

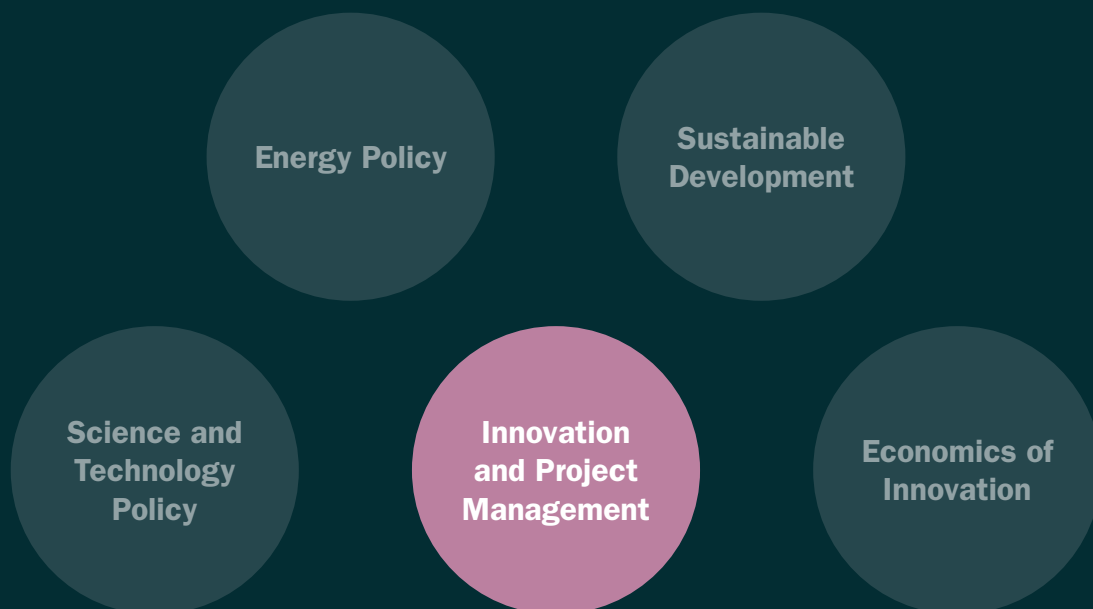
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## **Riskwork in the construction of Heathrow Terminal 2**

Rebecca Vine



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## **Riskwork in the construction of Heathrow Terminal 2<sup>1</sup>**

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All omissions are my responsibility

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<sup>1</sup> See Social Science Research Network (SSRN) for an earlier version

## **Abstract**

The failure to manage risk in large-scale infrastructure projects has attracted intense debate. Recommendations suggest rigorous planning and once the contract is in place, the narrative of accounting emphasises constructing audit trails to assure delivery commitments. However, this can lead to blame avoidance and boundary preservation. This paper develops an in-depth case study of the construction of Heathrow Terminal 2 (T2). T2 was a £2.5bn project on the Eastern Campus of Heathrow Airport that successfully opened on time and to budget, despite an initial risk management ethos that emphasised boundary preservation. This is explored through the lens of riskwork, a form of everyday maintenance work that sustained risk management practice. A process methodology revealed a diachronic pattern of riskwork phases from initial concerns about ‘one version of the truth’ to strategising with a ‘dashboard’ to a final ‘golden thread’ engaging suppliers in risk talk. Progress was sustained by paying attention to which ‘residual’ categories of risk were excluded. As the programme progressed, riskwork became less about managing compliance and more about learning from emergence. This paper demonstrates an important relationship between innovation, learning from emergence and an adaptive riskwork infrastructure. It also describes an important role for mediatory instruments such as dashboards, reports and forums in making risks visible and actionable. It has significant implications for policy recommendations that oversimplify the management of risk into a form of accountability management that mitigates risks by demanding compliance. On a theoretical level it reveals the importance of temporality and path dependency in the study of riskwork infrastructures.

**Keywords:** riskwork, accountability, infrastructure, projects, residual, emergence, innovation, Heathrow

## 1.0 Introduction

The failure to manage risk within large-scale infrastructure projects has attracted intense policy debate. Policy recommendations emphasise the mitigation of risk with more rigorous early-stage planning whilst placing responsibility with those most capable of managing risk (IPA 2017; ICE 2013, 2017; Constructing Excellence 2009; BEIS 2013). Once the contract is in place, clear accountability structures are emphasised to enable assurance of performance against initial delivery commitments. However, project innovation scholars warn against this approach when faced with complexity and emergent risk. Instead they recommend creating a project environment that engenders learning and flexible delivery models when faced with unforeseen change (Davies, Dodgson and Gann 2017, 2016; Lenfle and Loch 2010; Loch, Meyer and Pich 2006; Nightingale and Brady 2011). Here Heathrow Terminal 5 (1998-2008) is considered an exemplar with a governance structure based on integrated inter-organisational teams and financial incentives to encourage shared problem solving. Co-creation was enabled with a “scaffolding” of flexible plans, targets and incentives (Nightingale and Brady 2011; Gil and Tether 2011). Within a year of Terminal 5 opening, plans were developed for Terminal 2, a £2.5bn terminal and satellite pier on the Eastern campus of Heathrow. Rather than building on the ethos of partnership developed for T5, the governance design encouraged boundary preservation to minimise unforeseen change. Despite this, Terminal 2 was celebrated as a public success, opening on time and to budget by Her Majesty Queen Elizabeth in June 2014. This paper explores the risk management apparatus that successfully steered the programme to completion.

