Sir Michael Latham's influential report "Constructing the Team" was published which highlighted the central role of the client in enabling reform by overseeing the organisation of delivery relationships through teams. The report described the benefits for the industry of having more satisfied clients but also the central role of the client in organising teamwork and cooperation. The need to sustain cooperative delivery relationships with suppliers has remained a central theme in the current discussion for reform. Construction 2025 suggests that a "key driver" for change involves both "earlier" and "fuller" engagement of suppliers. The emphasis here is on the creation of "synergies" where a shared conception of value provides the focus for delivery efforts. However, although Construction 2025 recognises the importance of the client clearly articulating the nature of value in the early stages of a project there is little discussion about "how" this would be governed. In chapter 1 the discussion of the ICE 2013 Intelligent Client Capability Framework highlighted "how" more capable clients created a setting to foster a "safe" culture to encourage open and honest communication. The ICE framework emphasised the importance of offering incentives to align and integrate divergent perspectives towards a shared sense of purpose. However, there was little detail about how incentives might enable social integration when faced with suppliers that are unwilling to engage in collective forms of enterprise.

The latest reform initiative is "Project 13" which is in a developmental stage with plans to launch in the Spring of 2018. Project 13 is a cross industry initiative which intends to bring together a range of infrastructure stakeholders to consider pathways that move from "transactional" relationships towards collective "enterprise". It is attempting to move the construction industry away from a short-term perspective focused on "lowest cost" procurement models to developing shared responsibility across the industry for the delivery of "high performing" infrastructure assets (ICE, 2017, p11). With oversight from the ICE and a number of industry level champions, the project is considering potential improvements in the governance, leadership and organisation of infrastructure projects. So far, the building blocks to reform recommend a move towards more collaborative working practices underpinned by governance frameworks capable of encouraging and sustaining productive delivery relationships. However, rather than focusing only on the construction stage of an asset, Project 13 is considering ways of lengthening the engagement of contractors and suppliers across the lifecycle of the asset. Although the project is still in an initial consultation stage, some of the early ideas represent an important move

towards recognising the link between improving “value” and sustaining collaborative relationships focused on a common sense of evaluative purpose. Project 13’s long-term plan is to move the dominant focus of the industry away from “on budget and on time” to the whole life value of infrastructure assets (ICE, 2017). However, the initial capital expenditure incurred in construction is a major feature of any infrastructure asset. Therefore, fixing the persistent failure to deliver projects is a priority before moving on to a vision of high performing infrastructure. On Project 13 Heathrow plays a prominent role in leading the Capable Owner and Intelligent Client debate because of its perceived capability to effectively govern the construction of its major terminals. These points are revisited later in the thesis. However, for now it is important to note that Heathrow represents a significant site for innovation in the governance of risk and control. The following section in this chapter returns to the late 1990s to chart the development of the reform discussion that provided a setting for the Heathrow cases.

4.3 From Egan to Wolstenholme

By the late 1990s a series of influential reports focused on the need to improve poor productivity in construction. The most notable was Sir John Egan’s 1998 “Rethinking Construction” which introduced concepts of “lean thinking” as a way to challenge wasteful practices by focusing on the improvement of quality. At the time Egan was the Chairman of the BAA and the report reflected his knowledge of Heathrow and past experience from the car industry. The second major report “Never Waste a Good Crisis” was developed in 2009 to evaluate the progress since Rethinking Construction by Andrew Wolstenholme and the industry membership organisation, Constructing Excellence. At the time, Wolstenholme had spent 6 years as the Programme Director on Terminal 5 which opened in 2008. Wolstenholme’s report highlighted a significant lack of commitment in the industry to reform, although after 2008 the economic downturn in the industry created a more urgent need for change:

“the industry must rise to the challenge. This together with the dramatic changes being driven by the advances in material technologies, the green agenda, the internet revolution and globalisation, could create the most exciting and dramatic period in our industry since the industrial revolution”. (CE, 2009, p6)

In the following section Egan’s initial Task Force report is examined to highlight the evaluative principles underpinning the recommendations, which are then compared to Wolstenholme’s report and the more recent Construction 2025 strategy.

4.4 Egan and Rethinking Construction 1998

The Rethinking Construction Taskforce was appointed by the Deputy Prime Minister to develop recommendations that could transform efficiency and quality outcomes for the industry. It built on Sir Michael Latham's 1994 "Constructing the Team" report which recommended partnering to modernise the industry and challenge fragmentation and fracture. Rethinking Construction extended these ideas by considering the source of wasteful practices and major themes for improvement⁶⁴. Overall it recommended a client-led transformation to counter a lack of knowledge sharing across fractured supply networks. The report recommended the creation of integrated teams within construction projects with a focus on improving customer value through the elimination of waste:

"Continuous and sustained improvement is achievable if we focus all of our efforts on delivering the value that our customers need, and if we are prepared to challenge the waste and poor quality arising from our existing structures and working practices." (Egan, 1998, p3)

An analysis of drivers for change in the industry highlighted the need for more integrated processes rather than the existing fragmented approach to production. These ideas challenged traditional construction supply chains that reflected a sequence of sub-contractor arrangements with each supplier maximising their own return rather than integrating around customer defined "value". In this context "integration" and long-term arrangements were viewed as the solution to fragmentation and individualistic short-termism.

The report emphasised team learning combined with a commitment to long-term relationships, with suppliers moving away from traditional contracts to more relational forms of agreement. The gradual replacement of formal contracts was perceived as a progressive step towards fostering a belief in partnering to achieve common objectives. This was described as:

"if the relationship between a constructor and employer is soundly based and the parties recognise their mutual interdependence, then formal contract documents should gradually become obsolete. (ibid, p30)

The move away from formal contracts elevated the role of the client to a coordinator overseeing a "no blame culture" (ibid, p14). The task force recognised the challenges that "mutual interdependence", "continuity of workflow" and the need for "greater predictability" (ibid, p30)

⁶⁴ Improvement themes: 1. Margins: Persistent Low and unreliable margins discouraged investment in R&D 2. Clients: misunderstanding the difference between best value and lowest price/cost. 3. Fragmentation: too many small subcontractors preventing continuity of skills and relationships

presented to construction but framed the challenge as “companies with the right culture deserve to thrive” (ibid, p31). In this context, the “right culture” sanctioned whole team knowledge sharing and “right first time” quality initiatives to eliminate waste. These recommendations were heavily influenced by Toyota’s “Lean Enterprise” model as a way of removing waste and improving efficiency to add value to the construction asset.

4.4.1 Lean Thinking

Lean thinking focuses on the movement towards a theoretical point of perfection where customer defined value is achieved by integrating techniques and removing obstacles to meet customer demand (Womack 1990, 2007). Rethinking Construction described these principles as:

“Creating flow and pull starts with radically reorganising individual process steps, but the gains become significant as all the steps link together. As this happens more and more waste become visible and the process continues towards a theoretical end point of perfection, where every asset and every action adds value for the end customer. Lean thinking represents a path of sustained performance improvement and not a one-off programme” (Egan, 1998, p23)

Specific lean process improvement initiatives were recommended for projects that included:

1. Early stage partnership during product development
2. Pre-assembly routines and standardised components
3. A variety of quality initiatives to reduce waste and defects during delivery.

Design technologies (3D CAD and single-model software) were identified as playing a key role in making “design interfaces” more visible to enable co-ordination. Performance measurement also played a key role in tracking quality improvements. The Annual Construction Excellence Key Performance Indicators provided a framework to monitor improvements across the industry. The selection of targets emphasised the importance of controlling capital expenditure and waste with industry-level standards set to reduce capital expenditure (CAPEX) costs by 10% pa alongside a 20% p.a. reduction in defects and accidents. To track the accuracy of forecasts a targeted reduction of 20% p.a. in the “predictability” of capital expenditure forecasts was set (ibid, p16)

4.4.2 Governing by Numbers

The belief in the transformative power of partnering to sustain performance improvement echoed lean thinking principles explored in the classic book “The Machine that Changed the World” (Womack et al, 1990; 2007). In the more recent version of this book the epilogue revisits

the importance of social control and visible control technologies in sustaining lean principles. Womack et al reflect on the importance of control architectures that facilitated Toyota's "relentless oversight of every design, production, and process by asking hard questions about performance every day" (Womack et al, 2007, p65). In this context, sustained improvement was linked to the need for flexible and tacit learning responses with "people" being more able to adapt to complex change rather than codified procedures and automated responses. Relentless oversight was also linked to strong supplier networks based on deep and specific relationships that fostered a willingness to accept responsibility to improve the whole. Deep relationships combined with a control system to support relentless oversight were key parts of the lean model which enabled Toyota to steer supplier conduct towards "re-programmed" responses (ibid, p66).

Egan's vision of a collaborative construction industry required acceptance of the benefits of partnerships and a willingness to invest in lean practices to improve efficiency. Rethinking Construction describes a lean model based on shared accountability for performance. In this context, performance measurement played a central role in governing conduct towards shared goals. Rather than measuring final outcomes at the end of the contract the report recommended continuous monitoring and comparison. Collective evaluation was considered a key form of disciplinary control and the ongoing monitoring of quality, timeliness and cost performance an essential part of:

"bringing discipline to the relationships between clients, project teams and their suppliers"
(ibid, p30).

The continuous monitoring of performance improvements was considered to be a more effective and rewarding way of governing relationships than managing "by" the contract. Although these concepts suggested a move towards continuous evaluation, there is little discussion about the implications of moving to a model of control that required more rigorous forms of surveillance and interrogation. Womack et al 2007 highlight how deep relationships enabled the acceptance of rigorous monitoring and collective responsibility for performance improvement. However, within Rethinking Construction there is little discussion of the journey to enrol divergent interests and self-seeking opportunism towards accepting shared accountability for performance improvement. Ten years later the task force led by Wolstenholme revisited the progress of the industry and concluded that the hoped for "revolution" was instead just "a bit of an improvement" (CE, 2009, p3).

4.5 Wolstenholme and Never Waste a Good Crisis 2009

Never Waste a Good Crisis revisited Egan's report and described disappointing progress and the need for renewed effort for the industry to "think again" and develop a united vision to move away from short-termism. Setting the scene Sir John Egan noted that;

"People are now measuring performance, and it is heartening to look at the demonstration projects to see that some very good work has been done. The opportunity remains just as large today, with the added incentives of harder economic crisis and major environmental pressure. So, I congratulate the team on a thorough review and on pointing out the next steps on the way to radical improvement – every crisis is an opportunity" (ibid, p3)

4.5.1 The Minority Club

In the report, research identified only a "partial uptake" in partnering practices. Standard practices continued to favour competitive tendering and procurement based on the lowest price. The minority were considered as the few large "intelligent" clients that developed "in-house" client teams to work in partnership with suppliers to gradually develop leaner and more efficient "integrated" processes. An analysis of the poor diffusion of the lean partnering for performance improvement approach noted high levels of disinterest in partnering described as a lack of will to collaborate (ibid, p9). Research indicated that rather than a lack of will grounded in inertia, the persistence of short-term sub-contracting was considered a preferred way of limiting exposure in unpredictable projects. Short-term contracts offered low set-up costs and minimal maintenance to sustain delivery relationships. However, Sir John Latham's comments below link project failure, over-runs and poor quality to the persistence of tendering based on the lowest price;

"Partnering and close collaboration between the client and the whole of the construction team will mean that the project will continue to come in on quality, time and cost as terminal 5 did at Heathrow under Andrew's leadership. But if the lowest price is demanded by the client, the tender price will not be the actual financial outturn at the end of the project, because the supply side will be looking for claims and variations to make up for what was in the tender. As I said in my report 15 years ago, best practice means "all have won and all must have prizes". Alice was in wonderland then. But best practice must essentially continue in the construction industry."
(ibid, p3)

Latham's quote highlights Heathrow's "whole" team partnering approach as a model of best practice to enable superior performance outcomes. In contrast, lowest price procurement is linked to cost over-runs because constrained supplier revenues encourage the search for opportunities to make litigious claims or force scope changes to bolster additional margins. This discussion returns to the "underbidding" game where opportunism within a revenue constrained setting leads to over-runs and lateness. Latham's quote concludes that reform requires partnership models based on the Terminal 5 model where common purpose and shared prizes enabled "best practice". The need to move away from procurement based on lowest tender price is echoed throughout the report which highlights a link between (low) fixed price procurement and first tier suppliers attempting to "retain profits for themselves and pass risk down the supply chain, rather than using shared profit to eliminate risk for the whole team" (ibid, p8). This spiral of "risk dumping" (Brady and Davies, 2011) creates "much waste" when first tier suppliers "charge clients for taking risk, then seek to pass the risk down the supply chain" rather than developing a "mature" risk mitigation approach (CE, 2009, p20). This dumping of risk downwards reflects a deep concern that emergent changes would damage already weak margins and therefore suppliers would pass the accountability for risk on to smaller sub-contracting suppliers. Latham's comment claims that "partnering" models are superior because they involve common purpose and shared accountability for performance delivery and deviations instead of the pursuit of individual interests.

4.5.2 The "Built Environment" and Common Purpose

Wolstenholme's report develops a vision of a "Built Environment" that moves away from a narrow conception of construction as an industry focused on the production of built assets to a wider network of interactions extending over time across the life of the infrastructure asset. Rather than focusing on discrete production processes the Built Environment was extended to include multiple actors within a wider network. Wolstenholme describes this as a:

"complex picture of how people interact sustainably with the environment to maximise health, wealth and happiness. This requires integrated planning, design, construction and operation of built facilities. We believe that gaining wider acceptance for this concept is an essential step towards driving a new culture in our industry" (ibid, p5)

In the past, the physical location of teams and tangible task interfaces were more dominant themes when discussing the organisation of complexity, but the new vision emphasised social factors such as a shared culture as a focus for shared meaning. This extended the concept of

integration to include not only planning and production but also a shared vision of the future as a focus for common purpose across the supply network.

The reframing from industry to the Built Environment introduced a wider conception of efficiency linked to quality measures that compared consumed resources to improved economic and social value. This extended the evaluation of performance within the Built Environment over the “whole” economic lifecycle rather than focusing purely on the capital cost of construction. By reframing the nature of value, the discussion moved beyond measuring just built asset costs to evaluating a wider set of returns linked to improvements in social and economic value. This new ethos of monitoring non-financial indicators led to recommendations to develop project-level evaluative frameworks and incentives to reward quality as well as sustainability. Offering a “stake” in long-term performance was recommended to enable suppliers to demonstrate social, environmental and economic value. However, the report also recognised that the diffusion of Built Environment concepts would be gradual and at the time of the report there was only “sparse” evidence of change in the industry (ibid, p20).

4.5.3 Moving from Demand to Supply

Wolstenholme’s report detailed how the Egan client-led model had stalled because of a fundamental need to strengthen suppliers’ capability in delivering more for less. More challenging economic conditions had disrupted access to funding and at the same time the pipeline of work slowed. Harsh conditions required clients to engage more fully with suppliers. However, many clients had failed to adapt. The report noted a:

“lack of incentives currently provided by client business models for a supplier to innovate and deliver more sustainable solutions. As work becomes scarcer during the downturn, suppliers may become reluctant to offer value-based solutions through fear of being undercut by competitors on initial price. In reality suppliers cannot change the industry on their own. The time has come for a strong vision from Government and across industry which recognises the key contribution that the built environment makes to the UKs long-term economic prosperity and its aim in achieving a more sustainable, low carbon economy”. (ibid, p14)

This quote indicates a need for a clear policy vision and a united industry response to legitimise the new conception of sustainable long-term value. However, trade-offs exist between lowest (short-term) cost versus improving long-term sustainable value through innovation. Although investment in new practices and technologies is recommended, the threat of losing business to

cheaper suppliers created a significant point of resistance. The table below synthesises the main themes underpinning the 6 blockers creating “a spiral of resistance to change”:

Table 4.1: Blockers to Change

Blocker	Description
1.Lack of Cohesion of Industry Vision	Tensions about how the built environment should contribute to a prosperous & sustainable low carbon economy.
2.Few Business Drivers to Improve	Little incentive to invest in change
3.Construction “does not matter”	A belief in the industry that construction costs have a low impact on the client model which is more sensitive to other factors (land prices and location etc).
4.No Incentives for Change	Most client business models focus on short-term gains not rewarding long-term sustainable solutions.
5.Construction Regarded as a Commodity Purchase	Clients focus on upfront construction costs, rather than lifetime asset value.
6.Industry Culture Driven by Economic Factors	Harsh conditions during the downturn mean that many have “abandoned partnering behaviour and returned to transactional relationships”

Source: Adapted from Constructing Excellence 2009

Blocker 1 emphasises a lack of coherence in the policy vision of “how” the built environment should contribute to the economy in the future. Blockers 2-5 highlight a set of legitimised beliefs and values creating inertia or “lack of will” to change. If construction is viewed as “a commodity purchase”, clients would evaluate supplier worth based on the lowest construction cost. In turn, the procured asset is a “product” and quality-related risks and rewards are owned by the client. These ideas conflict with the new Built Environment model which seeks to share benefits and risks through value-based rewards spread over the life of the asset. Blocker 6 highlights how the economic downturn strengthened the persistence of the old transactional model of short-term relationships and an aversion to change and risk. These points highlight a need to build a “united” resolve where suppliers are engaged by clients for long-term value creation. The report recommended moving from short-term thinking and a sub-contracting model to the development of integrated teams and processes across the delivery cycle.

4.5.4 Delivery Relationships for a More Resilient Supply Chain

A central theme in *Never Waste a Good Crisis* was the need for suppliers to become more innovative and “show how they can create additional value” (ibid, p26). However, the business model in construction remained client-led. The report highlighted that partnering approaches required more integrated supply chains. However, fractured and adversarial practices persisted which frustrated knowledge sharing because of “competing agendas”. The report noted that in 2009:

“We are seeing a return to long tender lists, firms chasing work at unsustainable margins, cost and time overruns, the jettisoning of quality or sustainability initiatives and more of a claims-orientated approach”. (ibid, p19)

The roles of “both” the client and suppliers are emphasised to reform a spiral of unsustainable margins and fractured interests. For clients, a failure to adopt “smarter procurement” and the poor engagement of suppliers is linked to a lack of awareness of the benefits of collaboration. Dated procurement practices and a failure to engage early enough with key experts prevented fuller engagement of ideas and knowledge from suppliers. The need for reform in the management and transfer of risk played a major role in stalling progress. The report recommends that clients should avoid unnecessary changes to the specification of work by controlling the brief. However, there is recognition that discovery requires organisation to sustain closer delivery relationships:

“The more innovative the solution the closer you will need to get to the supply chain and the greater the potential to generate long-term value. Work with the supply chain to understand where they are best placed to manage risks on your behalf, and to deliver best value when they do so.” (ibid, p27)

These points highlight the need for deeper relationships working “with” suppliers to better manage risks when innovative approaches require discovery. In this context, discovery requires closer relationships and agreement in how risks would be managed to enable “best” long-term value. The report recommends the role of the client in clearly articulating how value should be conceived and working with suppliers to integrate a shared sense of purpose. In turn, suppliers play a key role in “embracing change” and accepting the need to invest in developing new skills and capabilities rather than focusing on “saving cash” and making short-term returns (ibid, p26). The report recommended a common interest in a more sustainable Built Environment for the

end user where the government, regulators and industry collectively play a key role in steering construction towards social and economic goals.

4.6 Construction 2025

Returning to the present day, Construction 2025 (CS2025) highlights major global opportunities in construction and develops a strategy to build on strengths within construction. The report synthesises many of Wolstenholme's themes whilst setting targets to underpin improved productivity by lowering carbon emissions, improving delivery speed, lowering construction and whole life costs and improved export performance. Strategic commitments and priorities focus on transformational change to improve trade performance, reduce costs and switch to new low carbon technologies. Upgrading to digital construction software is a key part of this transformation with BIM (in particular)⁶⁵ playing a key role in improving knowledge sharing. Digital engineering and design for manufacture ⁶⁶are identified as ways of upgrading the quality of the Built Environment to enable more synchronised operations. This transformation is linked to 6 key fundamental drivers depicted in the diagram below:

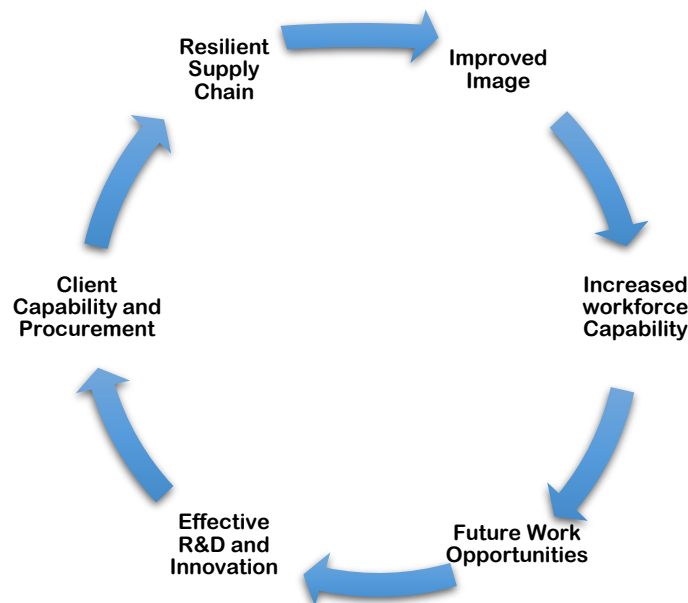


Figure 4.1 Drivers for Change in Construction 2025

The many themes discussed in Wolstenholme's report are echoed here but the effects of the economic downturn and a difficult funding environment have played out more fully since 2009.

⁶⁵ BIM is one of the largest "centrally driven" programmes in the world sponsored by the UK government (Hancock 2015) to encourage a more synchronised and adaptive approach to design.

⁶⁶Offsite and modular engineering for manufacture are recommended as a pathway to improved operational efficiency (CS2025)

4.6.1 Image, Capabilities and Visible Work Opportunity

On the right-hand side of the diagram (on the previous page), the need to invest and attract the right people is of central importance in order to improve the image of the industry and address a gap in skills. Career development and competency pathways are part of the strategy to attract a diversity of new talent into the industry. Strategic planning for long-term opportunities is also considered as fundamental to encourage suppliers to switch their focus to the future. Although investment in these areas are hoped to encourage improvement, progress has been stalled by the persistent weaknesses in the areas detailed on the left-hand side of the diagram.

4.6.2 Strong and Resilient Supply Chains

Progress in building a more resilient supply chain has stalled as the economic downturn placed increasing pressure on established relationships, making it difficult for supply chains “to thrive” (ibid, p54). Limited access to robust funding, lack of certainty and lateness in payment across the supply chain have been major blockers for improvement. Reducing insolvency risks through the introduction of project bank accounts and industry standards on fair payment terms have become key recommendations to ease cash flow problems. However, a lack of cash has affected the ability of suppliers to respond flexibly to opportunities. CS2025 emphasises the need to create greater synergies amongst suppliers by “bringing together value adding activities consistently so that the whole is more than the sum of the parts” (ibid, p54). However, this rests on greater agreement about the basis of client value and accountabilities for risk.

4.6.3 Client Capability & Procuring Innovation

Construction 2025 highlights an important role for clients in developing procurement strategies that move away from “piecemeal” sub-contracting to focus on procuring solutions for improved value. In turn, adopting practices associated with sharing cost information and profit sharing incentives are highlighted as building blocks to enable a move towards the deeper engagement of suppliers. However, CS2025 also notes that suppliers are not confident that novel and innovative products and services “will be commercially rewarding” (ibid, p61). Even when procurement strategies encourage innovation, knowledge transfer can be frustrated as the temporary composition of project teams result in lost capability. These problems require greater commitment to knowledge capture and also improved organisation of knowledge transfer. However, the report highlights a fractured approach and “patchy” collaboration across and between industry and research organisations.

Construction 2025 extends many of Wolstenholme's recommendations with a detailed vision of specific industry-level targets. Emphasis is placed on improving how clients articulate value to enable integration towards customer defined worth. Digital technologies play a central role in encouraging more efficient design and engineering. However, there are also significant blockages inhibiting the vision of supplier-innovators partnering with clients to develop long-term value-based solutions. Although, advanced technologies are viewed as centrally important to challenge barriers to co-creation, incumbent industry practices reflect a lack of will to invest in innovation.

4.7 A Discussion of Policy Themes

An examination of the emerging policy debate has revealed a tension between a policy vision based on long-term partnering and the reality of an industry entrenched in wasteful short-term sub-contracting and risk-dumping. There remains a gap between aspirations for smarter procurement combined with fuller supplier engagement and the reality of entrenched views of construction as a commodity purchase. The table below synthesises the main themes:

	Egan 1998	Wolstenholme 2009	CS2025
Proposition	Partnering and "Lean Thinking" to create value by improving quality	Economic and social value creation for the built environment	Vision of superior productivity and value
Delivery	Metrics, integration of the "whole", client/demand led, flow and pull lean models to improve operations	Incentives to share risk and benefits, foster inter-disciplinary knowledge sharing, match risk to capability	Low carbon and digital technologies, procurement to encourage supplier-innovators
Capture	Moving away from short-term contracts, procuring supply partners incentivised by share gains	Clearer articulation of value by clients & greater engagement of supplier ideas	Integrate around customer defined value, fuller use of technologies
Inhibitors	Lack of continuity in demand & lack of will to invest in relationships, Procurement based on lowest price tendering and risk dumping	Poor integration, persistent lowest price tendering at unsustainable margins, incertitude makes partnering and innovation too risky	Insolvency risks and cash flow delays, weakened economic relationships, poor knowledge transfer, lack of confidence in rewards for innovation

Table 4.2 Policy Themes for Value Capture and Creation

4.7.1 Egan's Model 1998

Egan's model emphasised value capture by procuring long-term partnerships and developing reward structures to encourage collaborative efforts. The lean thinking philosophy emphasised making waste more visible and accepting accountability for improving efficiency. Egan's vision of "delivering value" and governing by numbers elevated the role of client-led performance management where oversight focused on tracking improvements and removing obstacles to enable a more synchronised supply "flow" (Womack et al, 1990; Egan, 1998). This vision inferred an acceptance of client leadership guiding, protecting and overseeing delivery. Governing conduct suggests an infrastructure to steer performance towards improving the "whole" rather than self-serving forms of opportunism. However, within Rethinking Construction there is little discussion about the complexity of transforming existing practices that seek to protect weak margins by avoiding deviations from plan. In turn, over the 10 years from Egan to Wolstenholme, improvements in performance were persistently blocked by a "lack of will" to invest in collaborative relationships or frameworks of governance that sustain a shared sense of common purpose. The economic downturn damaged relationships leading to a spiral of lowest price tendering that frustrated quality initiatives.

4.7.2 Wolstenholme's Model 2009

Wolstenholme's Built Environment offered a new perspective to mobilise a shared vision of the critical role for construction in delivering social and economic benefits rather than being viewed as a short-term "commodity purchase". The Built Environment created a vision of future sustainability with suppliers and clients working towards enhanced long-term value creation based on social, environmental and economic returns. For the industry, short-term recommendations focused on developing ways of building new interdisciplinary skills and rewards structures. However, harsh economic conditions stalled a willingness to partner and pool knowledge and "both" clients and suppliers needed to more fully engage. Intelligent Clients were identified as exemplars to the rest of the industry in designing and procuring integrated ways of working in partnership with suppliers. The future challenge in Wolstenholme's model focused on capturing greater value with the client more clearly articulating the nature of value and working with suppliers to identify who is "best placed" to manage risk (CE, 2009, p27). However, progress required more visibility of risks and opportunities previously hidden within the layers of the sub-contracting supply chains. At the centre of the transformation debate was a call for more investment in digital capabilities and interdisciplinary expertise. However, damaged delivery relationships provided little justification for investment.

4.7.3 Construction 2025 and Heathrow

The table of policy reform themes describes a shift in emphasis in how the value proposition was conceived and captured. Egan’s “lean thinking” model for performance improvement focused on improving project-level efficiency with rigorous client oversight. More recent themes emphasise strategic goals and doing the “right” things to enhance value in delivery. The construction strategy outlines aspirations for improved productivity and whole life value, driven by state of art digital design and engineering technologies to enable closer delivery relationships. In turn, improved value delivery is linked to synergies from fuller engagement of suppliers and procurement arrangements to encourage innovation. Flexible incentives to share efficiency gains are considered important ways of engaging suppliers at the front-end of the project. However, the design and composition of the calculative infrastructure necessary to enrol suppliers to accept closer and more integrated relationships has remained outside the policy focus. Although Construction 2025 recommends closer delivery relationships to build synergies based on customer defined value, the broken business model highlights a problem with sustaining cooperation and a shared sense of purpose across supply networks.

The ICE Intelligent Client literature emphasises an important role for the client in encouraging collaboration and openness through incentive structures as a way of “integrating” a shared sense of common purpose. Project 13 outlines significant aspirations to move towards a model of collective enterprise that extends across the whole life of the infrastructure asset. However, there remains a persistent gap between aspirations for deeper delivery relationships and a lack of will to share responsibility for delivery outcomes or commit to innovative and risky endeavours. The Heathrow cases offer an important opportunity to reflect on the two very different models of governance which both successfully engaged with the supply network. The transition from the client-led lean partnering model (T5) to governance through clearly articulated accountabilities (T2) reflects some of the themes in the Egan to Wolstenholme delivery models described on page 90. However, T2 also moved away from a partnering model to an arms-length and perhaps more “transactional” model of governance. With the current Project 13 reform discussion highlighting the need to return to partnering and collective “enterprise” relationships, T2 represents an important case to examine “how” the programme was successfully delivered. The next section considers the initial orchestration of control on both programmes and the evaluative principles that underpinned the design of the two contrasting models of governance.

4.8 Reform and Heathrow Terminal 5

Terminal 5 (T5) was one of the largest airport constructions in Europe. It took over a decade to plan and gradually a sophisticated lean model was developed which emphasised driving through efficiencies by standardising procurement and operational processes (Doherty, 2008; Davies et al, 2009; Brady and Davies, 2011). The first-tier suppliers were procured through 10-year framework agreements which created long-term commercial relationships. Partner selection strategies focused on screening suppliers to ensure that they were capable of working within a co-dependent partnering environment. One senior executive noted that;

“It was probably a good half a generation before most people had ever worked this way, truly this way. So, we had a huge cultural challenge, whereby even though technically a lot of people were very competent. They just behaviourally weren’t able to adapt to working in that environment where their priority was to the programme or the project not to their corporate entity that they came from.” (Senior T5 Executive, 2014)

Senior executives were recruited from a variety of industries, including the oil, pharmaceutical and car industry where collaborative practices were more common. Recruitment focused on people successfully “doing it differently” to the traditional approaches in construction. Enrolment of the first-tier suppliers was marked by a signing ceremony where suppliers agreed to be part of the T5 Agreement’s ethos of a “co-located, team-based, partnering philosophy” (TECHT, 2001).

Integrated teams were structured around solutions that required a range of experts from a variety of organizations to focus on the delivery of common goals. The 1998 T5 Handbook accompanied the T5 Agreement. It described a code of conduct designed to shape partnering practices, especially a need to “leave yesterday behind” by transforming old practices based on a “lack of co-operation” and “pre-assigned” responsibilities and “transactional outcomes” (T5 Handbook, 1998). A different approach to discovery was recommended:

“Conventional project logic seeks to predefine all requirements and banish change once the project has started. Yet flexibility and adaptability are key objectives of T5. Conventional processes and solutions are therefore not tenable” (ibid, p8)

The Handbook described a new approach to performance management designed to encourage continuous improvement and expectations of proactive risk management to achieve “exceptional” levels of performance. Teams were co-incentivised and expected to pool knowledge for the benefit of the whole programme. However, this required a sophisticated

calculative infrastructure to settle tensions associated with how far performance deviations would be treated as acceptable forms of scope change or risks.

4.8.1 Enrolment into Doing Risk Differently

The construction of T5 presented a major commercial risk for the BAA as the construction cost represented 70% of the BAA's market capitalization at the time (Brady and Davies, 2011). The construction involved a business-as-usual approach keeping two of the busiest runways operational whilst dealing with the logistical challenge of a hugely space constrained site on the edge of the M25 motorway. This played out in the planning consent which took over 4 years and when it was received in 2001 it contained 700 specific conditions and restrictions (Doherty, 2008). In the two years preceding construction the BAA undertook a benchmarked study which concluded that no recent airport of this scale had been built on time and to budget. It noted that the scale and scope of the task could result in a two-year delay and a possible £1bn over-run (Nightingale and Brady, 2011; Doherty, 2008). The size of the business risk resulted in a decision to self-insure, with the BAA bearing commercial accountability for risks. However, potential risks also required visibility and oversight and the BAA pledged to offer "fair" rewards in return for open-book "transparency" by suppliers:

"The commercial basis between us is based on one of cost transparency. We share cost information between us to ensure that each has a good understanding of costs with a view to: 1. making fair and proper reimbursements, 2. understanding the value and benefit of proposed and incurred costs" (T5 Handbook 1998, p346)

Reimbursements of costs created certainty for suppliers by guaranteeing a 5-15% margin on costs deemed to be within scope. To supplement reimbursement, value-based incentives were established to reward performance improvement and prevent lock-in to the existing scope. The "value fund" rewarded "best" value as the relationship between functionality⁶⁷ improvements and cost. However, the "value challenge" involved trade-offs:

"when weighing up the impact of revisions, on your delivery and other delivery teams will always need to be balanced, to be mutually beneficial" (ibid, p33)

Common purpose was encouraged by pooling benefits into a common "pot" to reward value:

"You can spend all your time blaming whoever. We don't care, it comes out of everyone's bonus"
(T5 Executive, 2015)

⁶⁷Functionality involved a combination of KPI measures of time, safety and quality which were compared to cost to give an indicator of value improvement.

Encouraging collaboration by rewarding shared gains through a shared incentive “pot” required careful adjudication by the client teams to resolve tensions. Enrolment into accepting fluid scope and shared accountability involved a gradual process of negotiation and participatory involvement in setting performance milestones. The latter helped to enrol suppliers into agreeing targets which represented a major departure from traditional approaches to planning where teams were “normally held to account for the design of someone else’s programme” (T5 Executive, 2015). Milestone targets focused efforts on a common end point and levels of performance and productivity necessary to deliver critical outcomes.

4.8.2 Balancing Tensions

Building shared and common purpose through collective evaluation was a major theme on T5. However, the lack of fixivity of plans created tensions associated with concerns about how risk and emergent scope would be rewarded given the complexity of overlapping accountability. Gil 2009 and Gil et al 2012 recount how the contested effect of interdependencies and fluid and overlapping scope created a team environment like an “ants nest” wrestling over the same territory. In this context, Gil’s work emphasises the adaption of incentives structures whereby tensions were settled by agreeing new targets to reward performance improvement. The T5 Handbook extends these ideas by describing two key principles described as important “team values”:

1. STORM as success orientated risk management 2. Actively working “the interfaces”

STORM was described as a way of thinking developed to challenge traditional (reactive) risk management approaches by encouraging teams to adopt “active” risk management techniques to prevent risks before they crystallised. In turn, an ongoing search for opportunities to improve delivery was encouraged. STORM principles encouraged teams to adopt a “can-do, can-solve” (T5 Handbook, 1998, p60) approach where team values required an acceptance of relational dependence to achieve a “whole delivery solution” for the mutual benefit of the programme. The Handbook described the need to manage interdependencies through “actively working interfaces”, building on existing knowledge within and across teams to remove hidden agendas. This translated into behaviour described as:

“look I’ve got budget, but I might be able to do something better with it; because I see what you’re doing here and we are going to do this. Then you’d have to dig yours up, to do your thing. How about you do yours first and we do ours next?” (T5 Executive, 2015)

However, managing emergent opportunities also required “fluid” boundaries of accountability to prevent teams limiting the search for improvement within their teams. This partnering for

performance improvement model created the need for a complex and adaptive architecture of control with a clear resolution ladder to prevent the escalation of disputes (T5 Handbook, 1998)

4.8.3 Reform in Governing Risk on T5

The earlier policy discussion reveals that during this period, poor procurement practices, pricing at unsustainable margins and risk dumping blocked the development of stronger delivery relationships. On T5, the careful selection of partners willing to adopt new performance improvement approaches was an important foundation for the partnering model. The reimbursement of scoped costs created a degree of certainty for suppliers, whilst milestone and value-based rewards co-incentivised teams to focus on long-term performance improvement for the programme. STORM principles described a code of conduct where teams would search for ways of mitigating risks before they crystallised. Actively working interfaces and resolving issues for the overall benefit of the programme created a sense of common purpose. For T5, governing conduct involved a complex and adaptive architecture of control to support the continued acceptance of lean and active risk management. Prior T5 literature (Gil, 2009; Gil et al, 2012; Nightingale and Brady, 2011) describes tensions associated with fluid scope whereby resolution was achieved through collective evaluation and the adjustment of plans and incentives. However, within this literature there is limited discussion of “how” control was sustained and the nature of modifications necessary to mitigate destabilising tensions. In the next chapter, many of these themes are examined to understand the nature and composition of the calculative infrastructure that became visible once controversies challenged the existing evaluative order. In turn, there are more detailed considerations of the client’s role in governing conduct and the nature of calculative technologies that steered progress towards delivery.

4.9 Wolstenholme and Heathrow Terminal 2

By 2009 the economic downturn had created a harsh environment for suppliers with the return of competitive tendering at unsustainable margins and an increased risk of insolvency (CE, 2009). Wolstenholme’s report renewed the call for a more integrated approach to construction and a need to reframe the importance of sustainability and social value. In the short term, recommendations focused on clients working “with” suppliers to clearly articulate how value should be conceived and “who” was best placed to manage risks. During this time plans for the construction of Terminal 2 developed. The Capital Director of the BAA noted the partnership model was no longer suitable because:

“partnerships work well in small businesses and marriages but billion-pound capital programmes are too big to work around well-meaning best intentions” (Morgan, 2009, p1).

Complex Build Integrators were procured through a standardised set of terms and a framework of responsibilities using the New Engineer Contract (NEC3). Integrated teams and an ethos of partnering for performance improvement were replaced by clear lines of accountability. This reflected some of the reforms recommended by Wolstenholme, notably the clearer articulation by the client of the nature of work to counter a deeper concern for uncertainty.

4.9.1 Good Fences Make Good Neighbours?

Complex Build Integrators (CBIs)⁶⁸ were engaged to oversee the management of the supply chain. The assignment of clear responsibilities set out in the contract was perceived as a superior approach to managing change. Quoting the American poet Robert Frost, the Capital Director noted that *“Good fences make good neighbours”* (Morgan, 2009, p2).

The T2 model stepped away from a client-led project management role to a more arms-length commercial arrangement with the client focused on managing responsibilities defined in the contract. The Capital Director of T2 described the perils of client involvement in operational tasks as “un-intelligent”. Instead a more regulatory approach was adopted with the client clearly articulating requirements, enabling them to “get out of the contractor’s way” (Morgan, 2009, p1). The CBIs and Heathrow shared risks and gains in a fixed percentage “pain-gain” formula⁶⁹ agreed in the contract. The formula was tracked on an ongoing basis:

“The NEC3 is a good tool for incentivising cost containment, as the contractor shares in the savings if the project comes in under budget – but requires discipline on the part of the client not to change its mind” (Morgan, 2009, p1).

4.9.2 The “Right” Kind of Bribe

The allocation of pain-gain created a reward for cost management, but other incentives were necessary to balance an overemphasis on cost cutting. A further clause was added to the contract to broaden the conception of performance improvement beyond cost containment. Incentive structures were designed to enrol working practices that focused on safety and quality. Specific milestones were incentivised and KPI awards tracked safety and quality performance. A discretionary “award fee” was developed affectionately called the “right kind of bribe” (Morgan, 2009, p1) because it was intended to encourage the “right” behaviours from the CBIs. Evaluation took place every 6 months when the CBI presented a self-assessment case to justify payment and Heathrow scrutinised performance evidence. The discretionary fee rewarded a

⁶⁸ The CBIs were HETCo and Siemens

⁶⁹ The sharing formula was 60:40 Heathrow to HETCo and 75:25 Heathrow to Siemens

variety of initiatives that were intended to reflect the strategic priorities at the time. This exchange was designed to enable agreement about the codes of conduct over the award period. The “right kind of bribe” provided a structure to direct the CBIs’ attention towards priorities to supplement the focus on cost reduction. However, even though the right kind of bribe was developed to encourage shared and common purpose for the benefit of the programme, the 2nd tier of suppliers were not incentivised.

4.9.3 Data as Kingpin

Data scrutiny played a central role in regulating deviations from plan. The nature of subjectivization set an expectation amongst suppliers of being asked to justify the latest forecasts based on past and possible future performance.

“data integrity, this one version of the truth, this was kingpin and if you look to that organisation you would think it was the programme manager. This was the kingpin in all of this. So, if the information did not stack up, I don’t care what story you’ve got. Go and sort out your data or tell me what your data is telling me” (T2 Programme Controls, 2014)

Data integrity was important because a robust baseline represented the agreed single “version of the truth” to underpin performance analysis. The appetite for control described data as “kingpin” which created a moral constraint (Miller, 2001; Miller and Power, 2013) whereby “telling” a coherent story linked to the performance metrics was expected. In turn, incomplete explanations created a form of latent power (Clegg, 1998; Miller and Power, 2013; Miller, 2001) to encourage a search for a more credible and realistic story to explain performance. Monthly performance meetings provided the space and forum for the client to scrutinise data and pass messages back to the CBI through the client’s Programme Directors. For the CBI and Programme Directors on the client team, demonstrating an ability to develop realistic forecasts with few “surprises” was closely monitored. Performance data played a fundamental role in integrating attention towards shared priorities and goals.

The initial design principles described so far provide an important contrast to the T5 model of collective evaluation and co-incentivised teams. The adoption of an NEC contract, risk sharing incentives and the intelligent client system reflects a more standard industry approach to governing conduct at a distance. However, it also raises questions about how risks associated with emergent change were managed and how the 2nd tier was encouraged to share potential opportunities for performance improvement. Nevertheless, T2 was successful and the programme was delivered on budget and to schedule. These points are elaborated in chapter 6.

4.10 Governing Risk in Construction

This chapter has highlighted a dissonant and complex control environment for construction projects where navigating progress can be destabilised by uncertainty and competing interests. In this context, sustained value capture requires careful management to ensure that friction and rivalries amongst different justifications of worth do not destabilise progress. The ICE framework elaborates some of these themes by recognising that clients are intelligent when they develop governance and control approaches to enable strong delivery relationships that encourage knowledge sharing. In this chapter, the Heathrow cases reveal two contrasting approaches to encourage knowledge sharing that reflected very different appetites for risk. On T5, integrated teams were expected to proactively manage-out risks and continue to search for performance improvements. This involved the gradual enrolment of teams into accepting fluid scope and flexible responsibilities for the benefit of the whole programme. In contrast, on T2 a more regulatory model was developed to direct suppliers towards specific issues and risks requiring resolution. A clear framework of accountabilities defined the nature of performance commitments. These contrasting approaches to governing risk raise significant questions that are examined in the following chapters:

- On T5, although the incentive structures co-incentivised teams to accept fluid plans, prior research reveals tensions⁷⁰ over being held to account for performance deviations. Calculative technologies such as plans and incentives played a mediatory role, as they were adapted over the delivery lifecycle to build a shared vision of evaluative purpose. However, the existing literature provides little detail of the composition of the calculative infrastructures or the nature of modifications to evaluative principles that enabled progress. Therefore, how did the calculative infrastructures mediate and sustain control?
- On T2, the intelligent client model organised dissonance by emphasising the importance of the integrity of the “single version” of the data to deter divergence. Although a sophisticated framework of incentives existed between the Client and CBI; the only direct incentives for the 2nd tier encouraged delivering to the initial baseline commitments. This raises important questions about “how” the client could sustain the engagement of suppliers when emergent change challenged existing plans. There was

⁷⁰ Gil, 2009, Gil et al, 2012, Nightingale and Brady, 2011

little incentive for the 2nd tier to share local intelligence of new emergent risks or opportunities. Therefore, how did the calculative infrastructures mediate and sustain control?

Both questions address tensions across the industry linked to an aversion to change and a deep concern for the damaging effects of risk. Large complex projects pass through a lengthy delivery cycle where emergent change challenges initial plans. Calculative infrastructures can play a major role in steering conduct towards new plans and targets whilst settling concerns about being held to account. In the following chapters, the composition of the contrasting calculative infrastructures is examined to show how they sustained control despite emergent change.

4.11 Summary

This chapter recounts key policy themes since the 90s and the continued call for collaboration between the client and suppliers. The debate underpinning improved value capture focuses on more fully engaging “with” suppliers to reach an agreed conception of value. The discussion of the policy reform themes reveals several approaches to improving delivery through the development of shared incentives, lean principles and digital technologies. Here the emphasis has been on techniques designed to improve knowledge transfer and systems integration by exercising control “over” resources. However, the summary of inhibitors (on page 90) highlight persistent behavioural issues that reflect a lack of will to pool knowledge and engage in collective discovery. Closing the policy-practice gap and overcoming these issues involves the enrolment of suppliers into agreeing accountability, accepting responsibility and understanding evaluative priorities. These themes involve “social integration” and the fixing of a shared sense of meaning and purpose to balance dissonant tensions. Heathrow represents a significant site for innovation and so far, the discussion has highlighted two very different but successful approaches to governing risk. In the following two chapters, the dynamics of social integration and the reproduction of control are studied to understand how the ascribed evaluative priorities and principles became institutionalised within the calculative infrastructures on T2 and T5. The next chapter returns to T5 to consider in more depth the composition and role of the calculative infrastructures in enrolling suppliers towards the performance improvement model which reflected a desire to “do risk differently”.

Chapter 5

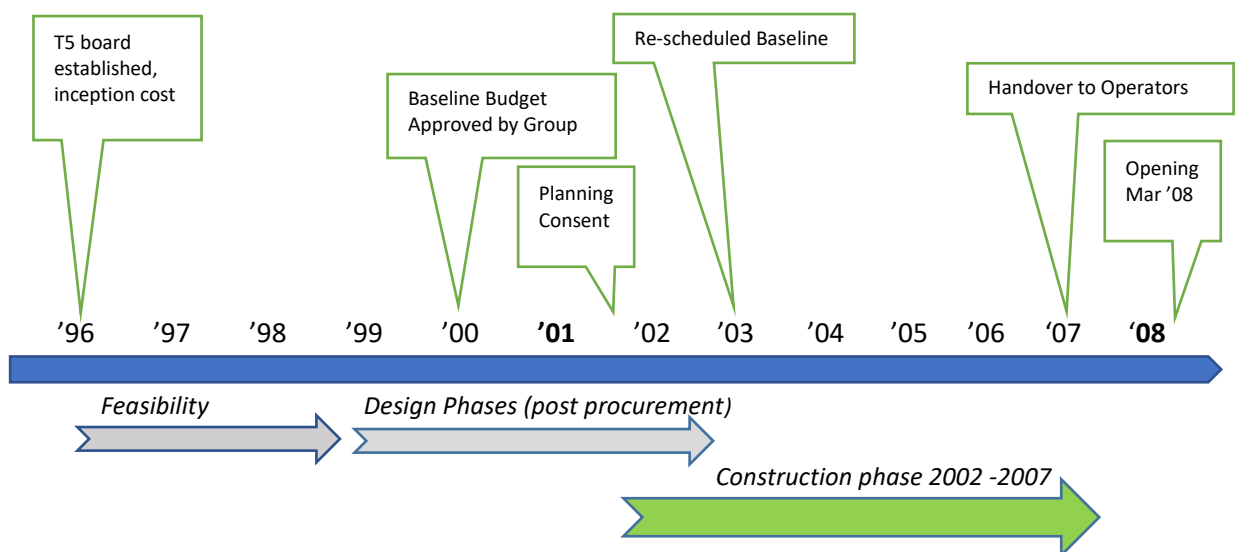
Terminal Five “Doing Risk Differently”

5.1 Introduction

This chapter examines the “doing risk differently” approach that enabled the implementation of lean thinking on Terminal 5 (T5). Steering conduct away from self-serving opportunism required a sophisticated controls methodology. Prior T5 literature identifies destabilising tensions that resulted in the modification of the calculative infrastructure. This chapter examines the detail of these changes in order to understand “how” the project teams were enrolled into accepting the lean performance improvement model. The last chapter described STORM and “actively working the interfaces” as key concepts to encourage teams to accept responsibility for discovery. This initial section examines the evaluative principles and procedures that underpinned the ethos of lean partnering.

The timeline below describes key dates over the 12 years from the establishment of the Project Board in 1996 to T5’s opening in the spring of 2008. Between 1996-8 feasibility plans were refined into an initial high-level top-down cost estimate to underpin the business case. The initial feasibility phase ended in 1998 as the key first tier contractors/suppliers were engaged through the T5 Agreement. Group-level approval was received in 2000 for the initial plans and in 2003 the final £4.3bn baseline cost was agreed with the regulator, the Civil Aviation Authority (CAA).

Figure 5.1: The Terminal 5 Timeline of Key Events



In the late 1990s the “Project Management Office” was established bringing together controls experts from the main UK built-asset consultancy organisations into an integrated team. The Control Team was called “TECHT” combining the names of the consultancy firms Turner Townsend with EC Harris. When baseline approval was received in 2000 a 3-year period of development and co-ordinated design continued. However, by August 2000 a sufficient level of “fixivity” was achieved to set the project baseline and the control activities switched to developing a performance management strategy. The control architecture evolved over time - an ex-Director noted that it took 3 years to develop;

“So, don’t assume the programme started with a nice suite of controls and everything beautifully in place ready to start on site. Because if it had been like that we would have been in a much fitter place. We probably were; first year I would describe as organised chaos, second year I would describe as controlled chaos and third I would probably say we were finally in control.”

(T5 Director, 2015)

The scale of the programme was huge and at its height it involved 8000 contractors, the construction of two terminal buildings, a new air traffic control tower, a multistory car park, hotel, the diversion of two rivers and extensions to rail links and motorways close to London (Doherty, 2008; Brady and Davies, 2014). Planning consent took over 4 years and when it was received in 2001 it listed 700 specific conditions and restrictions for a safe construction whilst keeping the airport open for business (Doherty, 2008). The size of the business risk resulted in a decision to centrally insure the programme. In this context, the BAA accepted responsibility for oversight and the main suppliers were engaged as partners pooling knowledge to develop a superior operational solution. A T5 executive explained:

“So that ability to manage risk, the main reason for doing it was for transparency and understanding our plans”. (T5 executive, 2014)

Visibility of progress and “transparency” of threats and opportunities required a willingness to pool knowledge. Oversight required a calculative infrastructure to monitor performance and steer conduct towards the “can-do can-solve” collective learning approach described in the Handbook. The T5 Agreement and Handbook ascribed an environment where suppliers would work together in common pursuit of better value. However, “value” was viewed as a progressive concept whereby task teams would co-create better design solutions and share their experience broadly. The control architecture needed to sustain aspirations for discovery to enable continuous improvement. However, fluid scope and blurred boundaries of accountability created a major control challenge.

5.2 Developing a Dynamic Framework for Control

The control methodology needed to encourage the proactive management of risks ascribed by the STORM approach. Emphasis was placed on sustaining an “open” dialogue:

“Open communications and easy access to real time information enables managers to constantly monitor progress and to make rapid decisions to prevent any ‘nasty surprises’ and reduces the need for extensive auditing and checking. Performance measurement supported by a continuous improvement mentality and the open, supportive culture ensures managers and suppliers are all operating in the best interest of the client and are not investing time in ‘protecting their position’ as in more traditional contracts” (BAA, 2001, p1)

This extract from the BAA’s “procurement concept” working paper describes the importance of real time performance information to mitigate “nasty” surprises combined with normative standards of behaviour focused on sustaining improvement for the overall benefit of the programme. A supportive “coaching” control environment was developed with dedicated control experts working with delivery teams to evaluate “what has gone to plan, what has not, why and what remains to be done” (Controls Handbook, 2001, p3). The control approach was underpinned by four main features described below:

Cost Reimbursement	Because commercial risks are “held” by the BAA: <i>“It is fundamental that the Project knows where, when and how costs are being incurred and the levels of efficiency being achieved”</i>
Procurement method	The final cost out-turn and completion date remains fluid until later in the programme: <i>“Project Controls tools will provide early trend analysis to raise confidence in predicted outcomes”</i>
Philosophy of gain-sharing	Shared incentives required: <i>“auditable and consistent” processes to capture changes that may affect those targets</i>
The scale of the business risks	Scale of risks faced by the BAA create a control challenge: <i>“Necessitating a disciplined approach to Project Controls”</i>

Adapted from Controls Handbook 2001

Table 5.1: Main Features of the Control Approach

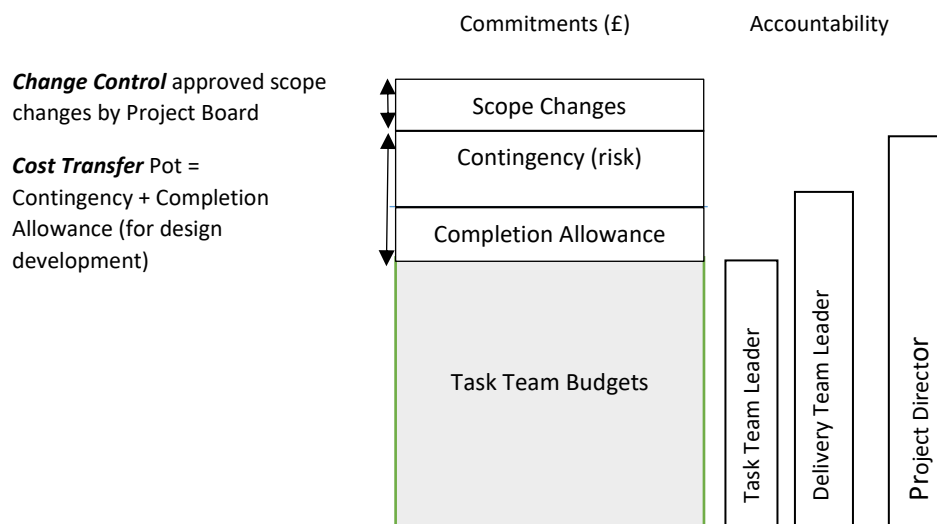
The four main features combined to make a complex control environment. Cost reimbursement was introduced to create more certainty for suppliers. However, testing the robust nature of initial plans and removing wasteful contingencies was necessary to avoid lock-in to “safe” forecasts. The fluid nature of plans described as the “procurement method” was part of the lean

performance improvement model. However, enabling adaptive plans required sufficient visibility to prevent dangers from being hidden within the team organisations. Performance reports and trend analysis were developed to improve the visibility of progress whilst highlighting potential weaknesses in the latest forecasts. The gain-sharing philosophy was intended to encourage a common goal of capturing improved value from the programme. However, it also required a robust control approach to ensure that gain-sharing bonuses were consistently evaluated and rewarded. The “scale of the business risks” required a rigorous system of control and the TECHT team became responsible for developing an infrastructure of management reports, meetings and forums to govern conduct across the programme.

5.2.1 Territories of Accountability

Team structures provided a basis to assign budgets and hold teams to account against targets and standards developed in the initial baseline budgets. However, once the baseline was set, some flexibility was necessary to allow for design changes. Cost transfers and risk contingencies classified as “operational” changes could be authorised at the delivery team level. However, fundamental changes in scope were closely regulated in a change control process which elevated authorisation up to the Project Board.

Figure 5.2 The Hierarchy of Authorisation for Change



Source: The T5 Handbook 1998

The Handbook differentiated between the need for routine operational flexibility and scope-related change noting that;

“evolving and adapting activity does not constitute change; it may involve re-planning and/or transferring roles, responsibilities, budgets, time etc. between teams and team members”

(T5 Handbook, 1998, p42)

Task teams focused on the delivery of a suite of specific work packages. These teams were clustered into larger delivery teams.⁷¹ A design development fund known as the “completion allowance” enabled adaptability and agreed re-design activities. Risk contingency transfers for unavoidable deviations to plan were considered a “project management responsibility” beyond the authority of the task teams. They required agreement with the Delivery Team Leader or the Project Director. In contrast, change control processes were stringently managed with formal authorisation by the T5 Project Board. The rigorous scrutiny of control changes reflected the need for awareness of scope changes across the programme.