Within project studies, Heathrow is considered an important innovator worthy of attention.<sup>2</sup> For Heathrow Terminal 5, a bespoke contractual agreement described how the client would bear programme-level risk and devolve responsibility to supplier teams to mitigate specific performance shortfalls as they emerged (Brady and Davies 2011, 2014; Davies, Dodgson and Gann 2017; Gil and Tether 2011; Vine 2018). In contrast, on Terminal 2 the initial governance structure emphasised clear lines of accountability. This was orchestrated through a standard New Engineering Contract (NEC 3) and a pain-gain formula to allocate the risk of cost overruns. This risk sharing arrangement was designed to assign “real pain” if the programme failed to deliver the plan (Morgan, 2009). Accountability demands were framed through incentives affectionately called “the right kind of bribe” (Morgan, 2009). This ethos attempted to steer conduct towards a suite of proscribed performance targets. Despite this, plans were modified (for the carpark, concourse and rail connection) and routines were adapted (Zerjav,

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<sup>2</sup> Heathrow Airport is the largest airport in the UK and continues to play a significant role in the UK economy (BEIS, 2017). It is also a hugely space constrained site positioned amongst a major motorway network that orbits London and much of the construction takes place whilst the airport is operational (Brady and Davies, 2014). From a research perspective it is considered an important innovator. The flexible T5 delivery approach has been described as transformational (Davies et al 2017; 2016)

Davies and Edkins, 2018) and trade-off tensions were settled (Quattrone, 2017) and the programme was deemed a success.

This paper examines the composition and role of the risk management apparatus on T2 that enabled adaptive plans despite the initial emphasis on boundary preservation. To do this we draw from the accounting and organisational literature to explore a concept called 'riskwork'. Riskwork draws from an institutional work lens to consider the situated microprocesses underpinning "small worlds of institutional resistances and maintenance" (Lawrence et al, 2009, p57). Rather than focusing on calculative acts within a risk department, it considers the distributed network of activities that make up the everyday management of risk. These activities took place through an infrastructure of technologies and spaces in the form of dashboards, reports and forums used to represent and interrogate situated notions of risk. This theoretical framing was used to understand *how* the regulatory apparatus on T2 evolved from boundary preservation to enable flexible routines and emergent risks

A process methodology was developed to trace the progression of the riskwork architecture over the delivery cycle. Temporal bracketing was used to break practices into riskwork phases. The riskwork narrative evolved through a diachronic sequence, from accountability concerns to agree a "One version of the truth" to client strategising with the "dashboard" and finally a "golden thread" of incentives, metrics and forums to engage supplier risk talk. Each phase was punctuated with unsettled periods that made residual risks left out of the riskwork narrative more visible. By tracing the co-evolution of the infrastructure of artefacts and riskwork narrative we reveal a pattern of development that encouraged innovation. Rather than eliminating the emergence of novel forms of residual risk, unsettled periods generated learning by revealing the limitations of the existing riskwork infrastructure.

This paper contributes to project studies by moving away from a traditional conception of project control as a mechanised practice to eliminate deviations from plan based on a known appetite for risk. Instead it observes a strong interdependency between account giving activities and effortful risk management. To respond to residual risk as it emerged, the client purposively adapted reports, forums and metrics. Here the role of the riskwork infrastructure went beyond measuring risks to brokering consensus about which risks were visible and who should be held to account. Gradually the initial rigidity in the T2 delivery model was compensated with an adaptive riskwork infrastructure that enrolled suppliers and contractors into learning from unforeseen events.

This paper demonstrates an important relationship between adaptive risk management architectures, innovation and the benefits of learning from emergence. It also describes a central role for mediatory instruments such as dashboards, reporting and forums in making risks visible and actionable. On a practical level it raises concern about the management of risk in large-scale complex projects by transferring accountability to others and demanding compliance. On a theoretical level it contributes

to the riskwork literature by revealing the importance of temporality and path dependency in studying the patterns of formation of riskwork infrastructures within projects. Empirically it extends previous studies of Heathrow T5 to describe what happened next. Finally, it contributes to the Quattrone (2017) study of the T2 dashboard by describing how its use was augmented and replaced by different forms of performable spaces that held contractors to account, forgave past performance and engaged suppliers in a more inclusive debate.