This hierarchy created a framework to monitor and sanction certain types of decisions. It also formed the basis of a reporting structure to categorise costs associated with change and adaptability. This structure enabled developmental learning whilst holding teams to account for budget commitments. However, bounding accountability within a defined structure created “interfaces” between teams. Task interdependencies could result in a lack of clarity about “who” should be held to account for change. Although teams were encouraged to “actively work interfaces,” client oversight was needed to resolve disagreements. The fluid nature of design development meant that tracking changes to the baseline was complicated. However, it was important to accurately monitor change and at the centre of this was a fundamental principle that:

“money should not be moved between budgets without moving the work that the money was originally intended to be used for and the time taken to do it”

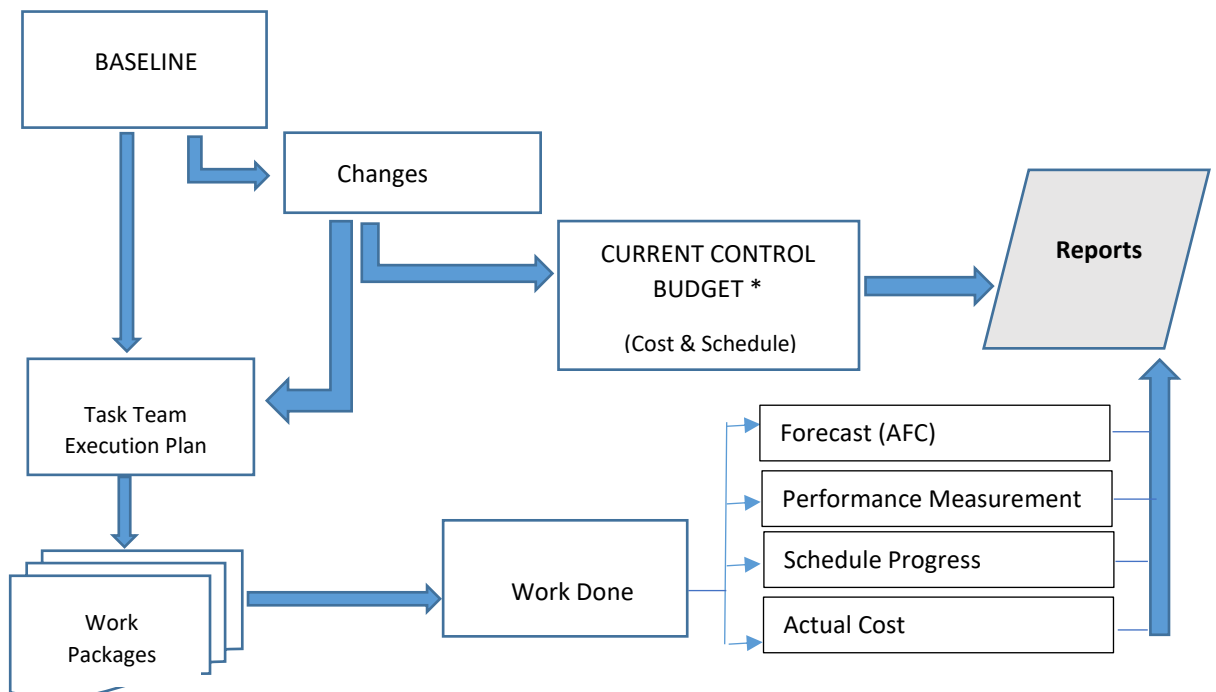
(Controls Handbook, 2001, p p9).

A control architecture was developed to ensure that costs and schedules were not decoupled. This architecture was supplemented by monthly reports that tracked and monitored authorised changes to the baseline.

⁷¹ In total the project engaged 16 main project “delivery teams” divided into “manageable chunks” made up of 147 sub-project/task teams.

5.2.2 Collective Evaluation

Collective evaluation was a key feature of monthly meetings. A participatory ethos challenged traditional approaches to reviews where reports were “static things that get produced once a month and people argue about them and then go away” (Industry Executive, 2014). Instead on T5, monthly performance reviews provided a critical space for deliberation. Management reports highlighted the progress of “work done”, whilst analysing different performance measures against the latest forecast of costs at completion or the “anticipated final cost” (AFC). The links between management reports, work package commitments agreed with suppliers, and the initial baseline are described in the diagram below:



Source: Adapted from Controls Handbook 2001

Figure 5.3 Linking the Baseline to Work Packages and Reports

This control process facilitated “drilling down” using a work breakdown structure ⁷²to enable an in-depth analysis of performance into “what is being delivered and where it is being delivered and who is charging for delivery” (Controls Handbook, 2001, p10). Baseline plans were broken down into task team plans and individual work packages which formed the basis for authorised payment to suppliers. The current “control plan” became the main budget for comparisons to analyse progress. Project teams were responsible for developing monthly rolling forecasts which

⁷² A work breakdown describes a list of deliverables broken down into work packages (PMBOK 2015, p567)

captured year to date performance plus an estimate for the remainder of the work package. This translated into the “anticipated final cost” (AFC).

Although integrated teams provided a space to pool knowledge when developing forecasts, there remained a tendency towards developing more than one version of the forecast “truth”.

A T5 Director noted:

“...because you’re in an integrated team, actually the teams would be reviewing their data in a way that they normally would, that any project team would. And those teams were made up of multiple members of different organisations. So, they weren’t just BAA people or just contactors, there were all sorts of people. And most importantly the teams owned their plans and they managed their performance associated with those plans. So, it was very hard actually in an integrated team for people to create too many different versions of the truth. You might get two versions of the truth i.e. the version they want to try and get the “governance” to understand and then the version they’ve got in their top drawer as their opportunity; and that happened quite often. But getting two versions rather than one version was a challenge; but we didn’t have multiple versions of the truth.” (T5 Director, 2015)

Challenging traditional practices such as a “two” book culture, with a “safe” governance forecast and the “top drawer” realistic one, required an infrastructure of control that provided sufficient oversight to scrutinise and test forecasts. However, rigorous forms of monitoring could be met with resistance. The controls approach needed to balance a desire for surveillance with a degree of autonomy necessary for active risk management. Teams needed to own their plans and accept accountability for performance. However, accurate forecasting also required a level of capability to understand the scale effects of changes on the schedule. As the programme progressed the composition of the teams also changed making knowledge transfer and capture an issue:

“All the heavy civils guys leave and all the systems and fit out people arrive. So, from going from having half a dozen contractors on site, you go to having 100 or 60 different organisations all with different varying scales of capability and you have to start the whole process of education all over again. That was a much harder challenge from an assurance and a performance point of view than in the first half. Particularly when it came to productive performance and ‘quality of thinking and problem solving. In that part of the job we put more capability in and around some of those kinds of people and organisations.” (T5 Director, 2015)

Building consistency in to reporting routines became important to prevent new entrants from adopting traditional practices that avoided accountability for performance improvement. From

2003, once the cost baseline was fixed, activities focused on refining assumptions to develop more precise performance targets. Within the existing T5 literature there is recognition that incentives and plans were modified but there is limited discussion of “how” or “when”. At the end of the last chapter a major question was raised:

On T5, although the incentive structures co-incentivised teams to accept fluid plans, prior research reveals tensions⁷³ over being held to account for performance deviations. Calculative technologies such as plans and incentives played a mediatory role, as they were adapted over the delivery lifecycle to build a shared vision of evaluative purpose. However, the existing literature provides little detail of the composition of the calculative infrastructures or the nature of modifications to evaluative principles that enabled progress. Therefore, how did the calculative infrastructures mediate and sustain control?

Prior research emphasises that collective evaluation was sustained by adapting calculative technologies over the delivery cycle. This enabled divergent tensions to be settled, steering conduct towards a common conception of performance improvement. In the next section, the gap in the current literature is addressed to examine “how” Heathrow modified the calculative infrastructure to navigate change over the delivery cycle.

5.3 The Phases of Control

The following sections examine the phases of control where key calculative technologies shaped evaluative principles and practices. In turn, the controversies that challenged each phase are considered and the nature of modifications to settle and balance tensions.

5.3.1 The Client Holds the Risk (1999-2001)

The BAA’s decision to self-insure the programme meant that the initial stages of T5 focused on developing a risk management model to capture and mitigate risks. An initial benchmarking study highlighted that the scale and complexity of T5 was likely to result in at least a 20% over run unless the client moved from the traditional fragmented subcontracting model (Doherty, 2008; Nightingale and Brady, 2011). The Integrated Team concept was a successful crisis management technique when the Heathrow Express tunnel collapsed in 1994. The recovery programme used a single team structure to quickly mobilise a response and mitigate further risks to the £440m cost base. This recovery approach demonstrated that rather than taking Balfour Beatty to court, resolving the problem by engaging co-located and integrated teams with

⁷³ Gil, 2009; Gil et al, 2012; Nightingale and Brady 2011

a sense of common purpose was a superior solution. The concept of “contracts don’t deliver projects; people do” (T5 Director, 2015) inspired the creation of integrated teams on T5. The team were carefully recruited from a wide range of industries to bring variety and talent to the programme. They operated in a co-located environment where emphasis was placed on the new T5 team identity rather than the organisations individuals came from. The T5 Handbook outlined expectations of how teams would be rewarded but also a code of conduct to guide collective problem solving. Teams were tasked with the gradual development of solutions to “exceptional” standards, adopting a lean mentality to actively seek-out superior solutions. The Handbook ascribed the rationale of “transparency” of costs within and across teams to enabling “fair reimbursements” to teams based on “value and benefit”. However, the controls approach needed to balance a desire for “transparency” with a level of freedom necessary to support active risk management. Gradually clearer processes were developed to deal with design development and scope related changes. However, fluid territories of accountability and task related interdependencies created tensions about “how” risks would be evaluated and how value-based rewards would be distributed across delivery teams. An incumbent tendency towards building “safe” forecasts with buffers and contingencies to offset potential over-runs could block attempts to develop a performance improvement model. At this point a robust reporting framework was needed to capture emergent risks and opportunities. A framework to shape attention towards realistic (rather than safe) forecasts and enable the development of a single, reliable and consistent version of the plan.

5.3.2 One Version of the Truth (2002-2003)

The earlier discussion revealed how running “two books” with a realistic forecast (which remained in the “top drawer”) and a disclosed “safe” forecast was a common practice. The development of a “one” version of the truth involved a slow process of behavioural change where delivery teams were encouraged to share performance information more fully with the project control group. The monthly performance meetings became a forum to drive dialogue between team members and the wider T5 programme. The control team played a key role in building confidence by coaching the delivery teams in how to develop realistic forecasts from schedule data. The composition of the reports shaped the parameters for attention and helped to focus evaluation by defining an order of priorities. The earliest versions of the reports focused on the shortfalls when comparing the budget to performance targets. The report started with a summary of the gap between the control budget versus the latest anticipated cost forecast (AFC). This comparison would shape a dialogue about current operational issues and drivers for performance. The summary was accompanied by tables and graphs comparing cost and

schedule progress by month to direct the task team's attention to trends and areas for improvement.

Earned value methodology played a major role in tracking productivity and progress. Earned value management differs from other performance comparisons because it focuses on progress to date by tracking how much has been completed against how much was expected at a point in time. Earned value is defined as the "value" earned based on the schedule of work completed to date compared to the authorised budget (PMBOK, p538). When individual work packages are complete they are viewed as "earned" and are then compared to the overall baseline plan. Trends in earned value are tracked by monitoring the "budgeted cost of actual work performed" compared to the budgeted cost of work planned to highlight efficiencies. This analysis was broken down into standard indices, known as the Cost Performance Index (CPI) and the Schedule Performance Index (SPI). The CPI highlighted potential areas of concern for overruns by calculating the ratio of budgeted cost for work performed with the actual cost. An evaluation of less than 1 indicated performance below expected levels and a possible "need to instigate appropriate recovery action plans to prevent cost overruns if the performance deficit is not addressed" (TECHT, 2002). The SPI measured progress by comparing the budgeted cost of work performed to the budgeted cost of work scheduled to establish if work was "taking longer than originally planned" (TECHT, 2002). Tracking CPI and SPI trends and earned value movements played an important role in standardising the focus for project teams on specific performance deficits. The precision of the calculation created a consistent basis to evaluate success as well as directing attention to performance exceptions and potential shortfalls. Persistent trends were tracked over three monthly periods to provide a warning of "continuing decline" and deficits which could lead to major performance risks.

Monthly reports focused mainly on current levels of productivity to predict underperformance risks and pinpoint areas for further scrutiny, intervention and control action. These reports were supplemented with weekly analyses detailing lateness or changes to the original schedule which could influence delivery. The Project Board report had a similar composition, although it contained a section dedicated to tracking change requests to highlight potential scope problems. Both the Project Board and Delivery Team (project) reports played a key role in establishing a level of consistency in the techniques used to evaluate progress. They also articulated an expectation of competence required when developing robust forecasts. The monthly meetings provided a forum to explore ideas and develop responses to questions raised by interrogating the numbers. The engagement of senior staff from other organisations (the principals) helped to ratify the importance of decisions.

“We would sit in a room and we would share with them effectively our management report. To get their influence and also their opinion, because obviously there was an awful lot of experience in the room. Especially when you do that around issues or changes. Especially early in the programme we did a lot of that. Because there’s no point in doing that towards the end of the programme when the job is nearly finished; you want those people in a room when they can actually influence the outcome. So, we would effectively have a principals meeting or a principals group then at project level there would be the project team that would have their own report and their own meetings.” (T5 Director, 2015)

Monthly meetings provided a forum to engage the experience of the senior principals but also to agree where they would direct efforts and attention to resolve performance issues. In this context, the “one version of the truth” represented the dominant case captured in the numbers as the basis for intervention. Over 2002 the composition of the delivery team monthly report changed in emphasis (see below) to focus on specific task team issues, trends and narratives.

Table 5.2: Changes to the Monthly Report on T5

New Report Sections	Change in Emphasis	Comments
Opening Section	Traffic lights: (Red-Amber-Green) for specific KPIs; Variances between Budget and AFC, CPI, SPI, Quality, Health & Safety	Focus on exceptions and rankings of targeted KPIs for critical questioning. The initial section linked a narrative to highlighted areas for investigation compared to standards to monitor conformance.
Change Control	Early warnings, Project Manager’s instruction and change orders categories in tables and charts	Mapping change order progression highlighted the size and value of scope changes, raising awareness of persistent and possible risks
Schedule reporting	Traffic lights to highlight progress	Emphasis on significant delays and milestone status rather than lists of activities
Narrative	Large section of commentary on KPIs grouped to explain trends. Quality commentary on non-conformance and disruption to milestones (red flags). Overview comments on risks and opportunities	More focus on diagnosis and accountability to track progress over time, building a narrative for performance evaluation. Narratives assigned clearer ownership “who” and accountability for “what next”
Overview and appendices of granular weekly data	The final section gave an overview of budget and forecast supplemented by weekly trends in costs and schedule performance	To support discussion of diachronic trending data as well as synchronic snapshots of overall progress

Performance ranking in a traffic light format compared the performance of delivery teams. Narrative responses required expertise to explain the relationship between specific local level issues and their translated effect on cost, quality and safety outcomes. More extensive narratives supported the ongoing development of diagnostic skills to respond to questions raised by the KPIs. Detailed trending data helped to build a diachronic view of persistent problems threatening compliance to standards. The final section of the report highlighted the synchronic snapshot of the anticipated final forecast, the control budget and differences between the two. This last section was intended to create a dialogue about risks in delivery and potential alternatives to mitigate past performance issues.

During this initial period, monthly rituals established a timetable and reporting schema to shape expectations of being held to account. Evaluation focused on narratives and indices mobilised to a local setting and used to scrutinise performance assumptions and possible pathways for improvement. In this phase technologies were developed to enrol teams into accepting accountability for devolved decisions. The controls group explained that “early-on” there was “no single point of authority” and this enabled local teams to develop a set of performance routines that suited their working practices. The reports tailored information to a few simple indicators creating a precision in planning and analysis whilst leaving local teams to interpret and develop responses to issues raised. Change control reporting was developed to drive a more sophisticated discussion about how changes might impact the overall scope of the program. The analysis focused on tracking tasks that persistently required more resources than planned, i.e. they became an indicator of a lack of control and therefore risk. Change control reporting also became an important surveillance technique delimiting the project team’s freedom to adjust plans without justifying and exploring alternatives. However, in July 2004 the programme was anticipating a £350m overrun and this led to a new phase in the control cycle. With just 3 years to “handover” this triggered an intense period of re-planning to develop a recovery strategy.

5.3.3 Foresight (2004-2005)

The first Integrated Baseline Review (IBR1) was the first time that all 25,000 activities and 147 sub-projects were integrated into a single critical path. The outcome was a “realistic” overview of the final delivery dates and associated costs for the whole programme. The review highlighted the need to consider different ways of engineering more value through new deals on materials or re-scheduling work. The Total Cost Management (TCM) initiative was launched described as the primary “change agent” to complement normal reporting routines whilst targeting areas to generate savings and performance improvement. In the previous phase of control, emphasis lay on developing a consistent and reliable infrastructure for reporting. The primary performance

indicators encouraged teams to focus on a narrow definition of success based on the delivery of the budget. However, the core T5 team delivery values were founded on principles of “doing things differently” to challenge inertia, to encourage discovery and drive up performance by proactively managing-out risks. Developing a framework of calculative technologies to sustain performance improvement was a major challenge, particularly when large over-runs were anticipated. The quote below illustrates the difficulty in keeping a broad vision to drive improvement when monitoring narrow measures of cost and time;

“So, everybody focuses on delivering time and cost, and nobody is saying, “Well, actually, are we doing the right thing?”. I always think of it in, again, just standard terminology, it’s are we doing the right things but also are we doing the right things right? So, the time, cost and scope is just about are we doing things right? But we don’t know if they’re the right things or not?”

(TECHT, 2015)

The project management literature (PMI, 2013) uses Drucker’s concept of management efficiency as “doing things right” and leadership effectiveness in delivering goals as leading by “doing the right things”. The statement above draws these concepts together by questioning whether the “right” goals have been chosen and if evaluative priorities reflect broader opportunities for improvement. This describes the peril of lock-in to a narrow conception of the “right” thing which can become a self-reinforcing legitimate measure of success used as “proof” of effective management (Power, 2007) despite better alternatives existing. The issue here was that by focusing on CPI performance to date, broader forms of discovery and inquiry had been neglected although they were necessary to solve complex, unique and perplexing problems (Dewey, 1910; Stark, 2009; Dougherty, 2016). Encouraging discovery and critical inquiry was fundamental to the design of the performance management framework to underpin TCM. Initially the TCM initiative was associated with a series of high level goals to bridge the performance gap highlighted in IBR1. These goals included;

- Reduction of the central risk contingency by £100m
- Delivery of existing opportunities in the pipeline of £175m
- Identifying and delivering £182m of new opportunities
- Improve Productivity
- Ensure commercial effectiveness of the change control process

(TECHT, 2004)

The goals of the TCM became strategic imperatives and the project teams were responsible for developing plans to deliver improvements. Reducing programme level risk and crystallising opportunities required extensive re-engineering of existing plans to consider ways of generating greater efficiencies. Project teams were expected to take a proactive role in improving productivity. Progress was closely monitored to assess risk reduction, opportunity conversion and productivity targets. However, capturing progress across the programme was complicated. The TCM programme literature described this as;

“How do we know that the actions being taken are effective in delivering the required results across the projects and the T5 programme as a whole?” (TECHT, 2004)

Designing calculable spaces to capture, shape and sustain improvements was a major performance management challenge. The TCM initiative had pinpointed a pathway for improvement, building on the IBR review. New delivery targets were captured in a series of critical milestones which brought the activities of the project teams together at key temporal points. New territories of accountability were set to match new delivery targets. However, the enrolment of allied interests in agreeing the new stretch targets required a period of negotiation. Governing by numbers was referred to as “knowing the numbers” and the TCM review meetings became forums where KPIs were intensively debated as proxies to monitor the delivery of results. Knowing the numbers was described as key to managing with “foresight”

“Knowing the numbers was partly about discussing the KPIs to date but it was also about giving us a heads-up that something had to change if we were still going to deliver the plan and I guess that’s all about managing foresight” (TECHT, 2015)

Developing foresight was described as having sufficient warning to be able to anticipate the need to adapt plans. Foresight was linked to the lean thinking principles and active risk management because it involved proactively managing-out waste to deliver superior levels of performance.

5.3.3.1 Mobilising Ownership

Radar tracking evaluated how far each of the 16 projects team had enrolled into the TCM programme by agreeing to specific plans and mobilising active improvement initiatives. TCM representatives were commissioned and tasked with agreeing the basis for accountability. Bespoke datasheets of key performance measures were developed to generate a progressive dialogue in examining performance to date.

The bespoke delivery goals were centrally assessed to consider;

1. Is there a plan? 2. Is there a clear owner of the plan? 3. Is the plan being actively managed?

A traffic light report summarised the status of the 3 questions and presented the results in a radar style analysis. Outcomes were monitored through some of the standard monthly KPIs measures that tracked efficiency trends such as the CPI and SPI data. Improvements in the Anticipated Final Cost (AFC) were ranked and monitored by project teams to create a sense of competition. These measures also formed part of the evaluation for the programme level incentives.

TCM continued for several years until the operations readiness phase began in 2006. TCM re-introduced concepts of “lean thinking” by encouraging a total quality approach which defined and articulated more precisely the “value” improvements required. A new architecture of performance measures and plans were refined with teams developing their own targets to generate savings. Part of the success of TCM can be linked to the gradual and iterative way in which new accountabilities were co-developed (BAA, 2006). TCM encouraged autonomy and enterprise but progress was also closely tracked to create a sense of urgency.

5.3.3.2 Oversight of Risk Citizenship

Monthly reports were rationalised and visually simplified and the content focused on the analysis of specific targets that tied back to TCM. The monthly reports were used to drive a discussion about trade-offs and improvements between productivity and sustaining quality and safety standards. Productivity and monthly progress was measured via CPI and SPI comparisons, and the “gap” between the baseline and the latest AFC. Conformance to safety and quality standards was fundamental and compliance statistics gave an indicator of operational robustness in executing these standards. The autonomy and freedom previously enjoyed at the project-level was replaced by a disciplined approach, whereby project-level risk contingencies were frozen to protect the bottom line. In turn “top ten” risks and opportunities were monitored and any changes in status routinely interrogated. This reflected a more stringent appetite for risk requiring teams to focus on driving-out waste and contingencies. The risk register process (called “CP07”) was upgraded to closely monitor emerging risks and to capture more distant threats. Due dates and control ratings were used to keep threats visible whilst assigning accountability for specific categories of risk. Check-points were developed to scrutinise the progression from initial “early warning” notices (EWNs) to project manager instructions (PMIs) and finally fully authorised “change requests”. The last part of the report catalogued in detail

risks and opportunities and significant hazards or threats to programme completion dates, reflecting the tighter control environment

By 2005 the control infrastructure reflected some of concepts of “risk citizenship” with accountability spread across the organisation. Risk became “everyone’s business” (Power, 2007). TCM improved “heedfulness” (Dougherty, 2016; Weick and Roberts, 1993; Power, 2007) within the teams by communicating a coherent vision of productivity improvements through precise quantified goals. The re-assignment of accountability for performance gaps devolved responsibility for risk management fully to the project teams. The tight oversight of change requests and contingency movements narrowed the project team’s parameters of choice. TCM created an environment to encourage “proactive” inquiry by rewarding teams for managing-out risks. The principles of active risk management moved from vague expectations of proactive behaviours to specific metrics designed to hold delivery teams to account. These were described in the BAA Step Change document, 2006, p3:

1. Measures should be few, simple and people should only be held accountable for issues that they have some influence over
2. Motivating behaviour drives change and so measurement should be linked to something that makes people want to change their behaviour.

Sustaining motivation involved teams accepting accountability for specific targets and standards reflected in the suite of TCM KPIs. Teams were empowered as risk citizens to work towards specific performance improvement goals creating a form of moral economy (Power, 2007) with decisions shaped by a few simple measures. This reflected the ethos of lean and partnering where collective dialogue was favoured above more directive forms of regulatory control. However, at this late stage in the programme, collective dialogue reflected the need for precision to steer the programme to completion. A few simple and precise measures enabled divergent tensions to be settled, steering conduct towards a common conception of performance improvement.

5.4 Synthesis of Themes

Building an appetite for lean partnering involved the gradual development of an infrastructure to steer conduct towards accepting accountability for active risk management. The initial control phase, the “client holds the risk” emphasised building confidence in working within integrated teams in a co-incentivised environment. By the summer of 2000 a baseline commitment was agreed at the group level. However, the scope remained fluid and cost reimbursement set an

expectation of guaranteed payments amongst teams. This created a complex control environment with a need to discourage using safe numbers packed with contingencies or cynical attempts to manipulate scope through change requests. Although a basic control architecture was developed to encourage active risk management, a robust reporting framework was needed to encourage the “right” behaviours.

In 2002 construction commenced and monthly reports played a key role in building confidence and also a willingness to develop realistic and robust forecasts. Translating schedule data into cost forecasts involved a degree of cost management capability, an understanding of cost behaviour, and the scale-effects of clustering work packages into delivery team forecasts. The gradual coaching of teams by dedicated control experts helped to develop team capabilities whilst encouraging teams to pool knowledge into “one version of the truth”. Teams were encouraged to develop their own performance management routines to provide credible narratives and stories. Monthly reports focused on progress to date and areas for concern by identifying current dips and anticipated shortfalls. Monthly meetings provided a forum to agree priorities for attention. Earned value analysis and the SPI/CPI measures provided a consistent basis for teams to focus on performance exceptions. Over time reporting was refined and competitive rankings and narrative responses focused attention on weaknesses and alternative strategies to mitigate performance issues. Collective evaluation and participation in agreeing priorities played a key role in enrolling teams into accepting accountability for performance shortfalls.

By July 2004 the first IBR identified the need for a robust recovery plan to mitigate a potential £350m over run. At this stage the composition of teams was moving from the “civils” to a variety of smaller suppliers. The appetite for risk switched from building a predictable forecast to scrutinising “doing the right things right”. A framework of KPIs was developed for each team to enrol agreement towards the TCM goals. The autonomy previously enjoyed was replaced by a disciplined approach to tracking progress, freezing risk contingencies and monitoring performance to generate a deliberate dialogue to mitigate any further slippage. Eventually a complex suite of reports shaped attention towards precise targets as the programme moved into the final stages of construction.

5.5 Enrolment and Controversies

So far, the discussion of the different phases of control has stressed the role of collective evaluation as a way of shaping diverse perspectives. Within each phase key calculative technologies created calculable spaces where responsibility was assigned and gradually accepted by project teams. Calculative technologies played a central role in settling debates and tensions. In phase 1; “The client holds the risk” involved the Handbook outlining the importance of “transparency” to support the client in managing business risks. The offer of “fair” rewards for more transparent problem solving was intended to persuade teams to share knowledge. A variety of key technologies such as the completion allowance and value-based incentives settled initial concerns about how teams would be rewarded for searching for improved solutions. However, tensions remained associated with traditional construction behaviours of avoiding change and holding on to valuable strategic knowledge. Once construction commenced, problematisation focused on intense debates about the need for the “right” behaviours to challenge a “two-book culture”. Gradually reporting rituals and reports shaped attention towards “one version of the truth” and the diagnostic capabilities of the teams developed. However, by the summer of 2004 the overrun identified in IBR1 led to phase 3; “foresight” where the re-assignment of accountabilities was animated through a framework of more precise standards and targets.

The table on the next page describes the dominant themes within each phase and the technologies and evaluative principles that gradually enrolled agreement. Within each phase certain technologies played a key role in mediating agreement towards standards of conduct and new evaluative principles. However, at the end of each phase major tensions became controversies challenging the existing “order”, leading to the modification of calculable spaces to enable progress. Progress reflected patterns of development, with settled periods followed by disruption and controversy which triggered the need for further modifications to settle tensions. Overall the table describes a gradual pattern of emergent learning, with calculative technologies adapting to settle tensions and enabling the programme to progress and pass through the different phases. An important observation is that there was a persistent trade-off between discovery and lock-in which created a dynamic control environment.

Dates	Phases of Control	Key Technologies	Enrolment	Controversies
1999-2001	<p><i>“Client Holds the Risk”</i></p> <p>1.The contract, T5 Agreement enrolled teams into a lean partnering arrangement accepting a common identity and agreeing to search for exceptional performance.</p> <p>2.The client held the risk to settle uncertainty & encourage discovery</p>	<p>1.The Handbook; described a normative framework of values for more transparent knowledge sharing.</p> <p>2.STORM ascribed “Active risk management” to encourage heedfulness and acceptance of responsibility to manage-out risk</p>	<p>1. Incentives: remove supplier’s commercial risk, distribute rewards through milestone & value incentives.</p> <p>2. Territorialized accountability: enabling adaptive search for “better value”.</p> <p>3. Change control: to interrogate trade-offs between regulation and discovery</p>	<p>Needed more oversight of “right” behaviours to;</p> <p>1.Prevent inertia and lock-in</p> <p>2.Develop robust forecasts to capture progress and emergence</p> <p>3.Stop teams hiding contingencies in safe forecasts</p>
2002-2003	<p><i>“One Version of the Truth”</i></p> <p>1.Capability to create realistic plans gradually developed through monthly reporting forums holding the teams to account in explaining the “numbers”.</p> <p>2.Reporting technologies evolved shaping diagnostic practices which converged in a single more robust forecast.</p>	<p>1.Monthly narratives, standards and targets set parameters for freedom through:</p> <p>a. Integrated CPIs/SPIs which captured progress to assess underperformance risks.</p> <p>b. Stringent change processes to justify transfers to/from budget.</p>	<p>1.Mobilising teams required an evaluative framework to emphasise “realistic” planning, sharing good/ bad news (rather than building contingencies).</p> <p>2.Infrastructure emerged through standardised and structured reviews</p>	<p>1.If success is only viewed through short-term savings to budget, then wider exploration may be avoided.</p> <p>2.How do you sustain inquiry and novel forms of worth rather than lock-in?</p>
2004-2005	<p><i>“Foresight”</i></p> <p>1.Emphasis on having more visible foresight to anticipate risks. Rather than directing suppliers this phase was characterised by progressive debates about alternatives and “doing the right things right”</p> <p>2.Developed a devolved risk citizenship model to capture local opportunities</p>	<p>1.IBR provided a critical space to assess the overall performance risk.</p> <p>2.TCM captured performance gaps in to specific plans and KPIs. TCM reports mobilised active risk management</p> <p>3. Risk registers broadened search to consider more distant risks.</p>	<p>1.Accountability for risk devolved to teams within precise parameters.</p> <p>2. Tighter control embodied clearer conceptions of efficiency reflecting a more constrained appetite for risk.</p> <p>3. Teams empowered to explore opportunities</p>	<p>1.As the composition of the programme changed and new suppliers were enrolled; “How” do you sustain and drive lasting and progressive improvement?</p>

Table 5.3 Terminal 5 Phases of Control

5.5.1 Phase 1 – Client holds the risk (1999-2001)

Teams were procured through the T5 agreement to accept lean partnering principles and a common identity. The reimbursement of costs was intended to settle payment concerns about how work package claims would be treated. Teams were encouraged to accept greater transparency and a heedful approach by “actively working interfaces” and subordinating individual concerns for the common good of the programme. The pledge of value-based rewards was intended to encourage teams to seek superior solutions for the mutual benefit of the programme. Change control procedures and the completion allowance provided the foundations for the control methodology. However, the reporting infrastructure was in its infancy and tensions developed about how risk would be monitored, assigned and evaluated. Cost reimbursement provided a strong incentive to avoid uncertainty and lock into the initial scope and enjoy the guaranteed margin. To sustain the iterative learning approach described as “active risk management” teams were required to accept fluid scope and adaptive planning rather than a lock into existing plans. Although teams had participated in early stage plans there was a tendency towards “safe” numbers, creating buffers and contingencies to hide minor overruns. Although the Handbook ascribed partnering and lean principles, teams needed to develop a willingness and capability to produce realistic forecasts.