The remainder of this paper is organised as follows: the next section reviews the projects studies literature to identify key themes associated with managing scale, complexity and emergent risk. It reviews the limitations of traditional models of risk management, conditions for flexible delivery and the implications for the regulatory apparatus on T2. This leads to exploration of the riskwork literature and theory associated with the arrangement of everyday risk management routines, the role artefacts and factors influencing scaling-up or disintegration. This is followed by a methodological discussion before presenting the empirical case findings. The discussion section explores patterns of evolution through three riskwork phases and examines the dynamics of learning from the emergence of residual risks and the implications for traditional models of control. In the conclusion, future areas for research include; 1. The relationship between risk practice, innovation and learning from emergence; 2. Dynamics of enrolment spaces in risk and accountability management; 3. The generative nature of riskwork architectures.

## **2.0 Literature themes**

The following section starts by exploring the main themes associated with managing risk, scale and complexity within large-scale projects. This leads to debate about the limitations of traditional risk management and a need for reform to foster flexible delivery

### **2.1 Risk Management in large-scale projects**

Knight (1921) classic work on risk and incertitude links the two concepts to imperfect knowledge of the future as a result of unforeseen change. He distinguishes between uncertainty and risk by describing risk as measurable incertitude. In a project context, risk is described as an uncertain event or condition which effects project objectives (PMI, 2015). These unforeseen events may manifest in delays and cost overruns and this creates variances against plan. During project execution the traditional approach to managing risk assumes a “known terrain of events” (Loch et al, 2006) captured in a planned schedule. This approach leads to debates about keeping the project on track and intervening if the project swings out of control.

Flyvbjerg (2017) describes the persistence of poor performance in large scale ‘megaprojects’ (>\$1bn). He warns that when project plans are conceptualised as deterministic endeavours with linear cause and effect relationships, they are likely to fail. Lenfle and Loch (2010) warn that one-size-fits-all project

control frameworks deter innovation. In their study of the “lost roots of project management” they describe how an overemphasis on checking compliance to standard project phases may crowd out opportunities to learn from novelty. Levitt and Scott (2017) recommend enhancing contractual governance arrangements with relational governance mechanisms to engender cooperation and a shared identity and purpose. Davies, Dodgson and Gann (2017) study of notable UK megaprojects observes that although different governance and risk sharing arrangements exist, specific key capabilities are needed to enable flexible delivery

This project studies literature reveals three persistent themes. Firstly, traditional models of control seeking to manage risk by eliminating change are inappropriate for the stochastic nature of large-scale project delivery. Secondly, there is a need to encourage innovation and flexible delivery models when faced with emergent risks. However, flexible delivery models require institutional change to encourage a mindset of collective problem solving. These themes are examined in more depth below.

## **2.2 The limitations of traditional models of control for risk management**

Large scale infrastructure programmes are inherently complex organisational structures made up of multiple smaller interdependent projects. The term “complex” derives from the Latin for interwoven, which describes the woven interdependency between the activities and responsibilities in complex phenomena. Lessard et al (2014) study of the complexity in projects associates it with “non-linearity” and “variability” of outcomes. Davies, Dodgson and Gann (2016) illustrate project complexity as:

“..multiple contracting parties; the high degree of uncertainty at the outset about the project’s goals and the means of achieving it: how much it will cost and how long it will take; and what form of contract and processes are required for dealing with changing conditions and converting uncertainty into certainty as the project progresses towards completion”

(Davies et al, 2016, p30)

Brady and Davies (2014) study of comparative project complexity describes the difficulty in organising the dynamic complexity of projects when external change can destabilise plans. Rather than avoiding change, they describe how megaprojects such as the Olympics and Heathrow Terminal 5 carefully developed delivery structures to fit the conditions of dynamic and structural<sup>3</sup> complexity.

In spite of the documented challenges of managing the unknown within large scale projects, Loch, Meyer and Pich (2006) describe how traditionally uncertainty management is treated as an instructional activity. Unfortunately, this leads to assumptions of a bounded solution space and a defined terrain of events to be managed by eliminating deviations. In this context they warn that efforts

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<sup>3</sup> Brady and Davies (2014) describe ‘structural complexity’ as an arrangement of the project architecture. However, dynamic complexity relates to the changing relationships within and between the system and its environment over time.



tend to focus on delivering the plan rather than the objectives of the project. Similar themes are echoed in Lenfle and Loch (2010) study of the “lost roots” of US defence projects. Originally defence projects in the 1940s and 1950s used the flexible structure of a project as a vehicle to innovate and search for novel technical solutions. However, there was a fundamental move away from this ethos with the establishment of project management as a legitimate profession with a standardised body of knowledge. By the late 1960s this led to institutional pressures towards standard control frameworks, such a Critical Path Methods (CPM) and Program Evaluation Control Techniques (PERT), that provided a one-size-fits-all approach to monitoring progress against standardised stage-gate criterion. These frameworks became synonymous with professional project control techniques expected in “modern project management” that still exist today. However, Lenfle and Loch (2010) warn that these standard execution routines frustrate strategic forms of innovation by promoting a box-checking mentality that is unsuitable for novel and experimental projects. To counter this, they recommend moving to a contingency approach described as “targeted flexibility” where the use of experimental routines (such as testing and trialling) are adopted based on the degree of observed uncertainty (Lenfle and Loch 2010; 2017).

### **2.3 Creating the institutional conditions for flexible delivery**

Although Lenfle and Loch (2010) and Loch et al (2006) recommend more flexible control models, they do not address how this transition might take place. Levitt and Scott (2017) address this by considering the case for institutional reform in the governance of megaprojects. Their work describes how traditional inflexible regulatory control frameworks can lead to incompatible interdependencies as change emerges over the life of a megaproject. Instead they recommend regulatory and relational governance mechanisms to encourage mutual adjustment such as integrated project delivery clauses,<sup>4</sup> however, they also describe a need for field-level reform.

Levitt and Scott (2017) describe the importance of reinforcing a social order beneath conscious awareness by creating the conditions for taken-for-granted assumptions that enable cooperation. However, Flyvbjerg (2012; 2014; 2017; 2009; 2005) associates megaprojects failure with powerful institutional drivers and competing interests. These interests are conceptualised as “sublimes” related to vote-seeking politicians, reputation-seeking engineers and the economic sublime of job generation (Flyvbjerg, 2017). The persistence of these sublimes encourages overpromising which may manifest in delusional ‘optimism bias’ or even deliberate ‘strategic misrepresentation’. Several empirical studies describe how opportunistic planners have a vested interest in overpromising benefits and under specifying costs in collusion with sponsoring agencies. These factors lead to planned commitments that are based on misinformation about costs, benefits and schedules. Here risks associated with unplanned

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<sup>4</sup> Examples proposed by Levitt and Scott (2017) are the reimbursement of direct costs, shared incentives and the waiving of liability claims

events and overlooked complexity may remain unmanaged and unaccounted for. Practical recommendations to deter this suggest auditing and testing plans with reference class forecasting benchmarks. However, Flyvbjerg (2017) also warns that once plans are in place, if projects are managed as deterministic endeavours, with linear cause, effect and control relationships this may lead to a lock-in to 'slow failure' at scale, where it is unclear who should be held to account

Davies, Dodgson and Gann (2017) work on innovative UK megaprojects describes how more flexible delivery models designed to strategically adapt to change may overcome problems of lock-in to a flawed plan. This work draws from empirical studies of UK megaprojects; Crossrail, Olympics and Terminal 5 (T5) at Heathrow. The study observes five similar strategic capabilities: '*Search*'; '*Problem-Solving*'; '*Test and trial*'; '*Strategic Innovation*' and '*Balancing*' trade-offs between execution or adaption. These capabilities were conceptualised as "dynamic capabilities"<sup>5</sup>, purposively developed to enable the reconfiguration of routines in order to survive a changing environment. For example, change control procedures provided a standardised process to scrutinise change and also informed *balancing* decisions between execution or adaption. Similarly reference class forecasting was used to verify planning assumptions and also inform *search* decisions.

All three projects adopted a similar ethos of partnering to deliver the programme through integrated interorganisational teams. However, Davies et al (2017) describe the importance of the bespoke "T5 Agreement" as a "transformational" contract that ascribed a code of conduct based on partnering and performance improvement. Earlier work by Davies et al (2016) describes how the mobilization of partnering principles into everyday practices was fragile and vulnerable to breakdown. It required an institutional environment to encourage cohesive inter-organisation teams and disciplined flexibility. This transformation was gradual. However, the fundamental principle that the client would hold accountability for programme-level risk and reimburse in-scope cost remained an important feature to enrol others into an ethos of partnering. Within a year of T5 opening, Complex build Integrators (CBIs) were engaged to oversee the construction of Heathrow Terminal 2. Similar to the Olympics and Crossrail an industry-standard New Engineering Contract (NEC) was adopted with a modified risk-sharing clause. However, delivery teams were not integrated, and control oversight was managed through a bespoke performance and risk management system. Early observations of this delivery model noted that Heathrow seemed to have "relinquished" the partnering ethos gradually developed on Terminal 5 (Davies, et al, 2016).