5.5.2 Phase 2 – One Version of the Truth (2002-2003)

A consistent methodology for more robust forecasts were gradually developed. Structured reviews created an evaluative order where teams were routinely engaged in justifying their comparative performance. Earned value principles were powerful concepts which travelled across the programme mobilising a performance dialogue to explore strategies to mitigate productivity shortfalls. Structured monthly routines provided a framework to monitor progress. Teams were given the freedom to interpret their results and develop their own action plans to mitigate possible risks. Over time teams became more willing to share knowledge in the development of robust forecasts. However, at the end of this phase the threat of major overruns forced a re-think of existing plans. The current control infrastructure encouraged predictability rather than abductive inquiry. By the end of 2003 there was a need for change and a new architecture of technologies to rapidly mobilise re-planning and a broader search for novel solutions to generate significant savings.

5.5.3 Phase 3 - Foresight (2004-2005)

Within the TCM programme a suite of technologies were developed to mobilise ownership of the new accelerated plans. Enrolment involved an initial period of negotiation to agree new responsibilities. Once targets were set, technologies were developed which precisely defined efficiency and acceptable levels of variability in performance. TCM reintroduced lean thinking concepts passing ownership to the teams to develop detailed plans. Principles of active risk management were translated into specific commitments to deliver new opportunities, savings and productivity improvements. Reports were developed to monitor tangible improvements in opportunity conversion and risk mitigation. Trade-offs between improved productivity, safety and quality were scrutinised to ensure balanced growth. TCM was considered a vehicle for a “step change” by clearly articulating new performance expectations but also creating an environment for risk “citizenship”. A sophisticated infrastructure of technologies provided oversight of devolved activities. By the end of phase 3, a more precise appetite for risk was clearly articulated and active risk management principles were embodied in project level plans. In 2006 a BAA project report ⁷⁴ was commissioned which recognised how TCM was a significant catalyst for change because it enabled the reassignment of accountabilities to match risks with team capabilities. The calculative infrastructure underpinning TCM played a fundamental role in developing heedfulness by quantifying and assigning opportunities and risks whilst creating calculable spaces to enrol teams into accepting accountability

5.5.4 Synthesis

Within each phase, progress was sustained by adapting mediating technologies to enable progress. This adaptation reflected an appetite for risk which underpinned the controversies and tensions at the time. In phase 1, the lean partnership model required teams to recognise the benefits of collaboration and accept responsibility for managing-out risk. At this stage ambiguity in who would be held to account for fluid plans created friction and tensions. By phase 2, monthly rituals and reports improved the diagnostic capabilities of teams working to collectively evaluate progress. Earned value management and a focus on exceptions and variances enabled the development of more realistic reporting. The calculative infrastructure rewarded “predictability” by scrutinising change control processes and analysing trends to reduce surprises. However, from 2004 the infrastructure of reports to support TCM devolved accountability for risk, quantified and captured in precise targets and standards. By this final

⁷⁴ A Step Change: the T5 Case Study from the BAA

phase, aspirations of “foresight” were enabled by teams agreeing to be held to account against a more rigorous framework of standards and targets. However, this acceptance was gradual and the machinations of testing and contesting gradually developed an infrastructure capable of steering the programme towards performance improvement.

5.6 How Did T5 learn to Govern Through Numbers?

In the last chapter, the dissonant setting for construction was discussed in some depth. Egan’s lean thinking model emphasised eliminating waste by synchronising supply and steering performance towards an agreed conception of value and purpose. However, for many major projects, weakened supply networks and an aversion to change had frustrated progress. The findings in this chapter describe the careful orchestration of an infrastructure to govern performance improvement. Governing conduct required an adaptive framework of control to administer reimbursable claims and distribute gain-sharing incentives whilst providing an architecture of reports to track progress. However, on T5 the calculative infrastructure played a more fundamental role in shaping emergent learning and capturing agreement through collective evaluation. Tracing the evolution of calculative technologies over the delivery cycle has highlighted how key technologies enrolled agreement towards a shared conception of evaluative purpose. In the early phases, ascribed lean principles remained vague and ambiguous. The development of a robust reporting architecture settled tensions about accountability for risk with the monthly rituals shaping more predictable forecasts. By the final stage, acceptance of new territories of accountability and risk citizenship was supported by a sophisticated infrastructure that embodied learning from earlier phases. The machinations of testing and contesting were part of the development of the infrastructure to govern performance improvement.

These findings contribute to the T5 literature by highlighting the composition of a calculative infrastructure that enabled performance improvement. The “system integrator” literature emphasises the leadership of the client on T5 as an integrator overseeing component knowledge transfer within and between integrated teams (Davies et al, 2009; Brady and Davies, 2011; 2014). In this literature, superior levels of learning and knowledge sharing are linked to the incentive structures and particularly the cost-plus arrangement underpinning cost reimbursement. Emphasis is placed on moving away from the usual risk dumping observed in fixed price agreements. Guaranteed costs were portrayed as a way of settling concerns so that teams could focus on generating additional bonuses from the gain-sharing arrangement. However, the T5 findings reveal that the reimbursable agreement alone did not remove

uncertainty. Instead, the fluid nature of scope created blurred territories of accountability which triggered intense debates about evaluating change. A complex calculative infrastructure was developed to manage risk contingencies, scope changes and design development. Client oversight was supported by a sophisticated suite of reporting rituals, forums, standards and targets to gradually enrol the acceptance of lean. This created a calculative infrastructure that adapted to balance persistent tensions between discovery and lock-in. The reimbursable arrangement was just a part of this wider calculative infrastructure.

Gil 2009, Gil et al 2012 and the Nightingale and Brady 2011 papers recognise the social complexity of control and the existence of contested situations challenging plans and incentives. These papers elaborated on how tensions were stabilised by modifying the evaluative principles built into incentives and plans. Nightingale and Brady's 2011 work highlights that flexible planning created a "scaffolding" to coordinate and shape diverse behaviours. Plans became mediatory instruments to support collective deliberation whilst capturing learning within more realistic assumptions. These papers highlight a role for calculative technologies in balancing divergent perspectives and settling unstable and contested periods. Although they observe reflexive learning through calculative technologies, there is little description of "how" or "when". The T5 findings fill this gap by describing the changing composition of technologies and the controversies and tensions that shaped modifications over the different phases of control. Although plans and incentives were adapted, the new targets and accountabilities underpinning this adaptation created tensions. These tensions were settled "through" calculable spaces; the monthly reviews, the IBR and the TCM architecture. An important finding is that incentives and plans were part of a wider infrastructure that shaped an appetite for risk as the programme progressed over the delivery cycle. An infrastructure that gradually evolved to enable risk citizenship.

5.7 Concluding Thoughts

Much of the existing T5 literature describes in detail the initial design of the commercial arrangements on T5. Although control outcomes are discussed there is little detail of the development of the control architecture that enabled delivery. By adopting a process approach this chapter has detailed the gradual enrolment of teams into a complex control model that enabled emergent learning. Rather than implementing active risk management from day one, the findings observe a gradual devolution of accountability which enabled the BAA to distribute performance shortfalls through a suite of new targets and standards. Echoing Wolstenholme's 2009 advice, risk was placed with those most capable, however, this was only

possible because of the complex and adaptive infrastructure of calculable spaces and technologies. The TCM programme created an intelligent system of control that enabled “action at distance”. This point is important because as T5 opened in 2008 formative decisions were made for T2 that reflected the later stage control approach on T5. Many of the technologies developed during the construction of Terminal 5 were adopted on T2.⁷⁵ These points are examined in the next chapter.

Finally, the T5 case reveals an innovative response to major business risks and uncertainties. Rather than removing performance deviations, the T5 approach treated contested situations as an opportunity for critical inquiry and emergent learning. However, its success required careful management of tensions to sustain progress. These findings highlight the complex and unstable nature of sustaining control within a construction project. Social integration and the enrolment of a shared sense of meaning was shaped by modifying calculative technologies. Making teams “governable” emerged over time by redefining calculable spaces and re-assigning accountabilities. The development of “risk citizens” involved a gradual enrolment within each control phase. This chapter has developed a picture of the evaluative principles and procedures underpinning the acceptance of the performance improvement model. Enrolment within each phase involved agreement by modifying evaluative priorities. The gradual shaping of institutional subjects, or “subjectivization” within and across the different control phases is considered in more depth in the later discussion chapter 7. The next chapter returns to the construction of Terminal 2 and the move away from partnering and collective evaluation to clear lines of accountability and a foresight model that attempted to govern “by” the numbers.

⁷⁵ The IBRs, earned value management and a structured monthly timetable

Chapter 6

Intelligent Foresight in Terminal 2

“When roles are confused or blurred, then chaos, disputes, ill will and frustration follow and just as in a football game, the whole team goes down in the flames of defeat. It is the contract not alliances, that make good team mates”

(Morgan, 2009, p2)

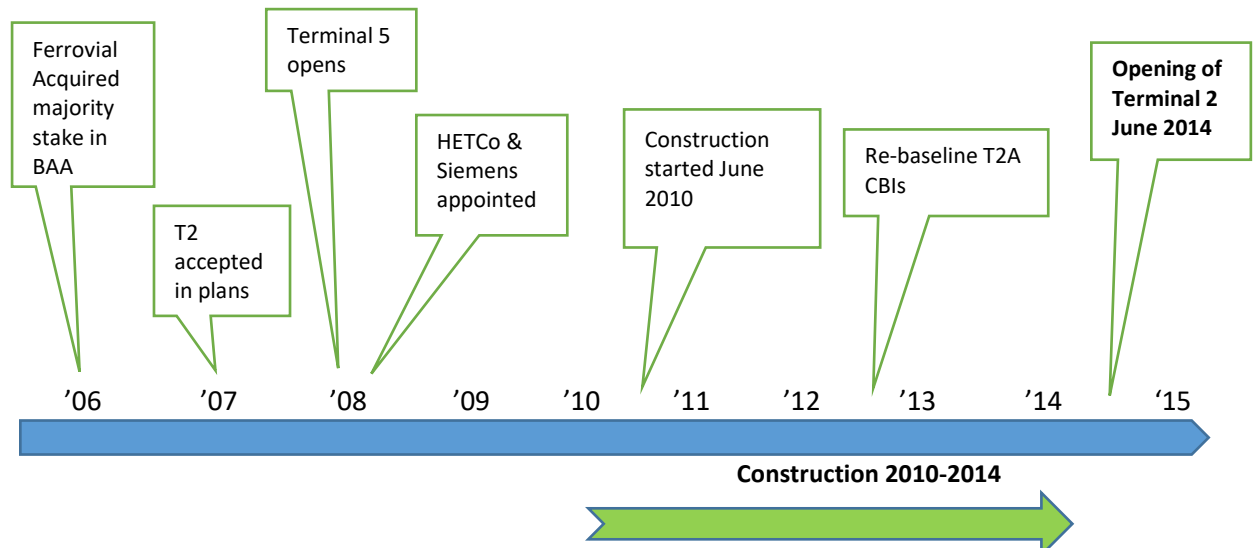
6.1 Introduction

The economic setting for Terminal 2 was marked by the downturn in construction, which created difficult conditions and an increased insolvency risk amongst suppliers (CS2025; CE, 2009). The opening quote from the Capital Director overseeing T2 reflected a desire for more clarity in responsibilities defined by contract. This was a commercial response to a weakened supply network, echoing Wolstenholme’s 2009 recommendation that to settle financial concerns, accountability for value and risk should be more clearly articulated. In chapter 4 the quote from T2 that “Good Fences Make Good Neighbours” (Morgan, 2009, p2) reflected a belief that clearly assigned roles and responsibilities defined “up front” in the contract would settle tensions and encourage team work. This chapter examines these themes by elaborating on the dynamic control framework which adapted to support these more bounded territories of accountability. In turn, it considers the phases of control and the nature of enrolment and controversy that resulted in adaptation despite the initial rigid governance design.

The £2.5bn construction of Terminal 2 (T2) was known as “Britain’s New Front Door” because it extended the domestic flight capacity from Heathrow from 2 to 20m passengers. The construction involved an 180,000m² terminal building (T2A), a multi storey car park and a satellite pier (T2B) on the Eastern Campus of Heathrow. The planning lead-time for Terminal 2 was short. The terminal only became part of Heathrow’s strategic master plan in 2007 and within a year the CBIs; HETCo and Siemens were appointed. HETCo was a joint venture between Laing O’Rourke and Ferrovial Agroman commissioned to design and construct the T2A terminal building. Siemens was the primary integrator for the Eastern Campus Baggage Programme with oversight of various IT service providers; Cap Gemini, Atkins RI, Fujitsu, Tyco CCTV and Schneider. The construction of T2A started in June 2010.

The timeline below describes some of the key features of the governance approach for T2 starting with the acquisition of Heathrow by the Ferrovial Group in 2006⁷⁶.

Figure 6.1: The Terminal 2 Timeline of Key Events



Integrated Baseline Reviews: IBR (7) Dec 2010; IBR (8) March 2012; IBR (9) Nov 2012

The performance management approach transferred many of the features from T5 with a timetable of monthly performance meetings to monitor progress over the delivery cycle.

“Heathrow had to act fast and move quickly. So, it moved its contracting model on. It didn’t want to take all of that same level of risk. A lot of the upfront work that we’d done in the design and development on T5 and Heathrow said very quickly so we can do a bit of the same on T2”

(Industry Executive, 2015)

Although some of the features of controls architecture were transferred from T5, the way in which reviews were conducted reflected a preference for precision and auditability. The governance model was underpinned by clearly defined contractual responsibilities and an intelligent control system to hold the supply chain to account against baseline commitments. A timetable of Integrated Baseline Reviews provided a structured framework to formally review performance.

⁷⁶ By 2012 the BAA was renamed Heathrow Airport Holdings Limited known in the interviews as “HAL”

6.2 Governance Framework

A framework of duties was developed to oversee the execution of contractual obligations with functions broken down into contract management, service delivery, commercial management and control.

6.2.1 Church and State

The contracting officer, informally known as the “church and state”, held oversight responsibility for the administration of the contract. The importance of this function reflected the traditional approach to contract administration where litigious disputes required swift resolution. Contract management also facilitated disciplinary processes to sanction acceptable forms of contractual change. The emphasis here was on the diligent management of change to assure the administration of scope.

6.2.2 Service Delivery and Intelligent Conscience

The Heathrow (HAL) service delivery team leaders were known as the “Programme Directors.” They held oversight responsibility for project management whilst liaising with the CBI project managers. Programme Directors met on a monthly basis with the rest of the programme leadership group to evaluate, interrogate and agree next steps from the monthly performance reviews. The commercial team or “intelligent conscience” played a critical role in balancing commercial tensions by developing commercial solutions with the CBI.

6.2.3 Controls

An “intelligent” performance management framework was developed to provide lateral and vertical data to support decision making across the programme. The model of governance was described as:

“a thinner organisation at the top informed by great data which came from the project; with a controlled environment of value management feeding up into their leadership so that they could make smart decisions” (Controller 2014)

The intelligent client system monitored progress using an earned value management methodology to monitor cost and schedule progress against the baseline. However, in the early stages of the programme, the scope changed with engineering and design modifications to the baggage system, carpark and rail link. A rigorous framework of change controls procedures was developed to ensure that accountabilities remained clearly defined.

6.3 Dynamic Control Framework

The reporting system consolidated detailed work package data from the 2nd tier suppliers. Control account structures coded the work packages and assigned accountability to specific CBI project managers. Work breakdown structures enabled a detailed level of analysis culminating in an overview of the programme schedule. An open-book approach was important to enable the control teams to test the integrity of the schedule assumptions regarding tasks, task durations, handover points and interfaces between suppliers. This supported modelling of alternative configurations when changes and improvements re-framed the scheduled plan. This degree of openness and granularity was intended to support detailed diagnostic inquiry to test weaknesses within the schedule. Emphasising the importance of robust data was intended to deter “safe” forecasts and contingency building. Scrutiny of the data through sophisticated risk modelling played a key role in assuring the integrity of the data. Managing the risk reserves was part of the financial engineering of the programme and provisions and their corresponding cost impact sat in a centrally controlled fund.

6.3.1 Risk Drawdowns

The process of making a reserve was known as a “risk drawdown” requiring a dialogue and sign-off to authorise transfers from the budget into the risk reserve. At a programme-level the cumulative value of risk formally accounted for was reported as a “waterfall”, which reflected the total level of “risk-funded” change accepted and provided for across the programme. Waterfall charts formed the basis of the monthly dialogue that assessed the current year to date performance and offsetting opportunities from recovery plans. Over the life of the programme the cumulative waterfall ⁷⁷decreased, as offsetting opportunities were created to mitigate the effect of old risk drawdowns. As a visualisation, the waterfall chart played an important role in guiding a focused dialogue about next steps to recover drawdowns.

6.3.2 Float⁷⁸

Sophisticated planning techniques were developed to interrogate and test the schedule for opportunities to save time. An innovative technique called a “shock absorber” was developed to mitigate the effect of delays on the critical path by strategically creating additional time and funds to absorb delays. Shock absorbers were also used to de-stress schedule “hot-spots” where interdependencies might amplify the effect of delays at points in the future schedule. Float

⁷⁷ Hence the name “waterfall” because the chart plotted a reduction in reserves over time

⁷⁸ Float represented a time provision to create slack in the schedule (PMBOK 2015)

creation techniques facilitated more adaptable planning as a form of “time-pacing” within the schedule to reconfigure the intensity and direction of efforts (Dougherty, 2016). From a client perspective, shock absorbers were a cost-efficient way of resolving issues before risks materialised into significant delays, possible claims and disputes. Floats and reserves were managed to mitigate risks but they also changed the parameters of accountability, shielding contractors from the “pain” of underperformance. Balancing the need to protect the overall programme whilst ensuring that suppliers were held to account was part of the complexity of managing risk.

6.3.3 Risk Exposure

Quantitative schedule risk analysis (QSRA) was used to statistically test the parameters of variation embedded within the schedule. Schedule risks were quantified by modelling the network of tasks and their interrelationships which informed an analysis of the probability distribution of durations. Outputs of this analysis were “P80” (80% percentile) or “P50” (50% percentile) reports generated from a distribution of estimated completion dates. This was accompanied by a quantitative cost risk analysis (QCRA) where a probability distribution was applied to model cost variations and P50 and P80 reports could model expected variations in the work breakdown scope. Typically, the P50 was used to calculate the median risk value for the whole programme at completion. The analysis could also be used to audit and test the logic of the critical path whilst assessing relative risks, potential alternatives and impact. As the programme progressed, more sophisticated risk exposure techniques were developed. They enabled more precise forms of interrogation and what-if analysis to explore alternative plans and milestone configurations. Many of these activities took place centrally to support discussions between HAL and the control team, and occasionally to help HAL and the CBIs to negotiate reserve levels:

“So, quantitative cost risk analysis.... We had a P 50 risk level at £32 million, for example, and we were holding £30m. So, actually we could use that because we are not holding too much risk centrally and so let’s look at what’s been happening with our drawdown on this going forwards as well. So, let’s bank that to defend our position.” (T2 Controller, 2015)

This quote describes how the P50 would result in a £32m variation in baseline cost. However, possible reserves for £30m had already been notionally set aside leaving only a £2m exposure. The QCRA analysis legitimised the £30m risk drawdown, building confidence that it could be “banked” and placed within the central programme-level reserve. This quote demonstrates the linkage between risk exposure, the creation of provisions and contingent drawdowns. This link

provided a basis to plan mitigating actions such as floats and shock absorbers to minimise the financial impact of uncertainty.

The robustness of risk forecasting and modelling technologies depended on how risks were defined, perceived and communicated. Although benchmarking and risk modelling could test the underlying principles and variability of assumptions, ultimately a robust definition of scope was essential to create a realistic plan:

“Let’s look at how well you have defined scope, because if you can’t don’t define your scope - I can’t give you a good cost plan and I can’t give you a good schedule and I certainly can’t manage your risks; because all of those things all stem from here. And if that’s flawed - then we don’t move on in a very constructive way.” (Programme Controls, 2015)

Risk identification, evaluation and plans to mitigate uncertainties were driven by a scheduling “logic” and specific phasing, durations and interdependencies. Uncertainties became quantified and recognised when events fell outside the parameters of the scope. However, scope assumptions and the phasing of the schedule came from the 2nd tier plans. Aspirations of intelligent foresight from sophisticated risk modelling required some forecasting capability. Temporal risks could easily arise out of oversimplified phasing and timing assumptions. The calculative infrastructure emphasised disciplinary control, scrutinising the integrity of the data, and holding suppliers to account against closely defined responsibilities. However, providing an accurate forecast also required a form of moral constraint (Power, 2007) whereby 2nd tier suppliers were willing to openly share accurate forecasting data. Although the client and CBI shared accountability for delivering outcomes, there was little incentive for the wider supply network to proactively manage the schedule or flag opportunities for change.

6.4 Building a Sense of Common Purpose?

Safety and incentives were two key areas developed to enrol suppliers into agreeing evaluative priorities. These areas were linked because a large part of the “discretionary” award fee was used to incentivise safety innovations. A sophisticated reward structure was developed to incentivise acceptable forms of conduct.

6.4.1 Rewards and the “Right” Kind of Bribe

The award fee structure was described as the “right” kind of bribe (Morgan, 2009, p1) because it was designed to shape the CBIs’ attention towards an order of priorities co-defined with the client. The use of award fees was viewed as a way of shaping standards of conduct by rewarding conformance to predetermined targets.

The incentive structures were divided into 3 parts:

- Temporal milestone incentives linked to the programme schedule
- KPI-based award
- A discretionary “award” fee to be negotiated.

For the discretionary award, self-assessment was a key part of the negotiation and deliberation process to agree an order of priorities. Evaluation and the final judgement of performance sat with HAL and in some cases award fees were held back. Incentives were used as “carrots and sticks” for disciplinary control “over” the CBIs:

“More effective carrots and sticks need to be used. Contractors should not just be wagering their fee, they need to feel some real pain if they lose control over cost” (Morgan, 2009, p2)

The three different categories of incentives are detailed below:

Milestones	Incentives for the achievement of key milestone dates
KPI Awards	Performance Tracking based on indicators for: <ol style="list-style-type: none"> 1. Safety, SPI and Quality 2. Commercial Indicators (actual costs vs forecast, reduction in EAC⁷⁹) 3. Change instructions answered within period, time to raise a EWN⁸⁰
Discretionary Award	Negotiated award for the CBI to demonstrate exceptional performance in various agreed priority areas

Table 6.1 Categories of Incentives on T2

Milestone incentives created temporal targets to bring together organisational plans and interests into a narrowly defined set of deliverables. These incentives focused on outcomes associated with key completion dates within the schedule. Monitoring progress towards these lead indicators created a tangible incentive for reliability in meeting deadlines. Key Performance Indicator (KPI) awards monitored specific targets for Quality, Safety, SPI performance and commercial delivery. KPI success was defined by precise standards, such as the number of injury free hours for safety. The mix and relative standards evaluated through these indicators were periodically reviewed. The “commercial indicators” rewarded predictability in forecasting by closely monitoring cost savings whilst tracking the reduction in the estimate at completion (EAC)

⁷⁹ EAC is “estimate at completion”

⁸⁰ EWN is a “early warning notice” to highlight potential delays in the schedule that may become risks

over time. Potential trade-offs between cost cutting and retaining scope commitments were balanced by tracking change requests drivers and the speed of resolution in authorising change to the committed baseline plans.

Discretionary rewards were intended to shape the “right” behaviour towards Heathrow’s espoused core values of integrity, respect, listening, passion, honesty, discipline and collaboration. A new basis for the discretionary fee was agreed every 6 months to reflected the programme’s appetite for control and preferred strategic imperatives. To achieve the discretionary award fee the contractor presented evidence to the “Fee Determining Officer” to justify how performance demonstrated the criteria for assessment. A self-assessment ranking drove a verification process where the intentionally subjective measures forced a fuller dialogue to negotiate and defend discretionary claims. The nature of discretionary measures and assessment criteria was adapted as the programme progressed. This enabled incentives to shape attention towards different evaluative priorities and “drive different behaviours”.

The incentive structures were designed to shape attention towards a quantified conception of success. Milestone incentives were designed to focus attention on significant strategic points within the delivery cycle to sustain progress. KPI rewards shaped parameters of choice by articulating acceptable standards in safety, quality and progress in completion. The discretionary fee was designed to enrol agreement towards a shared conception of success which evolved to match the needs of the programme. However, over time a large part of the discretionary fee was awarded for safety initiatives, safety innovations and examples of collaboration linked to safety excellence. This reflected the strategic importance placed on safety.

6.4.2 Safety as a Common Core

For much of the programme, safety excellence was the one key areas of common purpose. The importance of safety as a priority in construction is a common feature of large programmes. However, on T2 safety performance was considered “world-class” with an exceptional 5.5 million RIDDOR hours ⁸¹reported. Awards for safety innovations were intended to encourage the CBI and suppliers to invest in a safety infrastructure. Several initiatives were developed to communicate the importance of safety with posters, storyboards, meetings and slogans “safe

⁸¹ RIDDOR hours are hours free of “Reported Injuries Diseases and Dangerous Occurrences Regulations” (HSE 2015)

and proud". The sharing of safety ideas was encouraged and site meetings routinely started with a "safety moment" where suppliers shared learning and best practice with others.

"The contractors were incentivised to continually innovate in safety. Heathrow drove an agenda from the leadership down through leadership tours, lots of visibility out-on-site, lots of behavioural safety training with the workforce." (Controller, 2015)

An extensive reporting architecture was developed to monitor and reward awareness of safety and the mitigation of hazardous risks. The monthly performance reviews summarised trends in reportable incidents and time losing events. Oversight reporting was linked to more detailed analysis, which emphasised the need for sustained and continued improvement. Supplier league tables ranked performance whereby initiatives rated as "excellent" were rewarded through the discretionary award fees. Reinforcing the achievement of exceptional safety performance was a priority:

"You can have a good safety culture and you generally get a good quality project. You know when you're on a site and it's nice and clean and tidy and everything's orderly? You generally get good safety performance as a consequence of that and you also get a great quality outcome as well. It's got to be one of the key focuses." (Controller, 2015)

Quality and safety were considered complementary principles focused on mitigating the risk of sub-standard practices and lateness by managing-out accidents and the need for rework. Wide participation in safety initiatives helped mobilise agreement and commitment across the programme. Safety provided a point of common purpose where sharing overlapping knowledge helped draw together competing interests in an agreed form of common evaluative purpose (Dougherty, 2016, Stark, 2009).