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<sup>5</sup> Dynamic capabilities are defined by Teece et al 1997, p515 as: "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments"

## 2.4 Implications for the regulatory apparatus at Terminal 2

The delivery approach on T2 appeared to reflect a return to a traditional model of control with the client acting as a procurer relying on upfront specifications and clear boundaries of accountability. This seemed to promote rigidity with a regulatory framework that assigned risks based on a fixed risk ‘pain-gain’ allocation. The move away from integrated teams raised questions about how the traditional institutional norms of individualised opportunism were balanced to avoid damaging commercial tensions associated with incompatible interdependencies. This also raises questions about how far risk and control methodologies adopted a one-size-fits-all approach to hold the CBIs to account for executing agreed plans. Despite this, Zerjav, Davies and Edkins (2018) undertook a study of the operational handover phase of Terminal 2. Here they observed flexible operational routines in a patterned sequence of “*reconfiguring*” and “*adapting*” followed by “*maintaining*” which led to a smooth handover at the end of the project.

Quattrone (2017) on the role of a variety of visualisations in guiding judgement in ambiguous settings, describes the importance of the monthly performance dashboard on T2. This work conceptualises the dashboard as a semiotic device that compressed the ambiguities of the programme into a central visual space enabling inquiry and discovery. In this context it acted as a mediator that brought together “actors and aspirations” (Miller and Power, 2013) towards a temporary settlement. Quattrone (2017) describes this as balancing “in-tension”, “in-difference” and “in-divisions”. These points lead to key questions about *how* the seemingly inflexible regulatory apparatus was able to balance tensions and encourage discovery and how this linked to the adaptive routines observed in the handover phase. This leads to 3 fundamental questions for the T2 case.

1. What was the composition of regulatory apparatus that enabled evolution from an initial emphasis on boundary preservation to an environment that encouraged flexibility?
2. How did this apparatus evolve over the life of the programme, leading to flexible routines and the ethos of discovery?
3. How did it accommodate unforeseen and emergent risk?

## 2.5 Studying the “Riskwork” apparatus in a megaproject

To examine the evolution of the regulatory apparatus on T2 over time we used an organisational concept described as “riskwork”. Riskwork combines the concept of *risk* as an object emplaced by a risk management apparatus and *work* through an “institutional work” lens that explicitly considers “small worlds of institutional resistances and maintenance” (Lawrence et al, 2009, p57). This approach moves away from making a priori assumptions about coherence or reproduction of routines in the management of risk. Instead, the focus is on the situated work arrangements that enable the everyday life of risk management. Within an organisation setting, risk becomes *actionable* when responsibility is assigned

through targets and plans. For this reason, riskwork studies consider the linkage between risk management routines and the wider network of account-giving within an organisation.

In Power (2016) several academics document the dynamics of riskwork practice within a variety of organisational settings. A common theme across this literature is the tendency towards asserting accountability for risk on others rather than engaging in effortful riskwork. This results in a hybrid form of riskwork described as “auditwork”. Auditwork activities emphasise gathering storable traces of action to prove due process. The collection of riskwork essays describe a persistent institutional pressure to succumb to auditwork. Several academics examine the role for new reporting systems, risk maps and interactive forms of “risk talk” in overcoming the auditwork drift (Pentland 2016; Arena et al 2017; Mikes 2009; 2011; 2014; Boholm and Corvellec 2016). However, in settings where safety is a strategic priority, there is a greater emphasis on rule-based compliance (Macguire and Hardy 2013; 2016). Overcoming this drift towards auditwork may involve intense negotiations entangled within an institutional infrastructure of everyday risk management. It is therefore important to consider the dynamics of negotiations. To do this Power (2016) recommends situated studies of riskwork ‘in action’.

Hilgartner (1992) describes the contextual construction of risk as an emplacement of danger (a situation or activity) conceived as a risk object. Emplacement is a process of constructing a relationship between the danger and the severity of consequences. This involves value-laden judgements to evaluate the object’s significance as well its worthiness of protection. Studies of risk artefacts describe the importance of an apparatus of plans, maps and models to instrument action by ‘rendering risks visible’<sup>6</sup>(Hall, et al 2016; Jorgensen et al 2016; Palermo 2017; Power 2007; Jordan et al 2013) For example, Jordan, Jorgensen and Mitterhofer (2013) conducted a 3-year study of the role of a standardised risk map on a large-scale gas plant project. Here the risk map played a key role in settling agreement at key stage-gates. They describe how the map acted as a mediatory instrument coordinating distributed actors and adjudicating interests to build confidence in the project. It also played an important role in gradually co-orientating priorities amongst the diverse project partners.

Quattrone (2017) describes how the dashboard sustained progress by providing a visual performable space that mediated the contemplation of dichotomic trade-offs. Rather than removing tensions, it provided a space for discussion as a “maieutic machine”<sup>7</sup>, generating questions rather than providing answers. The role of doubt in challenging taken-for-granted assumptions is an important theme across Quattrone’s work (Quattrone, 2009; 2015a; 2015b; Busco and Quattrone, 2016’). Busco and Quattrone

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<sup>7</sup> Quattrone refers to Maieutic from the Greek translation of knowledge emerging from the process of inquiry. This is explored in Busco and Quattrone (2017) where they explain that the Latin ‘Machina’ (machine) is less about predictive movements and more about construction. Here the Maieutic machine constructs inquiry through its use.

(2016) examines how the Balanced Scorecard combined fixed and adaptable features which helped with the iterative process of reconceptualising strategic indicators. In Quattrone (2017), the dashboard's four-quadrants provided a space to see, imagine and contemplate what was known in terms of cost and schedule and what could not be known in terms of possible risk. However, to understand more about its use in generating wise decisions, he recommends considering the genealogy and historical specificity of the dashboard's use (Quattrone 2017, p605).

In summary, both Jordan et al (2013) and Quattrone (2017) describe how artefacts can provide a mediatory space to engage collective deliberation and contemplate different notions of performance and risk. Riskwork studies also describe how artefacts are used to audit the responsibility of others in ex-post investigations. In this context, their use is less about contemplative deliberation and more about bureaucratic auditwork to verify that duties are compliant with expectations. As discussed earlier when dealing with emergence, an emphasis on auditwork may lead to blame avoidance and anxiety rather than the management of risks.

## **2.6 The dynamics of riskwork and emergence**

Power recommends untangling the balance between auditwork and riskwork by carefully examining how artefacts instrument attention within the spaces where risk management takes place. For example, risk registers often shape attention towards audit trails to provide proof of due process (McGivern and Ferlie, 2007). This emphasis on auditwork is conceptualised as when “the tail of accountability and possible blame” wags the “dog of risk management” (Power, 2016, p281). In other settings, artefacts such as risk registers may be used to explore relationships between performance and different notions of risk. In settings that emphasise safety and reliability, there is a persistent tendency towards rule-based compliance that can stifle inquisitive search and novel forms of inquiry. Not succumbing to a drift towards auditwork may require effortful action. In some contexts, “it may also be the case that riskworkers imagine that they are actively managing risks” when they are merely “designing representations” to prove good governance (Power, 2016, p281). It is therefore important to consider actual riskwork and auditwork practice within a situated context.

Power (2016) notes that there is a gap in riskwork literature that observes its path dependent development over time. Despite this several accounting scholars have used the concept of an “infrastructure” to consider the temporal patterns of formation in interconnected systems of artefacts. For example, Kornberger, Pflueger and Mouritsen (2017) study of platform organisations (Uber, Facebook) considers the central role of evaluative rating infrastructures in enabling growth. Power (2015) studies the Impact agenda in UK Higher Education by tracing the accretion of a socio-technical infrastructure of ideas and people that led to the birth of the impact case study. Similarly, Kurunmaki and Miller (2013) study business failure and the historical development of an infrastructure of narratives and calculations (ratios, ratings, forecasts) to define failing. Commonly, this literature describes

patterns of infrastructure formation as a scaling-up of multiple technologies and processes where guiding principles accumulate over time.

In contrast, literature examining the temporal development of riskwork practice observe patterns of formation that are more contested and episodic (Tekathen and Dechow 2013; Mikes 2009; Palermo 2016). Here the qualification of risk differs from other forms of commensuration because it involves documenting the absence of certainty. Mikes and Kaplan (2016) note a potential “revealing hand” of a risk apparatus when the setting enables learning and debate. Mikes (2009) explores the concept of “risk talk” as a sharing of concerns and collective envisionment of strategic risks. However, she describes how this is only possible when the “calculative cultures” of control foster an environment that encourages interactive debate. This point is echoed in Palermo (2016) where he notes that speaking-up about risk where safety is a strategic priority may require affirmative rewards.

Arena, Arnaboldi and Palermo (2017) field-study of the implementation of an Enterprise Risk Management system is an important paper that observes the formation of a risk infrastructure amidst professional struggles for control. Here the risk infrastructure was conceptualised as a “master narrative” knitting together an “ensemble” of routine work arrangements. However, risk routines were unstable because of contested struggles between risk experts keen to consolidate risk reporting and managers who required relevant information for local decision making. The master narrative provided temporary stability in work arrangements, representing the normative categories of risk rendered visible. However, the master narrative also exposed excluded categories of risk that did not ‘fit’ within the existing risk infrastructure. Drawing on Star (1996; 2010) work on information infrastructure development, Arena et al describes these as ‘residual’ categories of risk. In Arena et al (2017) these categories played an important role in destabilising the master narrative by triggering contested negotiations about which risks were more worthy of attention. This study demonstrates how by augmenting longitudinal studies beyond a single artefact to a wider infrastructure of work arrangements, it is possible to observe patterns of evolution in response to emergent change.

## **2.7 Synthesis of literature themes**

Large scale infrastructure projects have a well-documented history of failure. Although project studies scholars describe non-linearity and variability in the management of megaprojects, traditional models of control work towards keeping the project on a predetermined track based on a knowable risk appetite. Studies of governance across large scale projects describe the importance of creating an environment for cooperation with the adoption of regulatory and relational governance mechanisms to foster mutual adaption. However, Flyvbjerg (2012; 2017; 2009; 2005) clearly documents a long history of competing vested interests that manifest in overpromising of project deliverables. This starts in the early stages of a project and leads to flawed and underspecified plans. Davies et al (2017) describe the importance of flexible delivery models that are capable of strategically adapting in response to emergence.