6.4.3 Synthesis

The commercial and evaluative principles described so far emphasised clear territories of accountability. Incentives, risk exposure modelling and safety initiatives were designed to regulate performance towards acceptable standards of conduct. Emphasis was placed on audit and precision in delivering clearly defined responsibilities. The commercial team provided oversight by balancing commercial trade-offs with "intelligent conscience", and incentive structures to encourage cost containment. Although sophisticated risk management techniques were developed to test the integrity of the data within the schedules, this data came from the 2nd tier. Various incentives were developed to encourage the "right" behaviours, however, few included the 2nd tier. Instead performance management took place through a structured

schedule of cyclical performance reviews whereby reports acted as key calculative technologies to shape performance dialogues. These technologies evolved over time and their composition was modified to address new evaluative priorities that changed as performance issues emerged over the programme;

“In effect, they (the reports) tell their own story. They go from quite broad brush; lots of project control type numbers and metrics into very visual towards the end; floor plates, a patchwork quilt. But there isn’t one that works throughout the whole life of the project and we certainly found that. We certainly found that we had to evolve.” (T2 Controller, 2014)

The evolution of reports reflected progression within the programme. Priorities moved from initially testing the data at a broad programme-wide level to the tactical resolution of specific issues located on “zonal maps” within precise time frames on the critical path. This architecture of reports was studied over the lifecycle of the programme. The next section discusses the main technologies and spaces that steered the programme towards completion and the nature of progression between the control phases as tensions challenged the existing evaluative order.

6.5 Phases of Control

Throughout the programme the Integrated Baseline Reviews (IBRs) played a fundamental role in providing space for critical review and an evaluation of baseline commitments. The IBRs became the primary forum to sanction programme level change once an assessment of possible threats and alternative pathways had been considered. However, the nature of the focus evolved as the programme progressed.

“If I talk about the first IBRs, we just talked about very, very high level of scope and numbers, “Have we got the right sort of budgets?” The next IBR, we all talked to our individual scope, to try and identify whether we had any scope gaps. By the following one, we were talking to control accounts. So, we were in a very formalised work breakdown structure and we had individuals owning each of those elements of the work breakdown structure”

(T2 Controller, 2014)

The early IBRs focused on establishing a robust programme-level baseline forecast. Initially in 2009, IBRs were concerned with building a realistic schedule by testing for gaps in the scope whilst identifying weaknesses and possible hot-spots. By the winter of 2010 the IBR 7 focused on checking the integrity of the schedule and running risk models to test the effect of alternative plans on the delivery of milestone targets. By the spring of 2012 a thorough review of cost and

schedule plans redefined key project interfaces with a new set of milestones, risk allowances and mitigation strategies. This led to revised baselines for both HETCo and Siemens. The following IBR 9 was more delivery focused with intense debates about how to achieve the new delivery targets. The IBRs created a calculable space for strategic oversight where issues that emerged in the CBIs performance reviews became visible. However, resolution required an environment and calculative infrastructure that encouraged suppliers to pass news up through the project organisation. The following sections consider the evolution and emergence of this infrastructure.

6.5.1 Single Version of the Truth (2010-2011)

The development of a single and robust baseline was important to sustain a belief in the data as “kingpin” to be used with authority to sanction and evaluate progress and success. In this initial phase integrity tests focused on building confidence in the assumptions underpinning the baseline to assure a “single version of the truth”. Unfortunately, the gain-pain sharing agreement created an incentive for the CBIs to inflate the initial baseline forecasts. To add to this tension the traditional way the 2nd tier was procured⁸² created a tendency towards lock-in and resistance to changes to the initial baseline. To counter this, initial plans were scrutinised and tested. Although risk modelling helped to test the baseline integrity, a performance dialogue was also necessary and a structured reporting framework was developed.

6.5.1.1 Monthly Performance Reports (MPR)

The MPR provided a structured space to test, interrogate and get under the “skin of the data” and agree next steps. Gradually reports were modified and refined;

“for a while we were very data intensive with lots of different bits of information at different points in the month and we needed to say stop. You will get it once a month and it will be one version of the truth. Once we did that, it was fine. We could then actually start looking forward rather than constantly facing this challenge of checking the data integrity” (Controller, 2015)

In early 2010, an initial period of testing and contesting was necessary to build confidence in the control data. Once this period of client scrutiny stabilised, a standardised report was developed. Monthly rituals evolved over time to interrogate and develop a consistent “single” version of the truth. Being held to account by the data involved an intense and formal discussion focused on progress. The HAL Delivery Directors were expected to demonstrate the capability to answer

⁸² In many cases through fixed price arrangements

in-depth questions and respond with coherent and acceptable explanations. The development of the MPR reports enabled a more sophisticated discussion amongst the client teams focused on safety and quality standards, progress and potential risks exposure. The report contents are described below in table 6.2.

Sections	Contents	Comments
Overview section	<p>Health and Safety – monthly reportable and lost time injuries trends</p> <p>Cost Performance index (CPI) and Schedule Performance Index (SPI), Milestone target vs forecast date</p> <p>CPI and SPI targets vs actuals, % achieved in quality KPIs, Trends in Estimate at completion and the original “budget” at completion per month</p>	<p>Monitoring of conformance to standards, possible risks and hazards.</p> <p>CPI/SPI indicated the direction and size of progress in productivity and the need for recovery strategies.</p> <p>Focus on KPI exceptions for investigation that could affect the cost at completion and schedule progress.</p>
Risk, Opportunities and Earned Value	<p>Charts with trends: Waterfall by month forecast and actuals, opportunity versus risk values</p> <p>CPI, SPI data by control account per month and on a cumulative basis</p>	<p>Reserve management analysis focused on oversight planning and the creation of opportunities to mitigate risk reserves.</p> <p>CPI/SPI trends by control account gave an indication of persistent lateness and possible overruns</p>
Schedule and Logistics Overview	Delivery forecasts and manpower trends, tables of milestone dates	Progress in productivity was tracked to highlight possible obstacles and delays requiring resolution.
Quality statistics	<p>Overdue items, number of compliant items, requests for resolution. Inspection and testing plans samples, non-conformance issues to resolve</p> <p>Table of significant quality issues, impact, progress and accountable person and close out date</p>	Conformance to standards gave an indicator of waste, rework and cost inefficiencies. Logging issues created visibility of shortfalls and ownership for non-compliance.

Table 6.2 Monthly Management Report on T2

The report opened with an overview of safety measures tracking performance compared to standards and targets. Safety was a key part of driving schedule and cost improvements by mitigating hazards, delays and potential claims. The safety section of the monthly report detailed key leadership activities and the metrics to track performance improvements. The monthly review provided a forum to showcase safety successes which tied closely to KPI and discretionary award fees offered to the CBI. The remainder of the report’s first section provided an overview of KPIs and critical concerns. Earned value analysis compared monthly and

cumulative SPI ⁸³(schedule performance index) and CPI (cost performance index) trends to identify productivity issues or cost over-runs. This enabled a discussion of cost recovery plans and possible delays and weaknesses in the schedule. This analysis could be linked to the latest forecast estimate at completion (EAC) and the original full year budget to demonstrate the combined financial effect of cost and schedule performance across the life of the programme. Quantitative schedule risk analysis supplemented this analysis by modelling a range of completion dates which indicated the likelihood and impact of delays on expected milestones. This enabled discussion to focus on mitigation strategies to avoid missing milestone targets.

The second section integrated concepts of risk and opportunity management with the management of earned value. Combining risk analysis with the CPI/SPI created more precision in reserve management decisions, linking potential areas of underperformance with opportunities or efficiencies needed to mitigate shortfalls. The first chart tracked the overall value of known risks offset against opportunities for cost savings to show the net cumulative risk balance. The following chart displayed the anticipated cumulative “risk” balance over the programme life described as the “waterfall”. This could drive a discussion about persistent poor performance in the CPI and strategies to generate savings to mitigate cost overruns. It could also be used to reveal continually strong CPI performance (>1) where cost efficiencies could be reinvested to mitigate known future areas of weakness or risk “hot spots”. The integration of these concepts helped connect past performance to future forecasts with a precision that could enable more focused risk decisions.

The last two sections of the report contained high-level analyses of schedule and quality metrics. The schedule section focused on tracking productivity, comparing trends in the delivery of “trigger” milestone dates, manpower rates and materials delivery data. Quality statistics focused on non-conformance to highlight areas of concern that could hinder progress because of the need for rework. This section focused on conformance and deviations from schedule which reflected the client’s oversight role and concern with removing delays and clearing “away obstacles” rather than proactively⁸⁴ managing suppliers.

The MPR enabled the client to take an integrated approach to the strategic management of value. Risk management technologies were combined with earned value analysis to drive decisions about pooling gains and using funds to mitigate future risks. This systematic analysis

⁸³ If the SPI < 1 this indicated that work was taking longer than planned in the schedule. If the CPI < 1 then actual costs were higher than budgeted for the work performed.

⁸⁴ Instead the CBI was responsible for the management of suppliers

supported oversight decisions and the central management of risk provisions. However, this dialogue took place at a client “programme-level” rather than engaging directly with suppliers. For suppliers, priorities focused on tracking SPI and CPI progress compared to the baseline whilst maintaining a robust record for safety excellence. Much of the performance management dialogue between the CBI and 2nd tier focused on managing the schedule to date and defending poor performance in any given month. However, as productivity started to persistently fall behind a new form of reporting was needed.

6.5.2 The Dashboard (2012)

By 2012 estimated delivery dates began to slip reflecting poor levels of productivity from the HETCo supply chain. A new one page “dashboard” was developed for the HAL leadership team to direct attention to mitigate further risks. The dashboard was used as a powerful visualisation to mediate a focused discussion. Its design is discussed in Quattrone’s 2017 paper “Embracing ambiguity in management controls and decision-making processes: On how to design data visualisations to prompt wise judgement”. This paper highlights how the T2A dashboard created a visual space for inquiry within a complex and ambiguous setting. The emphasis of the paper is on rhetoric and design whereby the dashboard acted as a visual space to balance judgement. Quattrone also describes how the dashboard played a generative role in settling trade-offs and tensions whilst inspiring creative inquiry.⁸⁵ This paper focuses on the visual semiotics of the dashboard. However, this thesis is more concerned with the evaluative principles and situated context which shaped the dashboard’s use. At this point in the programme the appetite for risk reflected a concern for productivity and the possibility of delays. There was significant pressure to improve productivity and this was reflected in the performance dialogue. The dashboard was developed to agree a strategic focus and steer the programme towards a recovery plan. There was a concern that the client delivery teams were working with excessive amounts of data and a more precise “message” was needed:

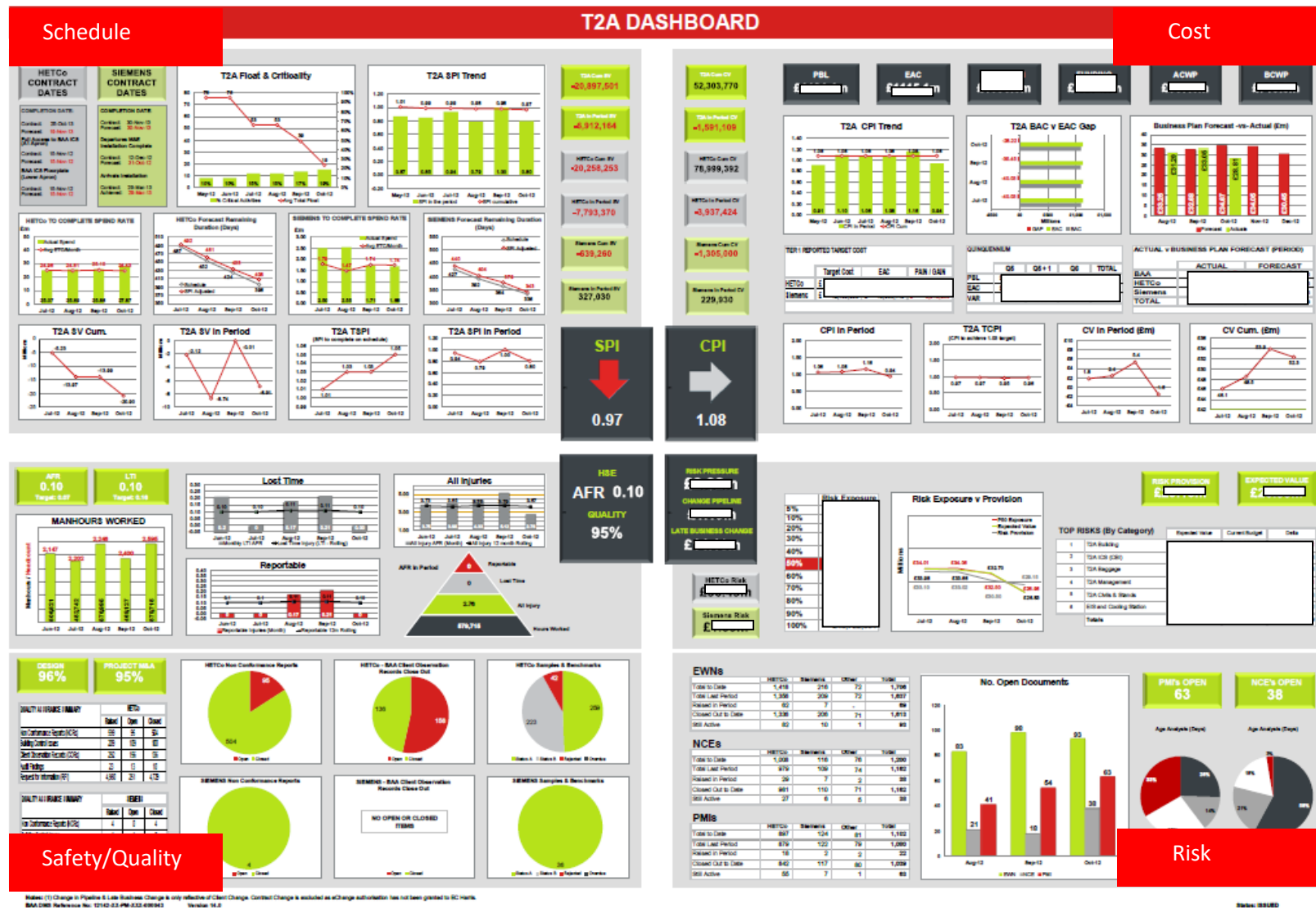
“you can do a lot of things but just choose 3 things that are going to make the biggest impact, because if you make a big impact you tend to find the other things will follow through; but if you’re trying to move the amplifier on all of them, a bit actually, you might find you’re not getting any sort of tackiness around them” (Programme Controls, 2015)

⁸⁵ The dashboard was associated with enabling and balancing “in-tensions”, “in-difference” and “in-divisions”

The dashboard was used as a diagnostic tool to enable the leadership team to focus on balanced solutions and “big impact” decisions. Although retaining the safety record remained a priority, a recovery plan was also needed. The dashboard organised the key evaluative principles into a structured framework as a “one-pager” enabling concurrent visibility (Chenhall et al, 2013) of strategic priorities. The choice of measures represented HAL’s higher order principles by closely monitoring injuries and accidents and conformance to quality standards whilst delivering to the cost and schedule targets.

“So, this dashboard was all around how do we get the pull? Where do we get the focus? And where do we focus the effort to get some more driver around all that?” (Controller, 2015)

The dashboard provided a space to agree “where do we focus the effort?”. The central quadrants described the outcome of year to date performance with the SPI and CPI measures displayed alongside accident frequency and quality data. Key risk measures were included with a focus on the current level of risk “pressure” which demonstrated how far existing provisions covered the expected value of risk. The “pull” came from interrogating the schedule data to highlight weaknesses and hotspots whilst developing strategies to mitigate performance shortfalls. The “focus” involved retaining high standards of safety and quality whilst managing the risk exposure implied by the estimate at completion. The dashboard is shown on the next page and on page 141 a framework is developed to explain the evaluative principles that underpinned its situated use.



Risk

Risk Exposure

Risk Exposure v Provision

TOP RISKS (By Category)

Category	Reported Value	Current Budget	Delta
1. T2A Building	100	100	0
2. T2A CDR (CNR)	100	100	0
3. T2A Bridge	100	100	0
4. T2A Management	100	100	0
5. T2A CDR & Bridge	100	100	0
6. T2A CDR & Bridge	100	100	0

No. Open Documents

PM's OPEN

63

NCE's OPEN

38

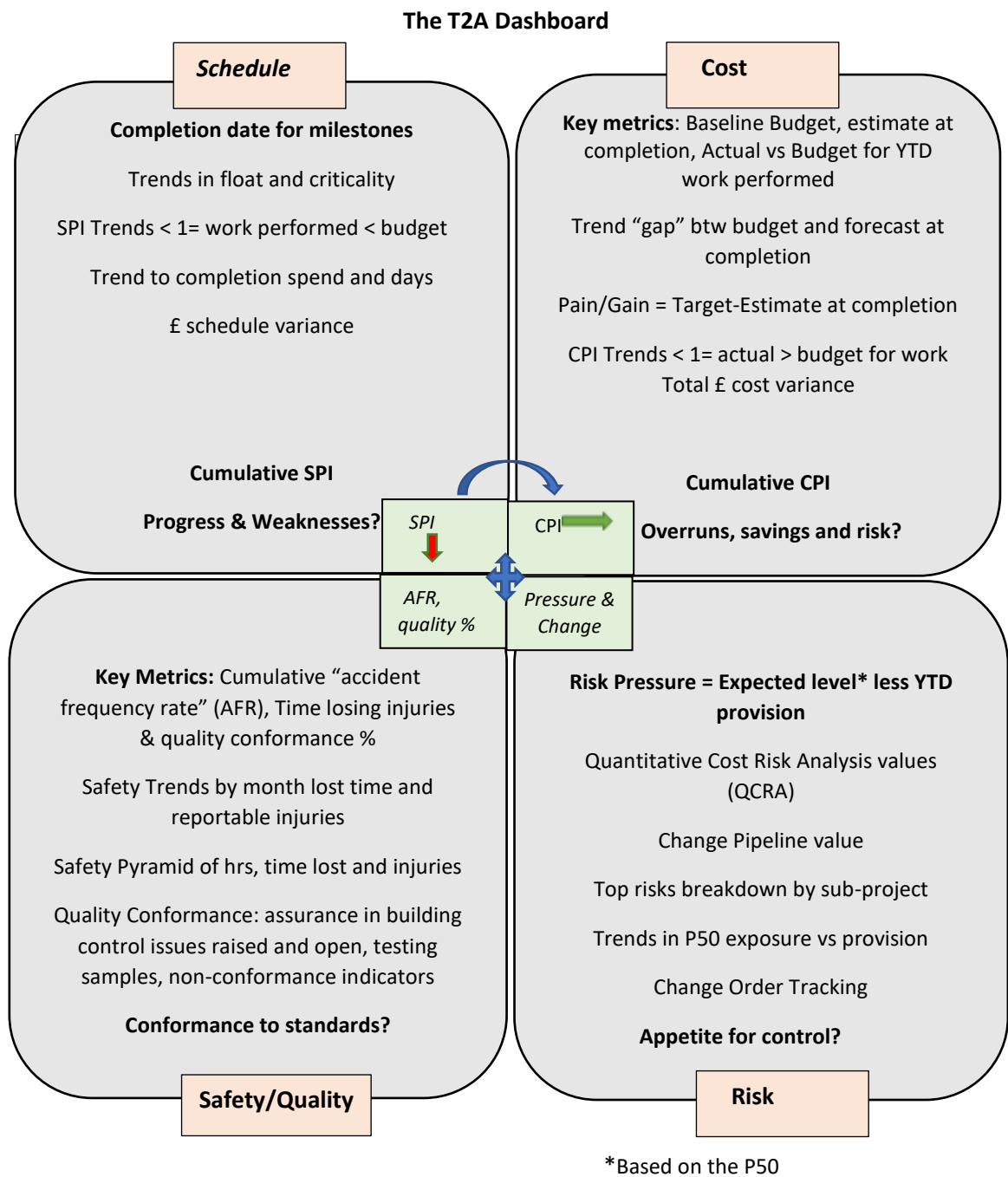
PM's OPEN

NCE's OPEN

Figure 6.2 The T2A Dashboard

Source: Adapted from Quattrone 2017, p599

The Principles of the Dashboard are summarised below in **Figure 6.3:**



The diagram above describes the key evaluative principles used to shape discussion and agreement. The key safety/quality, cumulative (year to date) CPI and SPI metrics could be traced back into the framework of metrics replicated in the CBI monthly reports. This consistency enabled a drill down discussion to guide performance issues across the rest of the programme.

6.5.2.1 Quality and Safety

Compliance checking and performance monitoring played a key role in sustaining low accident frequency rates and acceptable quality outcomes. The safety quadrant focused on monitoring hazards and accidents to highlight trends based on the man hour activity in the month. Monitoring quality and assurance activities indicated conformance to acceptable standards whilst detailing potential weaknesses that could cause delays and waste.

6.5.2.2 Schedule

The “pull” in the programme came from the schedule and this quadrant focused on productivity trends captured within SPI indicators. Trending data highlighted dips in performance and exceptions in any month. The “schedule variance” compared the difference between work performed and budgeted work valued at the budgeted cost. The variance was then broken down between HETCo and Siemens to assign accountability for performance shortfalls. To link schedule performance to possible future delays the report analysed “criticality” and “float” trends. The monthly critical % measured the % of activities on the critical path in any month. This indicated weaknesses which could delay the critical path. The “float” chart reported the time set aside to offset poor schedule performance. Combining float and criticality concepts together enabled a discussion about the need to engineer buffers to offset possible future risks.

6.5.2.3 Cost

The discussion focused on CPI trends and the effect that performance to date could have on the latest estimate at completion. Key metrics included the total “baseline” and the latest estimate at completion. The pain/gain calculation demonstrated the difference between the baseline “target” and the latest estimate at completion broken down between Siemens and HETCo. This analysis refocused discussion on the overall degree of control to date and the effect this might have on the baseline commitments. The total year to date “cost variance” was derived by comparing the “actual cost of work performed” and the budget for this work. Graphs of monthly CPI trends described progress, dips and persistent overruns over time. This analysis could guide a discussion of recovery strategies to mitigate persistent overruns or strategies to reuse year to date savings.

6.5.2.4 Risk

Sophisticated risk modelling enabled an integrated discussion about risks pressure influencing the delivery of milestones and possible 'hot spots' and weaknesses requiring mitigating action. The "risk" quadrant described the programme level exposure and expected estimates at completion based on the P50. Factors that could influence greater uncertainty and variability in expected costs to completion were modelled in the quantitative cost risk analysis. The monthly risk "pressure" value compared the difference between the risk provision and expected levels of exposure based on the P50. Greater exposure in the month created financial pressure that might require mitigation planning and additional provisions. A "top ten risk" breakdown focused discussion on specific issues, causes and strategies to manage risks whilst considering the expected and budgeted levels of risk money set aside. The final part of the risk discussion focused on specific pressures for change and change requests in the pipeline which could progress from early warnings to full entries within the risk register requiring more risk budget.

The dashboard was intended to shape messages to take back to the CBI, thereby prompting a confident dialogue across the programme. As a diagnostic tool, it enabled an integrated discussion about the need to balance financial risks with operational outcomes and progress. Throughout 2012 much of the client-level debate focused on the need to drive up productivity and capture risks early enough to develop mitigation strategies. As the programme progressed, reserves were drawn down to absorb the effect of unanticipated delays and change variations. For the supply chain, priorities remained focused on delivering to the baseline schedule. Although earned value data was collected and measured monthly, it was generally used as proof of performance gains or shortfalls followed by detailed discussion of activities within the schedule. By March 2012 IBR 8 involved a full reassessment of "cost pressures" resulting in a reassignment of baseline targets. However, by the summer of 2012 there remained significant shortfalls in the delivery of critical activities. IBR 9 took place in the winter of 2012, marking the end of this period with a plan for rapid recovery called the "Programme for Success".

The dashboard and the MPR were key calculative technologies to mobilise an intelligent dialogue at the client level. Sophisticated risk methodologies helped drive a broader debate to explore, test and anticipate the effects of performance on delivery. However, at this point in the programme milestone dates had been pushed out from November 2013 to the following February. A new suite of calculative technologies was developed to rapidly recover the programme and engage with the 2nd tier.

Then the dashboard became redundant:

“So, it had its day, because we were suddenly in a lot more granular world of reporting. This couldn’t survive and it wasn’t adding any value. You don’t do things that are not adding value, there’s no point. But it absolutely added value at the time and shifted the focus from backward-looking to forward-looking.” (Controller, 2015)

6.5.3 Golden Thread (2013-2014)

This period was described as a “step change” on the programme where a “SPRINT” initiative created rapid turnaround plans. Until then there had been limited opportunity to engage directly with the 2nd tier in collective problem solving. The golden thread was described as a “top” to “bottom” control approach that linked the programme to local decision making:

“So, we call it the golden thread, you start right at the baseline and say okay show me. Then down a level, down a level and down a level. The way the control structure works is that you need the same work breakdown structure that goes right down to the first, second, third tier and then builds its way back up. And it rolls up and up and up and right up into the client reporting system. So, you would test it right from the top. Follow it all the way through and almost to the point of; “show me on site?” (Controller, 2014)

Operationalising a “golden thread” required mediating spaces to enrol allied interests. By 2013 milestone incentives were finally shared with the 2nd tier to co-incentivise suppliers to focus on strategic dates. Fortnightly meetings provided a space for collective deliberation where the 2nd tier leads met “on masse” with the CBI and control team to agree accelerated plans. Previously the 2nd tier had focused on schedules using reports such as maps and drop-line lists to talk through detailed plans and blockers preventing progress. There was a need to move from an unfocused list of activities:

“How do you look at a drop-line list and say whether it’s good, bad or indifferent in different geographies of the building.” (Controller, 2015)

With approximately 9000 activities remaining to completion, interpreting the schedule by analysing each item in a “drop-down” list lacked focus. A suite of reports was developed to steer attention towards the critical path. What was “good, bad or indifferent” was defined by considering the impact activities could have on delivering critical activities linked to milestone targets. Over time, a recovery plan emerged through a reflexive process of reporting, evaluative dialogue and agreement of next steps.

6.5.3.1 Driving the Critical Path

Reports were developed to steer the dialogue towards delivering the critical path. Discussion focused on identifying the “biggest bang for your buck” (Controller 2014) critical activities and possible hold-ups and delays around these activities. The fortnightly meetings provided a forum to discuss blockages and potential action to mitigate delays. Top ten critical supplier rankings helped to guide the discussion and assign accountability for performance to specific groups of suppliers. These activities created more visibility of accountability for progress. Critical path analysis was supplemented by earned value metrics to monitor SPI performance that had persistently underperformed. For example, at this stage of the programme there were significant issues linked to the door fit-out. Although a door seems like a simple construction, they involve the integration of a complex network of tasks. Installing a door requires a completed wall, a glass lining and cabling services within the sub-structure of the wall. In the airport doors also need to be safety compliant, fire proofed with security monitoring through CCTV cameras. Various complex issues delayed the completion of doors linked to fire tests, laminate types, positioning of metal strips and manufacturing delays. Eventually these issues combined and escalated to have programme-wide impact. The fortnightly meeting provided a forum to agree the root cause of delays and set mechanisms in place for swifter resolution. They also provided a ritual and timetable of expectations to hold those responsible to account. The “door” SPI was used as a simple oversight measure to monitor and capture improvements. The door example demonstrates how structured reports, metrics and meetings quickly created a space where various perspectives were enrolled in collective problem solving across organisational boundaries.

This final period successfully accelerated the schedule which enabled the programme to be delivered on time. A “golden thread” of targets was developed to drive the critical path and focus attention on managing critical activities, SPI exceptions and milestone outcomes. This refocused supplier interests from individualised schedules to programme-level problems. Calculable spaces such as the fortnightly meetings and progress reports shaped conduct towards a shared conception of how the programme would be delivered on time. However, at the end of the programme, there remained gaps in the completion of the fit-out. The door issue slowly improved as the infrastructure mediated and enrolled key suppliers into shared problem solving. However, even at the handover date, there remained some incompleteness not captured in the reports and a large list of snagging items that reflected coordination issues.

6.6 Enrolment and Controversy

Although the model of governance that evolved on T2 encouraged conformance and predictability amongst suppliers, at the client-level it enabled discovery and learning. Underpinning the design of T2 was an aspiration of developing “foresight” through calculative technologies. Initially enrolment on T2 emphasised clarity in roles and visible authority structures to create bounded territories of accountability. These territories were regulated by expectations of being held to account within the parameters defined in contract. The initial phase focused on regulating conduct by building expectations of audit scrutiny and testing the integrity of performance data. However, although the concept of data as “kingpin” was intended to deter suppliers from hiding intelligence, reporting silos made it difficult to capture local intelligence. In the second phase, the emphasis shifted to developing client capability with sophisticated calculative technologies; and the Dashboard and IBR to shape and direct attention towards strategies to mitigate performance shortfalls. Calculative technologies scrutinised past performance to encourage conformance to specific targets in safety, quality and earned value. Suppliers focused on past performance using the performance data as proof to defend payment claims. By 2012, CBI and 2nd tier enrolment in forward planning was fundamental to prevent over running. By the final phase, a rapid recovery plan was mobilised and Heathrow adapted the controls approach to create more visibility of the critical path.

Calculative technologies played a major role in testing and contesting evaluative principles to create productive compromises within each control phase. However, at the end of each phase controversies destabilised the existing evaluative order and modifications were made to the calculative infrastructure. The table on the next page describes the evolution of the programme and the sequence of generative control phases. The movement through evaluative orders and the settling of controversies by adapting technologies and evaluative principles is examined in the following section.

Dates	Phases of Control	Key Technologies	Enrolment	Controversies
2010-2011	<p><i>“Single version of the truth”</i></p> <p>A regulatory architecture was developed to govern conduct within clearly defined territories. A structured timetable of performance reviews and IBRs became spaces to scrutinise performance and build confidence in the integrity of the baseline data as the single source of the “truth”</p>	<p>1.The IBR provided strategic oversight 2. Monthly reviews interrogated progress in Safety, quality and earned value</p> <p>2. Risk technologies were used to manage provisions and floats but also model and test exposure</p>	<p>1 Contractual clarity to settle concerns about being held to account</p> <p>2. Shared purpose with the CBIs was encouraged by pain/gain-sharing and outcome-based incentives; milestones, KPIs and award fee</p> <p>3. Cyclical timetable of IBRs, MPRs to shape performance expectations.</p>	<p>1.Tendency towards “safe” baseline forecasts</p> <p>2.Lack of opportunity to engage with the wider supply network</p> <p>3.Shared purpose focused on safety/quality and scrutinising past performance rather than building future plans or mitigating risks.</p>
2012	<p><i>“The Dashboard”</i></p> <p>Productivity lags required intense discussion to develop a recovery strategy. The dashboard was developed to generate a focused and integrated value management and risk discussion. The intention was to pass back a consistent and clear message to suppliers to close the performance gap.</p>	<p>1.The dashboard was used to enrol agreement towards a shared order of priorities amongst the client leadership. The composition balanced conformance to standards with risk exposure and value management decisions.</p> <p>2. IBR8 re-baselined the CBIs</p>	<p>1.Monthly reviews used to interrogate and shape a focused leadership message. Leadership competence developed and divergent perspectives balanced into a coherent message.</p> <p>2.CBI enrolment in forward planning remained an issue leading to re-baselining.</p>	<p>1.Focus on conformance, risk exposure and centralised mitigation but persistent shortfalls remained</p> <p>2. Issue of divergent interests. Needed to enrol local intelligence, build common purpose and switch attention away from justifying past performance.</p>
2013-2014	<p><i>“Golden Thread”</i></p> <p>Programme for Success was developed to enrol the 2nd tier into driving the critical path to completion. This intense recovery period finally enrolled the wider supply network into agreeing deliver plans to mitigate shortfalls.</p>	<p>1.Calculable spaces developed to build common “evaluative purpose” through fortnightly meetings, reports and milestone incentives.</p>	<p>1.Milestone incentives refocused 2nd tier on shared goals</p> <p>2. Reforms introduced new order of priorities moving suppliers away from justifying granular plans and defending past performance</p>	<p>The focus switched to delivery. However, programme-wide social integration remained an issue with the door example reflecting a lack of general common purpose.</p>

Table 6.3: Terminal 2 Phases of Control

6.6.1 Phase 1 - Single Version of the Truth (2010-2011)

Initially emphasis was placed on developing a regulatory framework to oversee the relationship with the CBIs. The MPR reports provided a space for oversight and a structured timetable of monthly reviews was established. At the client-level monthly reviews played a central role in testing the integrity of forecasts and developing an expectation of the need to provide accurate projections. Intelligent data became more robust as the client demonstrated an intolerance for overcautious targets. As client teams developed confidence in scrutinising performance data, a more refined version of the truth was captured. For the wider supply network, emphasis was placed on achieving conformance to safety, quality and baseline commitments. Incentives rewarded safety innovations and delivery of the SPI/CPI targets. However, productivity gaps emerged. There was a need to refocus plans to mitigate performance shortfalls whilst balancing the risk profile. Although an architecture to test the integrity of the baseline had been developed, calculative technologies were needed to support the client in understanding the performance dynamics of the programme.

6.6.2 Phase 2 - The Dashboard (2012)

The dashboard was intended to facilitate a focused discussion at the client level leading to a confident tactical dialogue with the supply chain. As a diagnostic technology, the dashboard was used to search for balanced solutions to mitigate risks whilst achieving performance standards. As a visual technology, it provided concurrent visibility of past performance and future projections, highlighting potential exposure to drive agreement about future priorities. The sophistication of the risk analysis enabled a broader discussion of possible risks and opportunities to agree priorities in meeting milestones. The dashboard enabled intense debates providing a strategic space for collective deliberation and learning. However, discussions remained at the client-level with limited opportunity to mobilise local intelligence to agree recovery strategies. As the productivity gap widened, the 2nd tier continued to focus on justifying past performance. By the summer of 2012 a failure to meet the committed handover date seemed likely. In the winter of 2012 IBR 9 signalled a “step change” when the CBI (HETCo) and HAL finally agreed a recovery plan which formed the basis of new delivery plans.

6.6.3 Phase 3 - Golden Thread (2013-14)

In this final stage, calculable spaces emerged to create an infrastructure to enrol the interests of the 2nd tier. After IBR9 the boundaries of accountability were widened to include the 2nd tier in a schedule for rapid recovery. The adaptation of the infrastructure created new performance aspirations for the 2nd tier. This moved the focus towards driving the programme-level critical path. Structured metrics and meetings provided a space to engage allied interests and agree plans. However, the doors issue highlighted gaps in the calculative infrastructure which failed to capture delays before they crystallised, resulting in significant rework. This point is important because it illustrates how the recovery programme achieved some systems integration by allocating rewards and measures towards the critical path. However, this settlement was fragile and fit-out issues distributed across the programme remained hidden. In many ways, this reflected an emphasis on regulating to specific targets rather than developing an ethos of citizenship. However, T2 remains a remarkable example of client learning and although the 2nd tier was procured up front to deliver to fixed commitments, by the end of the programme new accountabilities were agreed and devolved. This demonstrates the fundamental role that the calculative infrastructure can play in enabling adaptability by re-ordering accountabilities even though the initial procurement approach encouraged “lock-in”.

6.7 How did T2 Learn to Govern through Numbers?

The commercial model for T2 was conceived during a period of instability within the construction industry. Wolstenholme’s 2009 report noted that Intelligent Clients remained successful when they worked “with” suppliers to integrate activities based on a shared conception of value whilst establishing “who” is best placed to manage risks (CE, 2009). T2 followed these recommendations by commissioning CBI experts rewarded for performance improvements through a pain-gain risk sharing model. Following the advice from the ICE’s Intelligent Client Capability Framework “visible authority structures” were developed (ICE, 2013) and the client worked to balance and align divergence. However, emergent changes destabilised productivity in the early stages of the programme. Returning to the earlier question raised in chapter 4:

On T2, the intelligent client model organised dissonance by emphasising the importance of the integrity of the “single version” of the data to deter divergence. Although a sophisticated framework of incentives existed between the Client and CBI; the only direct incentives for the 2nd tier encouraged delivering to the initial baseline commitments. This raises important questions about “how” the client could sustain the engagement of suppliers when emergent change

challenged existing plans. There was little incentive for the 2nd tier to share local intelligence of new emergent risks or opportunities. Therefore, how did the calculative infrastructures mediate and sustain control?

Action at a distance and governing through the numbers required a complex and adaptive calculative infrastructure. The phases of control discussion demonstrated the various calculative technologies that mediated progress; the MPR, risk technologies, dashboard, fortnightly meetings and the IBRs. Throughout the programme there remained persistent tensions with the wider supply network focused on conformance to agreed safety standards and baseline commitments, rather than improving value. Enrolment involved an initial period of shaping expectations of being held to account, following by a period of client-level diagnostic discovery and finally devolving accountability to key suppliers. The T2 model reflected a cautious appetite for risk with a preference for client-level learning whilst directing the efforts of the supply network. Initially the client focused on asserting the legitimate authority of the data to deter gaming. The dashboard played a fundamental role in integrating client thinking and this helped to develop more realistic plans agreed in the subsequent IBRs. By the final phase, there was a need for a step change to capture local intelligence, which led to a re-assignment of accountabilities and a period of coaching and engagement with the 2nd tier.

Construction 2025 emphasises the importance of fixing the front-end with a clear articulation of value and risk in procurement. It also highlights the importance of process improvements through the adoption of digital engineering and design innovations to synchronise co-production in delivery. However, there is little discussion about control. The T2 findings describe various innovations that enabled the project to capture emergent opportunities whilst mediating and sustaining progress. The dashboard was a powerful tool to integrate ideas whilst orchestrating discovery between the client leadership group. Risk exposure decisions were carefully integrated with value management plans enabling the client to take a balanced view of progress. The IBR created a space to “forgive” past performance shortfalls whilst still holding the supply network to account to understand the root cause of problems. These innovations demonstrate an important role for calculative technologies in shaping evaluative purpose even when the commercial framework developed in procurement encouraged lock-in. Rather than steering the programme towards predetermined targets, the calculative infrastructure was adapted to sustain enrolment. These points highlight an important role for calculative technologies in sustaining co-production. These themes are examined in more depth in the following discussion chapter.

The existing Heathrow literature suggests that T2 represented a relinquishing of “project management capability” by commissioning the CBI to undertake responsibility for project management. However, the findings in this chapter suggest that although some accountabilities were shared with the CBI, the capability associated with leading service delivery and overseeing the management of the programme remained with Heathrow. The T2 findings describe a very different model of governance to T5, a model that encouraged regulatory oversight whilst accepting the need to re-plan when performance risks began to destabilise the programme. Although this model moved away from collective evaluation with suppliers to a more centralised and directed approach it still enabled client-level learning. The T2 findings are important because this commercial approach reflects the more cautious environment for construction today. They also highlight important advances in the use of control technologies that enabled adaptation. These themes are developed in the following chapters.

In summary, this chapter has described the evolution of a complex calculative infrastructure of risk technologies, a dashboard and the IBRs which enabled the adaptation of the programme in response to emergent risks. Heathrow adapted this infrastructure to settle tensions and gradually the 2nd tier was enrolled into delivering the critical path. However, the T2 findings highlight a very different appetite for regulation in comparison to the T5 lean partnering model. The next chapter compares T2 and T5 to identify differences and similarities in the approaches to control. It also examines the patterns of evolution of the calculative infrastructures and the nature of testing and contesting that enabled progression between phases. This leads to a comparative discussion about the different models of client governance and the way in which they “sustained” progress by governing an appetite for risk.

Chapter 7

Discussion: Making Projects Valuable

7.1 Introduction

This chapter brings together the Heathrow cases and compares the two different approaches to control. The last two empirical chapters described the composition and development of the T2 and T5 calculative infrastructures. This chapter returns to the central theme of governing risk by considering the different patterns of enrolment which shaped an appetite towards “performance improvement” on T5 and “regulation” on T2. Chapter 5 describes a variety of spaces and technologies on T5 developed to overcome resistance to fluid scope by agreeing “how” risk and discovery would be evaluated and rewarded. Chapter 6 describes T2’s regulatory model designed to settle concerns for risk by clearly defining scope and accountabilities “up-front”. However, gradually plans and targets were adapted to recover performance shortfalls. Both cases describe a mediatory role for a variety of calculable spaces and technologies and this chapter examines in more depth “how” these infrastructures sustained control.

7.2 Reform in Governing risk: Integration “through” evaluation

The ICE 2013 Capability Framework describes an important capability for Intelligent Clients in bridging, aligning and integrating divergent perspectives in order to capture value. Integration is a major theme within the control debate because of the complexity of organising diverse experts, organisations and tasks in a way that creates value by generating knowledge “synergies” (Scranton, 2015; Söderlund, 2012; Brady and Davies, 2011; CS2025). Although dissonant perspectives and interests can create an unstable setting for major programmes, multiple perspectives can be important to resolve perplexing problems and shed light on valuable new and novel solutions (Stark 2009; Antal et al 2015; Kornberger et al 2015). However, organising these perspective in a way that settles tensions and captures synergies from “productive friction” (ibid) involves mediatory technologies. The ICE Capability Framework links governing and integration to the use of incentives to “integrate” objectives and encourage conduct towards open ness and integrity. However, there is little discussion about “how”. The Heathrow cases address these concepts by describing the composition of a variety of different incentives designed to build a shared sense of evaluative purpose. However, both cases also highlight how incentives were a part of a larger calculative infrastructure which was modified to settle tensions. This chapter returns to examine the evolution of this infrastructure.

So far, the Heathrow cases have described two contrasting models of governance. T2's virtual "intelligent" control approach reflects a more common industry model of arms-length control with emphasis placed on the "integrity" of the data. An infrastructure of monthly reviews, dashboards and IBRs played a mediatory role that gradually connected people and performance aspirations. The client acted as an overseer to sanction and regulate attention towards specific standards and targets. In contrast, on T5 plans and incentives mediated collective learning between teams and the client. Collective evaluation within spaces such as the monthly reviews, IBRs and TCM forums gradually transformed the traditional aversion to scope change. Both cases describe the central importance of control through a calculative infrastructure as a way on enabling emergent and reflexive forms of learning. Both cases also describe the destabilising nature of dissonant plural tensions associated with the social integration of evaluative purpose. Social integration was observed as an outcome of evaluation where interests were steered towards a common sense of evaluative purpose. The next section returns to the concept of calculable spaces to consider in more depth "how" evaluation led to sustained control.

7.3 Calculable Spaces

Miller and Power's 2013 work describes how social control occurs within calculable spaces where accountability is assigned (territorialized) and individuals are subjectivized as they accept responsibilities and respond to performance judgements. In this context, calculative technologies play a key role in holding individuals to account by comparing performance against acceptable standards and targets. On T5, calculable spaces included monthly performance reviews, the IBR and the TCM forums. On T2, the dashboard, IBRs and the Programme for Success represented significant spaces. Although similar technologies were adopted in both programmes, how they shaped and governed conduct fundamentally differed. This is because calculative technologies played a mediatory role that went beyond measuring performance outcomes. Instead, on both programmes technologies enrolled collective action by steering plans through standards and targets and shaping action towards envisioned outcomes (Miller and O'Leary, 2007; Miller and Power, 2013; Boltanski and Thevenot, 2006; Lamont, 2012).

The envisioned evaluative order underpinning these outcomes reflected a fundamentally different appetite for risk in terms of a spirit of enterprise (Power, 2007) in comparison to a more cautious regulatory approach. On T5, territories of accountability remained fluid as the scope underpinning work packages changed to capture design and performance improvements. Calculative technologies enrolled collective action to resolve perplexing problems where subjectivizing encouraged proactive risk management. In contrast, on T2 subjectivization

involved building the legitimacy of “client intelligence” with greater emphasis on being held to account against forecasts and an expectation of scrutiny. Bounded territories reflected a belief in the importance of clear lines of accountability to settle tensions associated with uncertainty. The calculable spaces on T2 reflected an appetite for learning and discovery by the client. However, on both programmes this appetite was not static. Instead it evolved to reflect a changing order of priorities over the delivery cycle whereby testing and contesting resulted in modification.

Miller and Power’s 2013 work described a process of making agents “governable” which emerges through a recursive territorializing of calculable spaces. In these spaces calculative technologies enrol and adjudicate progress to shape the conduct of institutional subjects. Over the last few chapters the process of enrolment was studied by tracing the changing composition of practices, technologies and evaluative principles. Sustained control involved “fabrication” (Preston et al, 1992; Chua, 1995; Latour, 1986) where tensions were settled, and new evaluative principles were captured within the calculative infrastructure to enable progress. The patterns of fabrication differed across both programmes in terms of “who” was engaged in enrolment and “how” allied interests were settled. This is examined below.

7.3.1 Different Patterns of Fabrication

Fabrication represents the end of the process of enrolment into a final settled state when a translation moves from one phase to another. The study of patterns of fabrication and “fixing” of meaning can help reveal the solutions that enabled progress but also the nature of tensions that become visible during controversy and the process of settlement. On T2 and T5 different patterns of fabrication were observed in terms of “who” was involved but also the nature of problematisation and the way in which allied interests (interessement) were settled. On T5, the lean partnering philosophy encouraged collective learning. Interessement was shaped by a code of conduct designed to integrate interests and values. Enrolment was sustained over time through calculable spaces that enabled collective deliberation; the monthly forums, the IBRs and the later TCM programme. In contrast, on T2 in the initial orchestration of the programme, work packages were assigned to individual suppliers creating clear lines of accountability. Problematisation involved client-level critical inquiry through monthly reviews with little collective deliberation with the wider supply network. Instead progression was sustained by settling tensions and directing attention after dashboard discussions or during the 6 monthly IBRs.

These different patterns reflected a different appetite for risk and tolerance for divergent perspectives. The literature on innovation and dissonance has emphasised the importance of organising friction in a way that sustains “creative” tensions. This involves organising collective evaluation in a “principled way” which broadens the search space whilst balancing contending perspectives (Stark, 2009; Kornberger et al, 2015; Antal et al, 2015). This organising can enable deep learning and innovation by capturing “novel forms of worth” by recombining diverse perspectives in co-creation (ibid). This can lead to moments of inspiration described as a “collective ah ha” whereby new solutions and perspectives can shed new light on perplexing situations (Dewey 1910; Antal et al 2015). On both programmes, Heathrow recognised the persistence of behavioural risks and the need to modify and adapt technologies to prevent tensions from destroying progress and value. However, the appetite for acceptable levels of deviation from existing plans differed with T5 accepting the need for emergent scope and discovery whilst T2 reflected a more regulated model.

Different patterns of fabrication were observed on the programmes and this reflected different approaches to collective learning when resolving controversies. On T5, collective evaluation was fundamental to resolving perplexing problems. However, on T2 until the final phase of control, the client’s role emphasised regulation and settling tensions by ratifying acceptable solutions. Across both programmes the appetite for risk evolved. The previous chapters describe a general pattern of development from an initial “set-up” period to a period of developmental learning followed by an intense delivery phase. The next section returns to the T5 case and then back to the T2 case to examine in more depth the generative movement between control phases that enabled progression. This is intended to consolidate the phases of control into a holistic picture of the actual progression.

7.4 Terminal 5 - Doing Risk Differently

Chapter 5 detailed the gradual development of a lean partnering philosophy intended to encourage collective discovery. A code of conduct was ascribed through the T5 Agreement which laid out how multi-disciplinary teams would partner and manage risks. The performance improvement model was underpinned by STORM principles with the expectation that teams would be proactive in managing-out risks before they crystallised. Greater openness between the integrated teams was encouraged by offering “fair and proper” rewards (Handbook 1998). Within each control phase a “dominant theme” emerged which represented the focus of the evaluative order. In phase 1 the control methodology underpinning “doing risk differently” depended on a willingness to accept fluid scope. This required a belief that the pooling of

knowledge for performance improvement would result in superior performance and that a collective search for better ways of delivering the programme would be recognised and rewarded. Although the “client holds the risk” concept was a central feature to settle uncertainties, a calculative infrastructure was needed to encourage acceptance of a search for performance improvement. The table below summarises the problematisation themes within each control phase, problematisation debates and underlying tensions.

Phases (P1-3) with themes	Problematisation	Tensions
P1: Client holds the risk Handbook ascribed codes of conduct & lean principles to encourage knowledge sharing but in-scope reimbursement created inertia and aversion to scope change	1. Who would be held to account for changing scope and how would they be evaluated?	1. Trade-offs between encouraging a search for improvement & “lock-in”
P2: One version of the truth Monthly rituals and reports improved diagnostic capabilities in a reflexive process of collective learning. However, standards and targets rewarded predictability	2. How do you capture a realistic version of the truth?	2. Trade-offs between realistic and safe forecasts. How do you encourage sharing inconvenient truths?
P2: Foresight IBR1 provided the space for critical oversight. TCM provided forums for participation to reassign accountability for risk. How is control sustained?	3. How do you match risks with the capabilities of teams?	3. Balancing oversight with foresight through risk citizenship

Table 7.1: Summarising Problematisation Themes for T5

In phase 1 “fluid” scope created intense debates about who would be held to account for risks. Over phase 2 concerns were settled as diagnostic capabilities were developed. By phase 3 the TCM created forums to enrol the supply network into developing recovery plans. Over time the management of risks was devolved to the teams through new accountabilities and stretch targets. Devolution reflected an acceptance of lean principles, and an acceptance that the continual search for improvement for the benefit of the programme was a collective responsibility. This fundamentally challenged traditional self-seeking opportunism. However, to understand “how” this gradual transformation emerged we need to consider in more depth how conduct was governed across the control phases.

7.4.1 How did the T5 Calculative Infrastructure Mediate Control?

7.4.1.1 From Ambiguity to Order: Phase 1 to phase 2

The lean philosophy required acceptance of fluid scope. However, guaranteed reimbursement created a strong incentive to lock into initial plans. This created tension and ambiguity in how deviations from plan would be judged and who would be held to account for changing scope. Monthly reporting rituals provided a space to enrol teams into developing more realistic forecasts. Teams were given the freedom to operationalise recommendations and to co-develop more convincing and predictable performance narratives. Reporting visualisations articulated a schema of qualifying standards describing “how” performance success would be judged and how risks would be evaluated. Over time contentions were settled as team roles and evaluative routines became clearer. However, the building of diagnostic capabilities to create “one version of the truth” was only possible by engaging team interests and steering divergent perspectives towards acceptable standards and targets. By the end of phase 2, a first attempt to forecast the programme outturn identified significant strategic risks.

7.4.1.2 Risk Management to citizenship: Phase 2 to phase 3

In the lead-up to IBR1, teams became more familiar with the performance dynamics of the programme and the scale effects of changes to delivery outcomes captured in the “one version of the truth”. The client adjudicated decisions by overseeing performance through a framework of standards and incentives sanctioning an acceptable degree of variation in performance. As a calculable space, the IBR provided a forum for critical oversight to draw together team plans into a unified snapshot. It provided a forum for constructive deliberation to consider “are we doing things right?” and “should the nature of plans change”? The outcome of the IBR was TCM and the establishment of a new set of high-level financial goals. The issue of sustaining devolved control was managed by adopting a participatory ethos to engage the teams to develop bespoke recovery plans. New territories of accountability were established and calculative technologies were developed to direct attention towards a suite of targets and standards. During the final phase, the complexity of devolved risk management was reduced into a precise framework of measures. A form of risk citizenship emerged which translated the principles of proactive risk management into specific standards and targets.

7.4.1.3 Progression Between Phases

Productive compromises were achieved when calculative technologies moved beyond just coordinating activities to mobilising a progressive debate. Establishing a risk management order (phase 1 to 2) was complex because of a need to build new partnering and lean performance expectations which moved away from traditional risk aversion. Over time the calculative infrastructure mobilised teams by legitimising “realistic” rather than safe forecasts and rewarded driving out waste rather than hiding cost improvement. Monthly rituals created a forum to enrol teams to provide convincing explanations and forecasts. Moving from risk management to citizenship involved teams accepting accountability for risks. IBR 1 provided a space for critical oversight and TCM animated rituals to encourage heedful interrelating based on the new risk management accountabilities.

During each phase, a re-ordering of priorities was observed to address performance risks and surface hidden dangers. The client acted as an “adjudicator” (Miller and Power, 2013) animating progress by evaluating, judging and rewarding the “right” forms of legitimate action. However, what was considered “right” evolved as lean principles were accepted and refined. Over time an “order of worth” (Boltanski and Thévenot, 2006) representing risk citizenship emerged embodied within the calculative infrastructure. However, this emergence was gradual as the programme transitioned between successive stages. The next section considers the broad themes which enabled “sustained” control as the infrastructure accumulated over time.

7.4.2 How did the T5 Calculative Infrastructure Sustain Control?

Teams were expected to engage in a form of “heedful interrelating” (Dougherty 2016) by contributing to the lean agenda and subordinating action to resolve problems for the benefit of the whole programme. In this context, the ongoing pursuit of performance improvement was considered a higher order principle. Over time, lean principles became fabricated and embodied within the calculative infrastructure. The mobilisation of the network had two broad stages; 1. The legitimisation of lean thinking for risk management and 2. “Fixing” the meaning of risk citizenship by creating an order of worth to sustain control action across the programme. These stages are examined below.

7.4.2.1 Legitimation of Lean Thinking

Lean thinking models of control fix on specific standards of performance and continuous improvement moves towards eliminating waste to achieve defined levels of quality (Womack et al, 1990). However, on T5 the emergent nature of scope created an indeterminacy in control as

the standards of performance necessary to deliver the “ends-in-view” (Dewey 1939) remained fluid until 2003. Calculative technologies built an evaluative order over time and this involved an initial period of qualification to test “how” lean principles would be applied, given the changing nature of design. The monthly reports played a key role in the articulation of qualifying standards. The replication of monthly rituals focused on giving a realistic account and written narrative to explain performance deficits. Subjectivization involved the agreement of recommendations and responding to queries raised in the monthly reviews. A lean methodology evolved as teams learned to pool knowledge and provide credible narratives. Baseline forecasting became a more realistic “one version of the truth” and client oversight became more rigorous and precise. The gradual legitimation of lean principles emerged as teams became more adept at understanding the performance dynamics of the programme.

7.4.2.2 Fixing the Meaning of Risk Citizenship

IBR1 provided a space to draw together the client and supply network into collective deliberation. The TCM programme resulted in the rapid re-casting of territories of accountability. Strategic priorities were elaborated into a critical path of activities proposed by each delivery team. At this late stage, the complexity of active risk management was finally reduced into precise standards and targets. This approach to citizenship used quantification to rationalise and fix the meaning of performance expectations into specific cost saving targets. Rather than centrally managing risk, the client mediated control by allowing teams to build their own tactical plans and match their capabilities to emergent problems. This approach accepted the dynamic and complex nature of risk management and the client provided visible oversight of progress and KPI incentives to reward progress. This clarity of meaning enabled risk citizenship to devolve across the project organisation supported by an infrastructure of monthly rituals and performance principles. Tensions associated with trade-offs, such as balancing the need for disclosure of realistic versus “safe” forecasts, or improvement versus cost “lock-in”, provided a basis for critical inquiry. Diverse interpretations and “unintended” and contested tensions were important for learning. The outcome of mediation and enrolment was captured within the calculative infrastructure. The next section considers the dominant features of the T5 calculative infrastructure.

7.4.3 Learning to Govern Performance Improvement

Performance improvement was sustained over the phases of control by enrolling the network into a series of temporary settlements. The territories of accountability remained flexible enabling learning during design development. However, the legitimization of lean principles was progressive and gradual because of the need to overcome a powerful aversion to scope change. Calculative technologies played a central role in guiding learning and collective evaluation. The client adjudicator played a central role in balancing dissonant tensions to prevent disagreements and delays. The diagram below describes the gradual development of the performance improvement infrastructure:

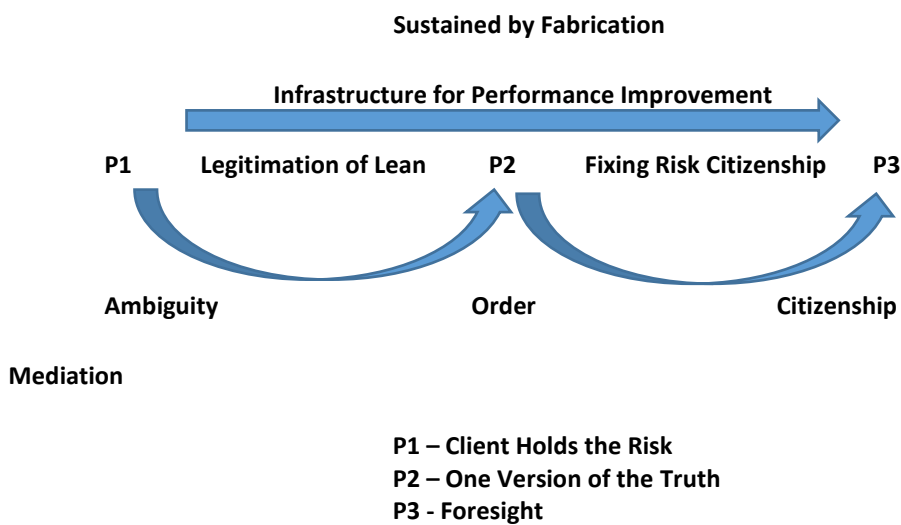


Figure 7.1: Development of an Infrastructure for Performance Improvement

The initial period of ambiguity reflected tensions and uncertainty because the T5 lean partnering model represented a major move away from traditional lock-in strategies. By phase 2 the risk management order steered conduct towards collective evaluation and the giving of realistic accounts. Gradually teams developed the capability to build a robust version of the truth. By the final phase, risk citizens accepted accountability for a search for better plans. The calculative infrastructure of KPI targets and rewards enabled the client to capture and anticipate performance issues with “foresight”.