Heathrow Terminal 5 is described as the first major flexible delivery model, based on partnering and performance improvement through integrated teams. In contrast, T2 seemed to engender inflexible regulation, rigidly defined roles and a fixed allocation of risk. Despite this, Quattrone (2017) observes a dashboard mediating trade-off choice. Zerjav, Davies and Edkins (2018) also observe flexible and adaptive routines in the handover of T2. *This leads to questions about the composition of the regulatory apparatus on T2 and how it evolved over the programme to accommodate emergent risk*

By adopting a riskwork lens this paper considers the translation of the initial regulatory apparatus into detailed work arrangements. Rather than focusing on the narrow technical activities bound within a risk department, this approach considers riskwork as a distributed activity where an apparatus of plans, maps and models are also part of organisational account-giving. Previous studies of the role of visualisations in large-scale projects by Jordan and Quattrone describe the role of dashboards and riskmaps in adjudicating interests and settling tensions. Quattrone (2017) describes the dashboard's semiotic significance as a visual space to consider compromises whilst inspiring contemplation about the unknown. However, field studies of riskwork in environments where safety is a strategic priority, observe a persistent drift away from contemplative deliberation towards looking to hold others to account for risk.

These points reveal the benefit of undertaking a longitudinal study of the regulatory apparatus on T2 to track how the programme evolved from an emphasis on boundary preservation to the dashboard period of discovery and beyond. Arena et al (2017) describes the fragility of risk infrastructures and the power of residual risks in triggering contested debates about exclusion. With this in mind, this paper examines the emergence of residual categories of risks and the detailed responses in terms of maintaining or adapting riskwork activities. The next section explores the methodology developed to do this.

### **3.0 Methodology**

A process approach was adopted to trace the temporal patterns of formation and evolution in riskwork practice before and after the dashboard. Initially the study focused on developing a chronology of instruments and practices used to manage risk over the lifecycle of the programme. Here we considered the changing composition and arrangement of programme-wide performance reports, key forums and programme-level processes designed to manage risk. Temporal bracketing provided a technique to break the data into blocks of time (Giddens 1976; Langley 1999; 2009a; Cacciatori 2012). The challenge for this bracketing approach was to identify periods of disjuncture in the temporal flow of routines. Here the concept of a master narrative and residuals were used to identify unsettled periods that led to a significant modification in the prevailing riskwork routines. These breakdown episodes provided a basis to carefully examine changes in riskwork (Langley et al 2013). The definition and effects of residual categories of risk were analysed in depth and this led to a study of the nature of modifications in riskwork practice.

### 3.1 Data Collection

The field study started in the autumn of 2014 shortly after Terminal 2 was opened. In the initial pilot study phase, industry documents were studied to consider the background context for reform in the governance of risk in the construction of major infrastructure programmes in the UK (1990-2019). Data was collected over 18 months with 24 interviews, direct observations, project-based, industry and policy documents. Further industry-level data was gathered through unstructured interviews, a conference and central government work groups. Project-based data included observations and unstructured interviews over a 14-month period from the winter of 2014.

The T2 case study covers the period 2008-2014 with 2 main programmes of construction, at Terminal 2B (T2B) and the main Terminal 2A (T2A). The case focuses on T2A which represented the majority of the programme<sup>8</sup> which was centrally managed through a consistent programme control methodology. Gradually, a large database of documents (1999-2014) was collected of project control timetables, procedural descriptions, process flows, checklist, power points and spreadsheets. Technical training was necessary as well as access to commercial and control professionals to understand their use of language, perceptions and world views.

The sensitive and specialist nature of the topic required access to people with sufficient experience to understand the context of performance management issues. The sampling strategy was purposive (Palinkas et al 2015) to select interviewees with either strategic or in-depth expert knowledge, As the study progressed more informal access was granted to the project ecosystem. The *appendix table 1* describes the 62 hours of interviews with 20 interviewees with a variety of professional backgrounds that were engaged on Heathrow projects. Over the time the study benefited from less formal engagement and immersion in the field to develop a contextual depth for ‘ethnographic sensibility’ (Star 1996; Adler and Adler 1987). All participants were anonymised and 52% agreed to be recorded and transcribed.