7.4.4 Implications for the Heathrow Literature

The current T5 literature emphasises the importance of integration, with a key role for plans and incentives in agreeing shared purpose (Brady and Davies, 2011:2014; Davies et al, 2009; Gil 2009; Gil et al, 2012; Nightingale and Brady, 2011). The “systems integration” literature (Brady

and Davies, 2011; 2014; Davies et al 2009) emphasises the importance of client oversight and the client acting as a knowledge broker coordinating learning activities in order to enable progression. The T5 case findings extend these ideas by describing the calculative infrastructure that enabled learning. However, the findings also describe an unstable control environment where the powerful aversion to scope change created a difficult and dissonant setting. Lean thinking concepts were gradually refined through a performance dialogue that legitimised a search for improvement and rewarded the giving of realistic accounts. In this setting the findings suggest that rather than being an integrator of knowledge, the client acted as an adjudicator and integration was an outcome of a gradual process of enrolment through collective evaluation.

The existing T5 literature (Brady and Davies, 2011; 2014; Davies et al, 2009) emphasises the importance of the risk transfer arrangements rather than the process of risk management. However, even though the BAA commercially insured the risk, they did not bear the financial effects of performance shortfalls because they were gradually devolved across the programme. Flexible plans and incentives were part of the framework enabling devolution. Rather than removing deviations, the T5 model encouraged collective learning, where creative tensions and controversy were tolerated because they provided an opportunity for critical inquiry. This flexible and adaptive approach was sustained by the calculative infrastructure that shaped and steered divergent interests towards new standards and targets.

Much of the T5 literature (Brady and Davies, 2011; 2014; Davies et al, 2009) deemphasises the institutional complexity of the reproduction of control. Instead success is attributed to client leadership or adaptive plans and incentives but there is little discussion of the calculative infrastructure enabling change. However, changing incentives and plans created high levels of uncertainty and calculable spaces such as the IBRs, monthly rituals and the TCM played a fundamental role in settling concerns enabling the agreement of priorities. The T5 findings reveal the importance of recognising tensions and the destabilising effects of the incumbent aversion to scope change. In this context, the calculative infrastructure steered productive compromises towards a lean performance improvement model. However, sustaining lean performance improvement and risk citizenship involved a continual balancing of friction with temporary settlements towards a shared sense of evaluative purpose. These points are elaborated in the next chapter where specific gaps in the prior literature are matched with the T5 findings and linked to the wider reform debate. In the next section, the development of the T2 calculative infrastructure over the delivery cycle is considered.

7.5 Terminal 2 - Developing Intelligent Foresight

Wolstenholme's 2009 report described how economic uncertainty had weakened supply resilience, which damaged a willingness to engage with more innovative builds. In response to this, the orchestration of governance on T2 reflected a regulatory model and a contract that shared risks with the CBI through a pain-gain formula. Subjectivizing emphasised the data as "kingpin" with an expectation that the client would scrutinise and test the integrity of the data. Over time calculative technologies constructed a more robust "version of the truth" through focused interrogation. The discussion in chapter 6 highlighted 3 main phases of control, from P1: a "single version of the truth" to P2 "dashboard" to P3 the "golden thread". These phases evolved in response to a need to draw together divergent interests and then rapidly deliver a robust plan. Initially, phase 1 focused on strengthening territories of accountability described by Capital Director as "fences" (Morgan, 2009) by developing an expectation of audit scrutiny. By the second phase, the emphasis shifted to mobilising client learning through the dashboard and the IBR which were designed to shape and direct attention towards strategies to mitigate performance shortfalls. In the final phase, a rapid recovery plan was mobilised which required more visibility of the critical path. Here the emphasis shifted to building a "golden thread" of control that connected supplier targets to critical activities. Calculative technologies played a fundamental role in developing the client's diagnostic capability whilst asserting the client's authority as an Intelligent Client. However, the enrolment of the wider supply network was more lengthy and complex. The role of the calculative infrastructure in mediating control is examined in the next section.

7.5.1 How did the T2 Calculative Infrastructure Mediate Control?

The harsher economic climate was linked to a return to gaming behaviours such as building contingencies into "safe" baseline projections. Although the pain-gain formula shared accountability for risks between the client and CBI, it also provided a strong incentive to overestimate the initial cost baseline. The procurement of the 2nd tier was based on fixed work package commitments and this provided little incentive for performance improvement. Initially, Heathrow focused on interrogating schedules to remove waste by developing a regulatory framework to test the integrity of the data.

The table below highlights the dominant themes within each control phases, problematisation issues and major tensions.

Phases (P1-3) with themes	Problematisation	Tensions
P1: Single version of the truth The development of a regulatory framework to test the integrity of the data. However, the framework needed to capture local intelligence	<i>1. The authority of the “data as kingpin” required a common focus</i>	<i>1. Little incentive for the 2nd tier to focus on performance improvement</i>
P2: Dashboard Dissonance was organised by the leadership team in monthly meetings where priorities were agreed & passed down to suppliers. However, productivity issues intensified	<i>2. There was little opportunity to engage local intelligence and yet complex performance dynamics required a pooling of knowledge</i>	<i>2. Suppliers continued to defend past performance rather than contributing to performance discussions</i>
P3: Golden Thread IBR9 “pardoned” performance shortfalls and a golden thread was constructed to drive the critical path. How do you capture emergence?	<i>3. A lack of visible common purpose manifest in an incomplete build (doors)</i>	<i>3. Focused delivery against specific outcomes but how do you sustain attention towards the performance of the whole programme?</i>

Table 7.2: Summarising Problematisation Themes for T2

Divergent interests were a major theme on T2 and progress was stalled because of a lack of opportunity to engage the wider supply network. Instead the IBRs and performance reviews were used by the supply network to defend past performance. The CBI continued to hold the 2nd tier to account for pre-committed work packages rather than developing plans for recovery. Although the dashboard was a powerful diagnostic tool used to develop client tactics, there was limited direct engagement with the wider supply network until later in the programme. Gradually suppliers were enrolled to contribute to the performance discussion in the final phase of control. The next section considers the nature of the generative progression between the phases to identify “how” specific technologies and spaces mediated and enrolled control.

7.5.1.1 Defining intelligence: From Integrity to Order (phase 1 to phase 2)

Initially, risk technologies were used to test the integrity of projections and the monthly reports tracked productivity and safety conformance. However, even though client teams became more capable of asking critical questions, it became clear that there was a divergence in priorities between the client and supply network. The dashboard played a fundamental role in giving “concurrent visibility” (Chenhall et al, 2013) of operational priorities. Rather than reducing complexity, it broadened the client discussion through visualizations to explore key relationships

between risk exposure and value. This enabled the leadership team to consider how far the continued performance plans would create risk pressure and the direction and timing of mitigating action needed to limit risk exposure. This helped to develop a consensus amongst the client teams about an order of worth. The dashboard enabled the client to agree priorities and tactics for value management and to pass consistent messages back to the CBI. However, it was not used to enrol a performance dialogue across the whole programme or to agree a shared conception of value. Instead it played a key role in preparing the groundwork for the IBRs where issues would be more fully scrutinised, bringing the whole programme more fully to account.

7.5.1.2 Golden Thread: From Order to Enrolment (phase 2 to phase 3)

IBR8 highlighted specific concerns about schedule delays but there was lag in mobilising attention from the 2nd tier. The fortnightly reports re-emphasised the importance of programme level priorities (such as the CPI/SPI indicators) switching attention from defending past performance. Reporting forums provided a space to agree priorities and make supplier contributions visible through competitive ranking. Gradually, the wider supplier network was enrolled to focus on specific critical targets and milestones. Although phase 3 represented a rapid turnaround, issues such as the doors remained hidden until they became significant problems. This lag in visibility reflected a separation of accountability into distinct territories. By the time the door issue became visible, its effects were amplified across the programme because of the interwoven nature of interdependencies. This point is important because it demonstrates the destabilising effect on the whole programme when there is a lack of opportunity to agree and articulate common goals.

Calculative technologies mobilised different groups within the programme; the dashboard as a client diagnostic, the IBR to hold the CBI and supply network to account, and monthly rituals to test conformance. However, there were limited spaces to develop common evaluative principles and as controversies and risks emerged, temporary settlements were achieved by asserting conformance against standards. This appetite for risk reflected a preference for reducing deviations into specific plans and standards rather than keeping a broad dialogue open with the supply network. Although EVM measures monitored supplier performance, they were used as a proof of success or failure to focus on compliance rather than future value. The outcome of mediation by holding suppliers to account was a prolonged period of dissonance which interrupted productivity. Over time, the destabilising effects of this divergence was mitigated and eventually the supply network was more fully engaged. This period of translation can be viewed as a “long translation” (Mouritsen et al 2009) where fixing allied interests into agreement

involved a complex process of persuasion and negotiation. The complexity of this long period of problematisation and the role of calculative technologies in sustaining control is examined in the next section.

7.5.2 How did the T2 Calculative Infrastructure Sustain Control?

7.5.2.1 Organising Dissonance

Initially the development of the intelligent system required an architecture of technologies to test and clarify boundaries of accountability. The authority of the data as “kingpin” helped to create an expectation of scrutiny. This expectation was an important foundation of the style of disciplinary governance or governing “by” the numbers where the client acted as an overseer of conduct. However, gradually major problems emerged, and the client only became aware when they had crystallised into significant delays. The main space for client oversight were the IBRs where the whole supply network was formally held to account. In between the IBRs, productivity issues were centrally debated but there was limited opportunity to engage directly with the wider supply network. Instead the 2nd tier was engaged by the CBI to explain past performance rather than pooling knowledge to mitigate performance risks. During this period, control was sustained by the client developing sophisticated risk management strategies to offset delays in the schedule. The management of floats and programme-level savings created risk contingencies, which softened the financial effects of performance shortfalls. The dashboard provided the critical space for these activities enabling the client to build consensus and pass clear messages back to the CBI.

7.5.2.2 The Long Translation

The monthly performance rituals helped legitimise the IBRs as a space to fix plans and communicate performance expectations. Finally, by IBR9 a shared interest emerged in a tentative plan, as the CBI conceded the need for a new recovery approach. This translation moved into a final stage of mobilising support once milestone incentives were shared with the 2nd tier. An “intelligent” set of reports steered attention towards delivering the KPIs and critical path. Innovative calculative technologies, risk modelling and the dashboard played a fundamental role in building the client’s capability to steer and direct a dialogue with the supply chain. The critical path which emerged from IBR9 was underpinned by in-depth analysis of the schedules provided by the suppliers. Incentives were placed on realistic milestone targets which helped to motivate a shared sense of purpose. Supplier ranking and performance reports charted the progress of critical activities. This re-emphasised the importance of delivering the

targets on the critical path. This final stage of control highlighted that it was possible to rapidly develop recovery plans if the 2nd tier suppliers were more fully involved in the performance dialogue.

The long translation demonstrated the complexity of sustaining control when bounded territories of accountability stall social integration. Eventually a golden thread was constructed to drive the delivery of the critical path. However hidden problems, such as the door issue, created waste and fit-out rework resulting in delays and minor cost overruns. This point indicates how managing risk by placing incentives on specific outcomes can focus priorities. However, unforeseen and emergent change can destabilise these outcomes. At the end of the programme, a temporary agreement was achieved to deliver the programme on time. Although the intelligent system was intended to provide client oversight to support the development of strategies for value management, bounded territories of accountability limited the visibility of risks and opportunities. Periods of intense debate resulted in a dip in productivity and although this was recovered at the end of the programme there was evidence of waste in rework. The next section draws these points together to consider the evolution of the infrastructure to support learning and control on T2.

7.5.3 Learning to Govern a Predictive Model

The initial orchestration was intended to build a predictive model that would enable intelligent foresight. Calculative technologies were designed to reduce the need for client adjudication as the monthly reviews would clearly articulate accountabilities, standards and performance expectations. Deviations would be mitigated by testing the integrity of data, and controversies would be managed and directed through the CBI. The patterns of development are described below:

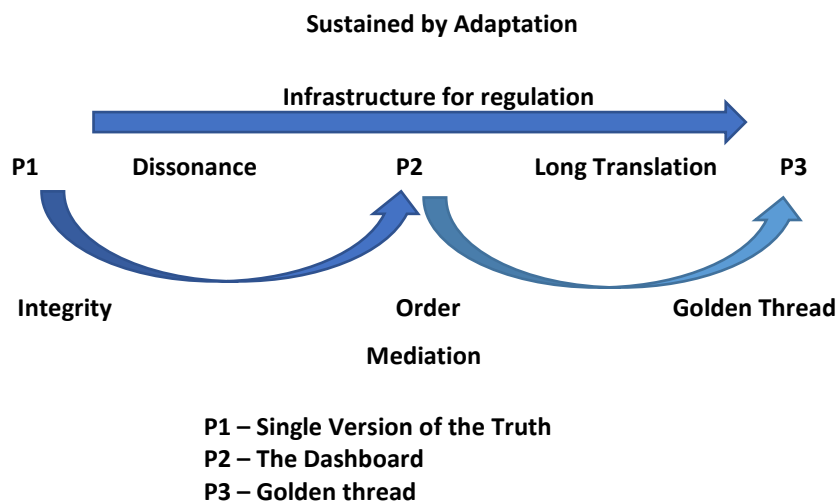


Figure 7.2 Development of an Infrastructure for Regulation

Patterns of mediation reflected an initial period of establishing the integrity of the data with technologies to judge conformance to agreed commitments. A lengthy process of “defining intelligence” through the dashboard settled multiple evaluative perspectives at the client level. However, the long translation reflected a lack of opportunity to engage the supply network. Over time these issues were settled. Innovative spaces and technologies such as the IBR and the latest value management methods played a central role in developing the recovery plan. Milestone incentives provided a “fix” to focus attention on critical milestones. However, the doors issue highlighted a lack of programme-wide visibility and a lack of common evaluative purpose. Although these issues were resolved, persistent dissonance had significant implications for productivity and delays.

The T2 case highlights a mismatch between aspirations for foresight with the design of a calculative infrastructure that emphasised regulation. Rather than engaging suppliers in a dialogue to explore possible future projections, subjectivizing involved directing supplier attention towards specific targets and standards. Control was sustained through the IBR recasting and “pardoning” performance delays. However, the doors issue reveals the perils of emergent change in complexity and the importance of capturing and engaging local intelligence to mitigate risks. This final point is important and has significant implications for the management of risk in complexity. Without forums or technologies to engage collective deliberation, large projects can be destabilised when faced with emergent change. This is because perplexing problems can require deeper forms of learning and critical inquiry. Resolution of perplexing problems can involve a wider search for solutions and the orchestration of a “collective ah ha” (Dewey, 1939; Antal et al, 2015). A search that may involve challenging “taken for granted” assumptions and abductive forms of reasoning (Quattrone, 2015; Dougherty, 2016). On T2, the lack of social integration in the first 2 phases of control resulted in hidden problems which gradually became visible once they caused significant delays. This last point demonstrates the limitations of a rigid regulatory approach that closes down reflexive learning and dialogue as controversies emerge. In the next section, the two infrastructures are compared to consider “How did Heathrow learn to govern through numbers?” across the delivery lifecycle.

7.6 Calculative Infrastructures and Heathrow as an Intelligent Client

The table below compares the two calculative infrastructures and the way in which they mediated and sustained control:

Table 7.3 Comparative Infrastructures

	Terminal 5	Terminal 2
How did they learn to Govern?	<p><i>Phases and technologies:</i></p> <p><i>P1 “Client holds the risk” T5 Handbook principles were translated into reimbursable incentives & team territories</i></p> <p><i>P2 “One version of the truth” reporting technologies evolved shaping diagnostic practices</i></p> <p><i>P3 “Foresight” oversight through the IBR and eventually foresight built through risk citizenship</i></p> <p>How did they learn? Calculative technologies mediated collective evaluation, fabricating learning by settling tensions and re-ordering priorities</p>	<p><i>Phases and Technologies:</i></p> <p><i>P1 “Single version of the truth” intelligent system established as an architecture to hold suppliers to account</i></p> <p><i>P2 “The Dashboard” building diagnostic capabilities of the leadership team for a tactical dialogue with the CBIs</i></p> <p><i>P3 “Golden Thread” constructing a critical path to mobilize local attention to deliver performance goals</i></p> <p>How did they learn? Calculative technologies defined client intelligence, regulated conformance, sanctioned “pardons” and directed attention towards tactical targets.</p>
Tensions	<p><i>i. Trade-offs between safe/realistic projections, hiding improvements vs driving out waste</i></p> <p><i>ii. Risk aversion and lock-in safer than possible scope creep risks</i></p>	<p><i>i. Incumbent focus on justifying past performance as a proof of worth vs realistic future projections</i></p> <p><i>ii. Incentives excluded 2nd tier and encouraged CBI to overstate cost baseline in “safe” forecasts</i></p>
Mediation?	<p><i>i. From Ambiguity to Order: By articulating a schema for signification of how success would be judged & failure evaluated</i></p> <p><i>ii. From Risk Management to Citizenship: From client adjudicated to precise standards & devolved ownership of risks to the teams</i></p>	<p><i>i. From Integrity to Order: Defining intelligence through the dashboard prepared the groundwork for the IBR to develop tactics to balance exposure and value</i></p> <p><i>ii. From Order to building a Golden Thread: Refocusing attention in the IBR to deliver the critical path</i></p>
Sustain?	<p><i>i. Legitimation of Lean Thinking: Sanctioning performance improvement by collectively defining “who” would be held to account through qualifying standards and targets</i></p> <p><i>ii. Fixing the Meaning of Risk Citizenship: IBR was a forum for collective deliberation. TCM a vehicle to match risks/opportunities with capabilities.</i></p> <p>Client adjudicator & calculative infrastructure enabled productive compromises by embodying learning in rituals, targets and standards to sustain risk citizenship</p>	<p><i>i. Organising Dissonance: Disciplinary control governing “by” numbers and risk modelling used to soften effects of performance shortfalls</i></p> <p><i>ii. The Long Translation: IBRs “pardoned” performance gaps, new milestone incentives and reporting rituals enrolled the 2nd tier into delivering the critical path</i></p> <p>Client regulator & calculative infrastructure slowly mobilised allied interests by re-focusing attention on specific goals and removing hazards and performance gaps</p>

On T5, lean partnering for performance improvement involved a gradual mobilisation of teams “through” collective evaluation. The territories of accountability remained fluid to enable learning during design evolution. However, fluid plans required adjudicatory intervention to sanction discovery. Gradually, lean principles were developed through an iterative process of judging and rewarding performance improvement. In the final phase of control, the meaning of risk citizenship was captured in precise standards where the IBR and TCM enabled a matching of capabilities with risks and opportunities. Calculable spaces emerged that embodied deep learning by capturing novel ideas and emergent opportunities from the various suppliers engaged on T5. The interplay between the client adjudicator, technologies and reporting rituals enabled social integration through a reflexive process of emergent learning.

In contrast on T2, the more standardised intelligent system was rapidly implemented, designed to drive efficiency by regulating control and reducing risks into precisely defined performance standards. The dashboard played a major role in building client intelligence and diagnostic capability to balance risk exposure and value. However, the assignment of tasks rather than enrolment and engagement of local intelligence destabilised the progress of the programme. Rather than embodying the learning from across the programme, there was a lack of opportunity to engage and shape the interests of the 2nd tier. Pardoning performance gaps through the IBR was fundamental in turning the programme around and milestone incentives nudged suppliers towards completion dates. However, a lack of heedful interrelating resulted in social integration problems, reflected in rework in the final fit-out stage (doors). This illustrates how it is possible to deliver a programme on time and to budget by directive technologies which coordinate systems integration. However, progress stalled because of unsettled periods of negotiation where the basis for evaluative priorities remained contested and unclear.

7.6.1 Similarities in Governing Models

Returning to the initial question “how did” Heathrow learn to govern? The Heathrow findings describe how a continued investment in new approaches to control was a key part of delivery success. Rather than adopting a traditional model of fixing the “front-end” (De Meyer et al, 2006; Morris, 2003) and keeping the project on track towards a predetermined set of instructions, Heathrow designed spaces for reflexive learning “through” evaluation. The continual investment in different control approaches reflected a changing appetite for risk. This appetite reflected evaluative orders within each control phase and the calculative infrastructure was adapted to enrol an agreed conception of evaluative purpose. This purpose reflected an ordering of priorities and underpinning assumptions about an “order of worth” (Stark, 2009; Boltanski and

Thévenot, 2006; Antal et al, 2015) and what was conceived as a risk or acceptable discovery. Returning to Dewey's quote:

"All deliberate, all planned human conduct, personal and collective seems to be influenced, if not controlled, by estimates of value or worth of ends to be attained" (Dewey, 1939, p2)

Emergent controversies created an unstable control environment where the pathways to the "ends-in-view" (Dewey 1939) continued to change. Making projects valuable involved a dynamic process of governing by enrolling conduct towards what was perceived as a worthy ends-in-view. However, notions of "worth" changed as the programme evolved. The sequence of development reflected initially early stage definition of how risks and value would be judged, followed by a period of diagnostic learning and finally a more intense delivery phase. There were 3 key similarities to this emergent learning approach 1. The development of building blocks 2. Pragmatic pardoning 3. Balancing persistent tensions. These are examined below:

7.6.1.1 Building Blocks for Learning

The initial phases of control enabled learning and innovation later in the programme. The initial periods of defining and organising an order of worth were followed by periods of diagnostic discovery to test the dynamics of the programme. On T5, although the Handbook ascribed lean approaches, principles were only animated once calculable spaces were established. Within these spaces the machinations of testing, contesting and fabricating agreement enabled learning. On T2 clear territories of accountability and the IBRs created a regulatory framework to set expectations of how suppliers would be held to account. However, the dashboard provided the space to agree operational priorities whilst exploring ways of mitigating performance shortfalls. These early periods of diagnostic learning created building blocks which enabled the development of more robust plans in later stages.

7.6.1.2 Pragmatic Pardoning

The IBR played a major role in both programmes as a space to routinely re-visit plans with an intention and willingness to pragmatically pardon unsustainable performance targets. This benevolent forgiveness was important to demonstrate the legitimate authority of the client in holding suppliers to account whilst forgiving past failures. This enabled the programme to progress. On T5 IBR1 enabled the BAA to exercise critical oversight and engage in constructive deliberation with the supply network to develop a recovery plan. On T2 the focus of the IBRs changed as the programme progressed. Initially they focused on testing the integrity of plans but later they provided a formal space to formally "pardon" past performance. Pardoning past

failures is a major departure to traditional project management guidelines that recommend managing uncertainty with rigorous definitions of programme requirements up-front. However, pardoning enabled the reassignment of accountability to those most “capable” of generating incremental value. This resulted in the gradual devolution of risk.

7.6.1.3 Balancing Persistent Tensions

Dougherty’s 2016 work on innovation in complexity describes how learning can be fostered in distributed settings if shared goals are organised so that heedful action responds to emergent opportunities. To take advantage of these opportunities, problem solving is organised towards collaboration, where heedful interrelating encourages joint action focused on common goals. In turn, collaboration is animated by abductive routines where repetitive action by diverse actors can generate new hypotheses. These ideas describe how deep learning can be achieved in distributed settings if shared goals are organised so that heedful action responds to emergent problems. However, within this literature there is little discussion about “how” subordinating action focused on discovery is sustained in contested and uncertain settings. However, on both programmes learning to govern through numbers was an ongoing and dynamic process where unintended controversies and contested tensions were an important part of learning. Sustaining heedful interrelating and encouraging abductive reasoning to challenge taken-for-granted assumptions required a calculative infrastructure to settle tensions. The table 7.3 on page 168 describes how tensions on T5 associated with an aversion to scope change were stabilised by collectively agreeing how risks would be judged, assigned and evaluated. On T2, initially there was little incentive to move away from justifying past performance until the calculative infrastructure refocused attention. In both cases, Heathrow recognised the existence of persistent tensions and modified the calculative infrastructure to sustain enrolment. Periods of testing and contesting, were part of the development of the calculative infrastructure which was modified and adapted to translate friction into creative tensions.

7.7 Return to the Reform Discussion

At the beginning of this chapter the discussion focused on the need for reform in governing risk and the importance of calculative infrastructures in shaping “how” risk is conceived. Construction 2025 recommends that a key driver for change in the industry rests on stronger delivery relationships to permit knowledge sharing. However, it also recognises that “how” risk is managed can destabilise and inhibit a willingness to collaborate when faced with uncertainty. The 2013 ICE Intelligent Client Capability Framework elaborates these concepts, recommending an oversight role for the client in working with suppliers to encourage deeper relationships by

encouraging openness and knowledge sharing. The ICE framework describes the need for clients to balance destabilising factors by agreeing goals and bridging, aligning and integrating divergent interests. However, the ICE framework does not describe “how” divergence might be settled. The Heathrow findings address this gap by describing two alternative intelligent client models that represented different appetites for “divergence”. T5’s performance improvement infrastructure sustained integration through collective evaluation. Discovery was sustained by enrolling suppliers in to a common dialogue to agree how value and risks should be managed. T2’s intelligent system emphasised regulatory control. However, divergent interests persisted because suppliers continued to be held to account by justifying past performance. On T2 the recovery was possible because Heathrow was willing to pragmatically pardon past performance shortfalls. On both programmes, rather than dealing with controversy by removing deviations, contested tensions provided a basis for critical inquiry and emergent learning. These points are important because they suggest that either performance improvement or regulatory models of governance enable delivery success when the Intelligent Client:

- Recognises and develops strategies to balance persistent tensions (including innovative recovery strategies, such as pragmatic pardoning)
- Invests in a complex and adaptive infrastructure that develops the building blocks for learning

Integration is a major theme within the reform debate and Construction 2025 emphasises balancing diversity to enable knowledge “synergies” to develop. However, the Heathrow findings demonstrate that the creation of synergies was more complex than “organising” knowledge transfer. Instead, within each control phase there was an ongoing dialectic (Power, 2007) between different appetites for risk as new tensions and trade-offs emerged. These ideas echo Stark’s 2009 work that describes how creating a form of “productive friction” involves the careful organisation of tensions to encourage creativity. Rather than removing differences, creativity can be sustained by carefully structured temporary settlements so that novelty and discovery are encouraged. The Heathrow cases describe this careful structure and organisation as a complex and adaptive calculative infrastructure. Recognising the importance of social integration was a key feature of Heathrow’s success as an intelligent client. This suggests that there are opportunities to extend the Intelligent Client concept to incorporate a capability that recognises the importance of social integration in effectively sustaining control. However, social integration and the development of common “evaluative” meaning and purpose is a dynamic concept involving the recursive construction of calculable spaces, the re-ordering of evaluative principles and the shaping of institutional subjects.

In summary, this chapter examined how Heathrow navigated complexity on both programmes to sustain control. Different patterns of fabrication and learning were observed, which reflected a different appetite for novelty and divergence. On T5, tensions associated with trade-offs between aspirations for performance improvement with an aversion to change were gradually settled. Monthly rituals, IBR and TCM created forums and spaces to overcome initial concerns for ambiguity. Gradually, control was sustained by capturing concepts of risk citizenship into an infrastructure of precise targets and accountabilities. Here the client adjudicator judged, evaluated and sanctioned collective deliberation. These findings extend the existing Heathrow literature by revealing how the emergence of control on T5 was underpinned by a complex and adaptive infrastructure to shape evaluative purpose towards performance improvement. In contrast on T2, aspirations for foresight resulted in a model that developed the predictive capabilities of the client team. Although suppliers initially continued to defend past commitments, this dissonance was gradually settled by creating forums for collective deliberation and eventually pardoning delays.

The Heathrow findings move away from conceiving control as an outcome of fixing the front-end and removing deviations to keep the programme on track. Instead, in both cases control emerged as Heathrow learned from controversies and continued to invest in developing an infrastructure to sustain reflexive learning. The next chapter draws these ideas together into a conclusion that uses the Heathrow findings to contribute to the key policy themes. The chapter also describes the contribution to the existing Heathrow literature by extending some of the concepts of “integration” and “scaffolding”. There is the potential for a major stream of further research in this area and the chapter identifies the main headings and themes.

Chapter 8

Conclusion: The Intelligent Client

8.1 Introduction

Projects are an organisational form developed to bring together a variety of perspectives in order to resolve complex and often indeterminate problems⁸⁶. Large-scale construction projects have a history of dissonance which creates a distinct challenge of competing value systems, commercial tensions and an unstable control environment. Traditional project management approaches recommend clearly articulating accountabilities at the front-end in procurement whilst implementing “checks and balances” to deter gaming strategies⁸⁷. However, rigid control methodologies can lead to “lock-in” and a lack of will to innovate thereby inhibiting collective problem solving. In contrast, the Heathrow cases demonstrate the benefit of adopting an emergent learning approach as a way of navigating complexity. On both programmes, plans were captured in a “version of the truth” which was gradually modified as emergent risks became visible. This was possible because the calculative infrastructures enrolled suppliers into accepting new stretch targets and accountabilities. On both programmes the machinations of testing and contesting new evaluative priorities was a key part of the emergent learning approach. Both cases describe how Heathrow navigated complexity by adjusting the appetite for risk. A complex and adaptive calculative infrastructure was developed to balance tensions and steer conduct towards a common sense of evaluative purpose. The nature of evaluative purpose also reflected the policy and reform debates at the time. T5 reflected Egan’s lean partnering philosophy and T2 a more cautious regulatory model. This chapter compares these case findings to the existing Heathrow and policy literature to contribute to the current reform discussion. It also matches some of the key findings to the Egan, Wolstenholme and current Construction 2025 recommendations. This leads to a discussion of a number of areas for further research focused on governing risk and intelligent client infrastructures.

8.2 Making a Contribution

Although the prior T5 literature⁸⁸ discusses the initial orchestration of control and the design of mechanisms for coordination; there is little discussion about the process or composition of control over the delivery cycle. For T2, prior literature comments that the complex build

⁸⁶ Scranton, 2015; Nightingale and Brady, 2011; Soderlund and Tell, 2012; Soderlund, 2012

⁸⁷ Flyvberg, 2012; Morris, 1994; Flyvberg and Cowi, 2004

⁸⁸ Davies et al, 2009; Brady and Davies, 2011; 2014; Gil, 2009; Gil et al, 2012; Nightingale and Brady, 2011

integrator model represented a relinquished level of project management capability⁸⁹, however there is little detail about “why”. The next section initially returns to these points followed by a more detailed discussion of the contribution of the case findings.

8.2.1 The Existing Heathrow Literature

The T5 “systems integrator” literature⁹⁰ describes the role of the client as a broker and integrator of component knowledge across and between integrated teams. This literature emphasises the development of an open-book environment where the client removed the burden of commercial pressure from the supply chain by “bearing” the risk which enabled collective problem solving. Although suppliers were expected to share performance information, Power’s 2007 work describes well how calculative practices (such as open-book accounting) are shaped by an appetite for risk. In this context, open-book may be part of an appetite for enterprise or reflect a more regulatory audit mentality (Power, 2007). The systems integrator literature assumes that open-book was linked to openness, enterprise and knowledge sharing as these aspirations were described in the T5 Agreement. However, there is little detail about the development and acceptance of this new order of worth. Yet a recurrent theme within construction over the last 20 years has been an avoidance of openly sharing cost information and strategic knowledge (CE, 2009; Egan, 1998; Latham, 1996; CS2025; Gann and Salter, 2000; Flyvberg, 1996; Clegg et al, 2012). Traditionally when faced with incertitude within construction projects, open-book becomes part of an architecture of control to enable audit scrutiny and regulatory checks (Gil et al, 2012; Clegg et al, 2012). Power’s 2007 work describes a complex dialectic and continual balancing of tensions between enterprise and auditability. However, the T5 “systems integrator” literature does not address the social and institutional complexity of moving to the new lean partnering “enterprise” model.

The second set of T5-related papers⁹¹ described a less stable control environment where adaptive plans and incentives mediated progressive change. Nightingale and Brady 2011 highlight how plans provided an adaptable “scaffolding” to coordinate reflexive learning across the programme whilst capturing more realistic assumptions. Gil (2009) links the adaptation of incentives to the removal of ambiguity associated with overlapping accountabilities. Although these papers suggest a mediatory role for plans and incentives leading to stability and control, there is little detail of “how” or “when”. These “gaps” provided an opportunity to examine the

⁸⁹ Brady and Davies 2011

⁹⁰ Davies et al 2009; Brady and Davies 2011; 2014;

⁹¹ Gil 2009; Gil et al 2012; Nightingale and Brady 2011

composition of the calculative infrastructure and the evolution of spaces, principles and practices that mediated control.

8.2.2 How did the Terminal 5 Calculative Infrastructure Mediate and Sustain Control?

The progression through the three phases of control described in the boxes below reflected the translation of lean principles into risk citizenship practices animated by monthly performance rituals. Although the principle of the “client holds the risk” was developed to enrol suppliers into a proactive search for performance improvement, there was an initial ambiguity about “who” would be held to account for fluid scope. Establishing order was gradual because of a need to move away from an incumbent aversion to scope change and traditional contingency building in safe forecasts.

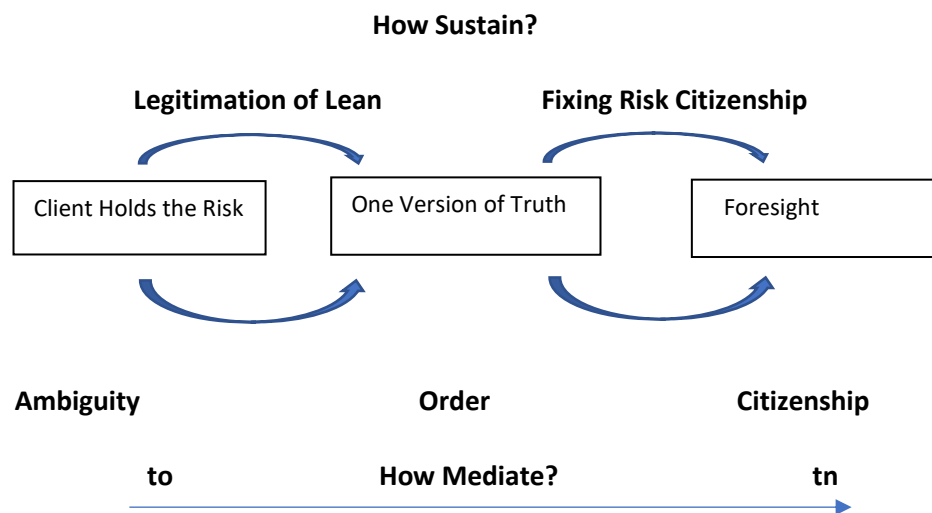


Figure 8.1 How did T5 mediate and sustain control?

Initially monthly reports engaged teams by articulating a schema of qualifying standards. Gradually “one version of the truth” was shaped through a collective performance dialogue where teams were given the freedom to explore solutions. Subjectivization of lean emerged as teams learned to pool knowledge and provide more credible narratives and predictable forecasts. The first integrated baseline review (IBR1) identified a need for “foresight” to anticipate risks and develop mitigation strategies. Rather than centrally managing risks the TCM approach devolved accountability to those most capable of generating incremental value. TCM enabled the re-assignment of accountabilities and an appetite for risk citizenship evolved as teams were enrolled into developing their own tactical plans. Over time, the complexity of risk was fixed into a precise infrastructure of KPIs and targets co-developed with the teams.

The “systems integrator” literature⁹² emphasises the importance of hierarchical client oversight of team activities and knowledge sharing with little detail of how coordination was sustained over the delivery cycle. However, the case findings describe the role of the client as an “adjudicator” (Miller and Power 2013), judging performance against the “version of the truth” and rewarding realistic and credible forecasts. Social integration was part of the process of enrolment as divergent priorities were shaped into preferred solutions. Collective evaluation was fundamental to the agreement of who would be accountable for generating more value and mitigating risks. Both social and systems integration were observed as outcomes of a gradual acceptance of lean thinking principles.

The 2nd body of Heathrow literature⁹³ links sustained control with adaptation, focusing on the way in which flexible plans and incentives can enable knowledge sharing and learning. However, the adaptation of plans and incentives also results in new territories of accountability. In the dissonant setting of a large construction programme this can have a major destabilising effect as priorities and rewards are adjusted. This level of change can create a spiral of tension within the supply network. However, on T5 the wider calculative infrastructure played a fundamental role in stabilising tensions. Monthly reports and performance review meetings, the IBR and the TCM programme, all enabled acceptance of fluid and changing plans. This point extends the concept of scaffolding beyond plans and incentives to include the different types of calculable spaces which were developed to enable productive compromises and the reassignment of accountability.

The existing T5 literature does not recognise the composition or role of the calculative infrastructure that underpinned T5. The case findings fill this gap by describing “how” the lean partnering model was translated into an infrastructure of technologies and spaces that shaped conduct towards performance improvement. Rather than implementing principles of active risk management and flexible planning on day one; they were defined through a recursive and collective process of testing and contesting. The client played a central role as an adjudicator shaping evaluative purpose through the development of a suite of calculative technologies and spaces. Tensions were balanced within each phase by collectively agreeing how risks would be assigned and evaluated and this enabled progression. Overtime the calculative infrastructure evolved which enabled performance improvement by translating lean principles into a sophisticated risk citizenship model.

⁹² Brady and Davies, 2011; Davies et al, 2009; Brady and Davies, 2014

⁹³ Gil, 2009; Gil et al, 2012; Nightingale and Brady, 2011

By 2009 the set-up of the T2A programme reflected Wolstenholme's recommendations of a clearer articulation of value and risk. Partnering was replaced by clear lines of accountability and an intelligent system to support decision making. However, a rigid framework of responsibilities raised questions about "how" action at a distance would be sustained when emergence created unanticipated problems. This point leads to the T2 case which examined "how" the calculative infrastructure sustained control.

8.2.3 How did the Terminal 2 Calculative Infrastructure Mediate and Sustain Control?

Asserting the authority of data as kingpin was fundamental to counter the return of traditional contingency building within safe forecasts. Initially emphasis was on testing the integrity of a consistent "single version of the truth" captured within the intelligent client system. The patterns of progression are described below:

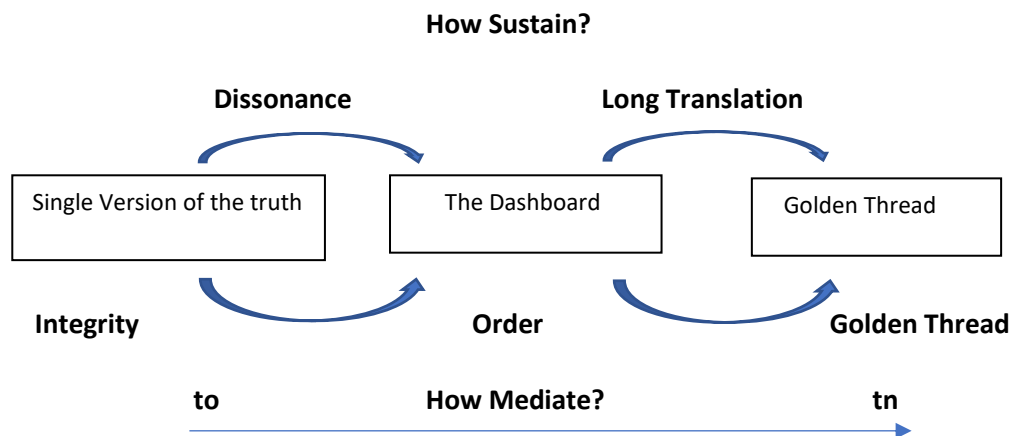


Figure 8.2 How did T2 mediate and sustain control?

Initially monthly reports provided oversight by tracking productivity, quality and safety conformance. As risks emerged, temporary settlements were achieved by asserting conformance to agreed plans. Although emergent change resulted in a need to explore alternative solutions to recover performance shortfalls, the CBI continued to manage the 2nd tier against pre-agreed work packages. The dashboard was developed as a diagnostic technology to broaden the client-level discussion by demonstrating a range of relationships between risk and value. It created a material space to mediate consensus and organise dissonant perspectives amongst the client teams about priorities. However, it was not used to enrol a performance dialogue across the whole programme. Instead the dashboard prepared the groundwork for the IBRs. By the autumn of 2012 after months of intense debate new recovery plans were finally agreed and captured in a "golden thread" of targets and standards. Once milestone incentives were shared with the 2nd tier; the fortnightly reports steered attention towards delivering the critical path.

Although the intelligent system was intended to build foresight and enable strategies for value management; the supply network continued to work towards committed targets rather than re-evaluating the effects of emergent change. In effect, debates about the meaning of evaluative principles were silenced which limited opportunities to shape the interests of the 2nd tier or capture localised learning and intelligence. Fixing allied interests was observed as a “long translation” where acceptance and agreement involved a complex process of persuasion and negotiation. For the client, long periods of critical inquiry developed a capability to understand the dynamics of the schedule. This learning was captured in the dashboard, as standards and targets reflected an acceptable relationship between value and risk exposure. The monthly performance rituals helped to legitimise the regulatory scrutiny of the IBRs as a space to “fix” and communicate performance expectations. The pardoning of performance gaps through the IBR enabled the programme to progress. However, the issue of incomplete doors reflected a lack of shared purpose and compromised visibility. This final point reveals the importance of creating spaces and forums to engage a performance dialogue when emergent changes challenge existing plans.

8.2.4 Differences and Similarities

Although the two calculative infrastructures contrasted in their overall appetite for risk they both enabled emergent learning. The continued development of new approaches to control was a key part of delivery success. Rather than fixing the front-end to deliver predetermined standards and targets, the ongoing re-ordering of priorities steered the programmes towards completion. The initial phases of control provided the building blocks for learning and innovation. On T5 lean principles were animated once reporting rituals were developed to test and contest evaluative priorities. On T2, a regulatory framework was initially established through the early stage IBRs and performance reviews. Later the dashboard provided the space to explore priorities to mitigate performance shortfalls. These early periods of diagnostic learning enabled the development of more robust plans later.

The IBRs were a key foundation of the governance of risk on both programmes. They created a critical space to pragmatically pardon performance failures, which demonstrated the legitimate authority of the client whilst forgiving unsustainable targets. On both programmes, pardoning failure enabled Heathrow to reassign accountabilities and this was a key part of proactively managing risks. This form of benevolent forgiveness moved away from the traditional emphasis on holding suppliers to account against the initial commitments. Instead pardoning enabled

Heathrow to reassign accountability to those most “capable” of generating incremental value. The IBRs enabled the programme to progress and move on.

8.2.5 Governing Risk in Construction

Traditional approaches of managing risk by rigidly controlling scope can reflect a deep concern for uncertainty (De Meyer et al, 2006; Clegg et al, 2012; Loch et al, 2006). When emergent change creates unanticipated performance deviations this can lead to a spiral of litigious claims and risk dumping. Although the policy literature⁹⁴ suggests working “with” the supply network to find “who” is most capable of managing risk; the Heathrow cases reveal this as a continuous process. The cases describe a dynamic process of risk management. A process that involved the recursive development of calculable spaces to enrol different parts of the programme into a series of temporary settlements as the programmes progressed. Rather than placing risk in a one-off transfer and sporadically measuring the outcome of deviations from plans the reassignment of performance risks was ongoing.

The ordering and re-ordering of standards and targets helped to adapt and shape an appetite for risk and discovery. Similar patterns of development were observed on both programmes with an initial period of organising an order of worth, followed by diagnostic discovery and a final period of recovery to devolve risk to suppliers. The appetite for risk changed with an initial period of narrowing to establish a methodology, followed by broader forms of exploration, and the final stage of capturing risk in more narrowly defined targets. Rather than removing deviations, Heathrow adapted the calculative infrastructure to shape and balance persistent tensions. These findings are important because they demonstrate the central role of evaluation in enabling progress by defining what is valuable and therefore what was considered an acceptable appetite for discovery and risk. The next section returns to the reform debate to consider the different appetites for risk underpinning the progression from Egan to Wolstenholme.

8.2.6 Revisiting from Egan to Wolstenholme

Egan’s Rethinking Construction (1998) placed the client in a central role, organising supplier learning and integrating processes towards improved client value and quality. Deeper partnering relationships were seen as a pathway to transform years of entrenched adversarialism. However, the performance improvement model required a major shift away from an aversion to scope change and self-seeking opportunism common amongst suppliers. The study of T5

⁹⁴ Constructing Excellence, 2009; Construction 2025

reveals the social complexity of transformation to the Egan model. It also describes the need for a complex and adaptive calculative infrastructure to gradually enrol teams into accepting fluid scope and accountability for performance improvement. On T5, the replication and refinement of monthly performance rituals played a key role in providing a space to test “how” lean conduct would be operationalised. Teams were given the freedom and autonomy to develop evaluative routines. The gradual sanctioning of giving coherent and realistic accounts all played a part in encouraging teams to pool knowledge and remove waste from forecasts. The IBR provided an important critical space for reflection to consider the “whole” programme perspective. This sequence of control strategies enabled the gradual legitimisation of lean thinking principles. However, sustaining lean also required a devolved model of risk citizenship to enable the proactive management risks. These points echo Womack et al’s (1990; 2007) work on lean enterprise that describes the importance of relentless oversight to sustain performance improvement as well as strong supply relationships. On T5 the calculative infrastructure played a fundamental role in providing this visibility and developing the capability of risk citizens to proactively manage risk.

By 2009, Wolstenholme’s report described the effects of the economic downturn on the construction industry:

“firms chasing unsustainable margins, cost and time overruns, the jettisoning of quality or sustainability initiatives and more of a claims-orientated approach” (CE, 2009, p19)

To improve productivity the report recommended closer engagement with suppliers to share the benefits of success. Value-based performance incentives were recommended and working with suppliers to establish who was best placed to manage risk. On T2 clear lines of accountability were developed to reduce ambiguity and the latest risk modelling techniques, a dashboard and intelligent system to manage risks. Although the intelligent system was designed to enable virtual control “by” the data, when productivity problems emerged there was limited opportunity to engage the wider supply network. Progress was stalled because suppliers continued to justify past performance as a proof of worth. Eventually dissonant tensions were settled by modifying the calculative infrastructure to create calculable spaces that shaped common purpose towards recovery plans.

The Heathrow cases describe how it is possible to successfully adopt different models of governance such as lean partnering (Egan) versus more regulatory approaches (Wolstenholme) if the client accepts the need to adapt the control approach and learn from controversy and emergence. The destabilising effect of dissonant and competing value systems is a major theme

here. Persistent tensions associated with competing justifications of worth can fundamentally destabilise progress. However, Heathrow successfully navigated these issues by developing a shared sense of evaluative purpose through the calculative infrastructures. An infrastructure that adapted to re-define what was valuable and therefore what was considered an acceptable appetite for discovery and risk.

8.2.7 Reform and Delivery Relationships

The Intelligent Client Capability Framework and Construction 2025 both emphasise the importance of stronger and more resilient delivery relationships as a pathway to improvement in construction. Construction 2025 focuses on aspirations for deeper supplier-client delivery relationships and the potential for improved learning synergies. The broken business model debate stressed the linkage between improving value in construction and the coordination of networks of cooperation between suppliers and the client. The Heathrow findings connect these ideas with the development of complex and adaptive calculative infrastructures to shape a performance dialogue thereby balancing tensions whilst orchestrating collective discovery.

8.2.7.1 Intelligent Client Capabilities

The ICE Intelligent Client Capability Framework 2013 describes important capabilities associated the governance of divergent objectives. It emphasises the role of financial incentives to bridge and align divergent priorities thereby enabling stronger delivery relationships. However, there is no explicit discussion about the different types of incentives or the role of the client or other forms of calculative technology. Alignment is a concept closely linked to subjectivization in terms of shaping attention and responsibilities towards acceptable standards and priorities. However, subjectivization has two different dimensions 1. Being controlled by another 2. Freedom of choice (Miller and Power, 2013). The Heathrow cases examined these two dimensions through the lens of calculable spaces designed to mediate priorities by evaluating and “adjudicating” performance. The cases describe a dynamic and recursive process of mediation and adjudication which combined to create both systems integration (control “over”) and social integration towards a shared sense of evaluative purpose. However, subjectivization also involved the recursive shaping of various calculable spaces beyond incentives. On T5 milestone and value-based incentives were intended to combine with the reimbursement of in-scope costs to encourage performance improvement. However, uncertainty about “how” fluid scope and discovery would be rewarded resulted in lock-in rather than “alignment” towards performance improvement. Gradually, the wider infrastructure of monthly performance rituals, the IBR and TCM forums legitimised performance improvement practices. These points, reveal the

importance of viewing the individual elements of the calculative infrastructure as part of a wider complex and entangled “whole” (Miller and Power, 2013). For Heathrow, alignment and the shaping of conduct involved gradual enrolment through a sequence of evaluative orders and calculable spaces. These points suggest that the ICE Capability Framework would benefit from thinking beyond control “by” incentives to consider more carefully the nature of control and the wider role of calculative infrastructures in governing conduct.

8.2.7.2 Construction 2025

Construction 2025 outlines ambitious targets for productivity growth over the next 8 years. However, the economic downturn, poor margins and slow payments have made it difficult for supply chains to “thrive”. Developing more robust relationships “with” suppliers is considered a fundamental part of unlocking knowledge synergies to improve project delivery. The Heathrow findings describe how generating learning synergies required extra effort in order to overcome negative friction within dissonant tensions. Learning required spaces and technologies, an infrastructure to encourage collective discovery and sanction new solutions. The T2 case revealed the importance of spaces to engage a performance dialogue when emergent changes challenged existing plans. The T5 case described how it is possible to develop a performance improvement model to encourage learning synergies if the entrenched aversion to scope-change is challenged. However, on T5 the successful adoption of performance improvement involved a lengthy and gradual legitimization of lean with oversight by an Intelligent Client adjudicator. In both cases transformation was facilitated by a pursuit of continual learning. The development of learning synergies was more complex than coordinating tasks or brokering knowledge transfer, instead it involved an appetite for critical inquiry to challenge and test evaluative principles when faced with perplexing problems.

The conception of control described in this thesis moves away from the traditional project management language of viewing the “numbers” as measures to objectively capture and report progress. Instead control and performance management is viewed as a process of shaping evaluative purpose by governing conduct - a purpose that is “value-laden” reflecting a schema of evaluative priorities and an order of worth. On both programmes control was observed as an unstable and iterative process of subjectivization to enrol heedful interactions as the programmes passed through different phases of control. Rather than silencing contested debates, ambiguous situations provided an opportunity for collective learning to recover performance. Returning to Stark’s 2009 work on dissonance, the existence of multiple evaluative perspectives was fundamental to resolve perplexing problems. However, balancing divergent

perspectives involved careful organisation to transform friction into creative tensions. On both programmes, this alignment was observed as a sequence of settlements reflecting a changing appetite for risk. Heathrow developed deeper delivery relationships by balancing tensions whilst encouraging critical reflection. However, this was only possible by developing a complex and adaptive calculative infrastructure.

8.3 Areas for Future Research

Recently initiatives, such as Project 13, have started to open the reform discussion to a wider audience for consultation. There are now a series of initiatives for Heathrow and other industry leaders to share best practice of how a “Capable Owner” and Intelligent Client construct and manage infrastructure assets. Within these discussions Heathrow continues to play an important role as a perceived exemplar to the rest of the industry. It is hoped that the findings from this thesis will contribute to this debate. Potential areas for further research could include:

8.3.1 Revisiting the Broken Business Model

Over the last few months Project 13 has started to examine the case to move from traditional “transactional models” of governance to different types of partnering and alliancing models. The T2 and T5 comparison is relevant to this discussion because it represents a partnership approach versus a more virtual and arms-length model. Further research could extend the Heathrow findings by examining the orchestration of a variety of different governance approaches to consider how these models engage and enrol suppliers during delivery. In this context, it might be useful to develop a comparison between the initial design of governance arrangements and other factors that contribute to the delivery of projects. This could include examining some of the features in the Heathrow findings such as different approaches to collective learning, appetites for governing risk and the engagement of innovative technologies and calculable spaces.

8.3.2 Virtual Control and Accountability

The way in which calculative technologies enable virtual control is also an area for further research. This could continue the Project 13 reform discussion by examining the role of control systems in enabling “action at a distance” within major projects. The T2 case findings could be extended to compare T2 with other types of “intelligent” system. Other approaches could be compared to the T2 “data as kingpin” model, to consider different ways of shaping accountability and holding suppliers to account. This stream of research could consider different

types and forms of justification and the role of evaluation in the shaping worthiness in the giving of accounts.

8.3.3 Governing Risk

Although the need to improve the management of risk in delivery is a recurrent theme throughout the reform discussion, there is little advice about “how” risk should be governed over the delivery cycle. Construction 2025 focuses on initiatives to improve the procurement of risk rather than the management of risk in delivery. However, the Heathrow cases reveal the importance of the initial building blocks for risk management as well as the various calculable spaces that assign, define and evaluate risk. Ideas developed within this thesis could be used for future research into:

- i. A focus on specific innovative technologies such as the dashboard, the IBR and the TCM initiative as novel approaches to integrate value management and risk governance. These studies could focus in more depth on the “inner workings” of these technologies, the evaluative principles and the detailed debates that underpinned “how” they resolved specific controversies to enable progression. The use and development of these technologies could be compared to literatures that consider the role of risk and value management instruments. In particular, it would be useful to compare the findings of the study to traditional project management texts⁹⁵ to explore gaps between theory and practice.
- ii. Different types of calculative infrastructure beyond the Heathrow “emergent learning” models of performance improvement (T5) and regulation for foresight (T2). The evolution of other models of governance and calculative infrastructure could be studied to explore how they define and organise risks during delivery.
- iii. The relationship between governing risk and organising discovery within projects. In particular, the role of different forms of technology used to instrument risk. E.g. risk registers, floats, dashboards and shock absorbers or calculative practices such as specific reporting forums and cyclical reviews. Research could examine the link between these different technologies and “factors” that contribute to a different appetite for discovery or risk.

⁹⁵ For example, PMBOK and practitioner texts such as Navigating Complexity

8.3.4 Process Research and “How” Questions

Much of the prior Heathrow literature uses T5 as an exemplar case to link different features and traits to innovative outcomes. This type of “know-what” modelling is intended to reveal the co-variation between certain traits and outcomes, to inform discussions of best practice (Burns, 2014). However, the process approach taken in this thesis was intended to be sympathetic to the importance of time in the development of both programmes. Rather than making assumptions about the role of specific loci of control; the methods traced the sequence of events to understand “what happened and who did what – when” (Langley, 1999, p692). This approach seemed the most suitable, given the nature of the “how” questions which focused on the complex relationship between time, control and the accumulation of learning. Temporal bracketing provided a basis to break the sequences down into manageable blocks for analysis. The “controversies” used to punctuate phases represented more obvious and visible points of disjuncture within both programmes. In this thesis, I felt that the level of detail in the three phases was sufficient to contribute to the “problem” posed in the research questions and the more general reform debate. However, there is still potential to break the sequences down in to smaller blocks of time, in order to scrutinise features of certain calculable spaces in more depth. This research could be used to extend the analysis of the governance of risk and accountability described on the previous page.

In this thesis, the study of emergence and controversy yielded unexpected findings which moved away from some of the perspectives described in previous research. Much of the prior T5 literature emphasised the critical importance of the commercial bearing of risk by the client as an important risk innovation to enable discovery. However, the T5 findings describe the “client holds the risk” as the initial phase of control. By the last phase, risk was gradually devolved and distributed across the programme. On T5, prior research emphasised the reimbursement of costs as a strategy to stabilise uncertainty and encourage discovery. Although the T5 case findings recognised it as an important enrolment strategy, reimbursement was also a source of early stage tension and trade-offs between lock-in and the need for discovery. These points highlight how process studies can uncover surprising events and interactions that shape the development of a project. They suggest that the adoption of more “how” style research questions and process methods could contribute to project management research when considering complex, plural and emergent phenomena.

8.3.5 Final Thoughts

In summary, major projects gather together a variety of experts and organisations in order to resolve complex and often indeterminate problems. However, plural tensions and competing value systems can create an unstable control environment. The broken business model debate reveals a need to improve the coordination of cooperative networks in order to improve value and productivity. The Heathrow cases describe the role of adaptive calculative infrastructures in mobilising allied interests. For Heathrow the ongoing process of testing and contesting of evaluative principles resulted in emergent learning. However, this was only possible by enrolling institutional subjects into agreeing evaluative priorities. A central theme running throughout this thesis has been the need to stabilise dissonance towards a shared conception of purpose and worth. However, as ends-in-view changed the nature of worthiness and priorities also changed. The cases reveal how the appetite for risk evolved from an initial setup, to a period of exploration and a final stage where risk was captured in precisely defined targets. Social integration emerged by enrolling agreement through a sequence of settlements within each control phase. However, the settlements were temporary. Heathrow acted as an Intelligent Client aligning, bridging and integrating objectives; but only up to a point. Rather than removing the deviant and deviations from plan, controversies provided a basis for critical inquiry to challenge and examine initial assumptions. This point is important because it highlights the role of friction in resolving perplexing problems. These points suggest that a major challenge for Intelligent Clients is to develop calculative infrastructures that organises “productive friction” in a way that settles but does not remove or silence creative tensions and critical inquiry.

Over the last 20 years, the need to improve the governance of risk has been a central theme in the reform debates. This thesis describes a powerful role for architectures of control in governing risk by encouraging discovery. The calculative infrastructures played a central role in making projects valuable by continually testing and contesting evaluative principles. Calculable spaces were adapted to steer conduct towards resolving perplexing problems. Once resolved, the solutions were embodied into standards and targets that represented new accountabilities, evaluative purpose and worth. This thesis highlights the potential for far more research into governing risk and accountability to improve value within construction. More research into the nature of different calculative infrastructures and the role of technologies and spaces in shaping different forms of evaluative order. To achieve the level of reform described in Construction 2025 this may involve asking more “how” style questions to challenge the traditional conception of control as a process of delivering predetermined targets and goals. Both T2 and T5 were delivered on budget and to cost but the pathway to success was not visible at the outset. This

suggests that there is a benefit for the reform discussion to step away from just focusing on the front end and instead think more carefully about preparing for the journey ahead.

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