#### *A phased approach*

Data collection commenced in 2014 with a pilot study followed by: Phase 1 (developing a comparative case); Phase 2 (joining the ecosystem) and Phase 3 (policy reform). The pilot study started with gathering comparative data to examine similarities and differences between T2 and previous large-scale construction programmes at Heathrow. Because planning for the construction of T2 started within a year of Terminal 5 opening, people with significant roles on *both* T2 and T5 were invited to interviews. These unstructured interviews focused on comparing and contrasting (Buchanan and Bryman, 2009) the different governance and risk management approaches on both T2 and T5. At the end of this initial phase more early stage finding were shared and access was granted to project-level people and

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<sup>8</sup> The T2B (£0.6bn) 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 here doesn’t include this element of the Terminal 2 programme.



documents. The second phase was a period of full fieldwork ‘immersion’ studying performance reports, dashboards and commercial documents. These documents were used to create a timeline of critical events on the programme. By phase 2, contacts snowballed and an industry “tutor” (Cacciatori 2012) sponsored data collection efforts with advice on a sampling strategy of interviewees and participants. The final phase involved attending industry and government events and interviews snowballed into meetings with central government. During this phase, several working groups were formed which provided useful forums to triangulate and hone the main conceptual themes.

The data collection period was longer than anticipated because of the proprietary nature of the topic. Interviewees typically involved people with a high-level of professional and technical knowledge. The sampling strategy focused on building a data set of interviews with people who had experienced the evolution in the risk management methodology across both T5 and T2. Triangulation between interview transcripts, technical control documents and cyclical performance reports revealed timeline and conceptual gaps which resulted in a later wave of interviews (see appendix for details). Involvement with working groups in phase 3 helped to contextualise the research within a broader industry and policy reform setting.

### 3.2 Analysis

Data analysis was structured in 3 stages: an exploratory stage, full fieldwork and finally tracing the patterns of development across the riskwork infrastructure. The initial phase involved abductive moving “back and forth” between the data, research questions and literature to identify gaps (Langley et al 2013; Eisenhardt 1989). The initial focus was comparative and trying to understand the transition from the celebrated business partnering approach on T5 to a framework of risk management that emphasised asserting accountability through rule-based sanctions and targeted awards. Bracketing off the data into riskwork phases was the final part of the analysis. This led to a period of analysing critical events alongside the mediatory instruments used to shape riskwork. Finally, within each phase a timeline of critical events (Langley and Tsoukas, 2017) of riskwork arrangements emerged.

During the full fieldwork a conceptual framework emerged that helped to structure the phases of riskwork into distinct categories for more scrutiny. The intention of the conceptual framework was to identify the master narrative underpinning riskwork arrangements within each phase. Gradually a plot was developed describing the risks deemed to be most worthy of protection and the mediating instruments that enrolled attention. This took months of notetaking, re-reading and scrutinising of interview transcripts as well as a dialogue of questions with contacts in the field to place specific mediating instruments on the control timeline. Gradually a sequence of events emerged that brought together the data from a variety of documents (Langley 1999; Pentland 1999). This formed a written ‘plot’, that acted as a sensemaking document (Langley 1999) to interrogate assumptions, meanings, drivers and contentions within each phase (Pettigrew 1990; Braun and Clarke 2006)

Thematic analysis (Braun and Clarke 2006; 2012) was used to identify initial patterns in the data. Open coding in NVivo was developed to search for the master narrative by building a hierarchy of themes and sub-themes within each phase. Bottom up coding resulted in the main sub-nodes for each phase which were structured around the headings “mediating instruments”, the “master narrative” and “residual categories” for each phase. The descriptive meaning for the parent theme was gradually refined through an iterative process of writing the plot whilst scrutinising existing data (Braun and Clarke 2006; 2012). This structure of one dominant parent theme and a variety of child sub-nodes grouped under the three main headings was repeated for each phase.

Gradually higher order themes describing each phase were rationalised and refined into a paragraph summarising each phase (Braun and Clarke 2006; 2012). The three phases were: Phase 1 “one version of the truth”, Phase 2 “dashboard” and Phase 3 “golden thread”. An overriding theme was developed to describe concerns for risk within each phase. For example, in phase 1 “integrity” described concerns about the consistency and reliability of baseline plans. Residual categories of risk associated with ‘blame avoidance’ and ‘unreliable/safe’ forecasts were examined. For each of the three phases the changing composition of mediating instruments, the machinations of modification and the inclusion and exclusion of major risks were analysed. The final stage of tracing the development of the riskwork infrastructure across the dataset involved linking each phase together by analysing the drivers for the transition between phases. Gradually, a model of the actual progression across the programme emerged which described how progress was sustained across each riskwork phase. In the next section we consider the findings, starting with the industry context.

## **4.0 Findings**

### **4.1 The industry context**

For over 20 years policy reports described a strongly ingrained adversarial culture within the construction projects (Egan 1998; Latham 1994; Constructing Excellence 2009; ICE 2013). Part of this issue was fierce competition in the bidding stage with contractors routinely over promising benefits and under-pricing cost. These reports describe the need for rigorous procurement mechanisms to deter misrepresentation. Recommendations emphasise improved cost containment and clearer accountability structures. Within this setting Heathrow was considered an exemplar client; one of a “minority” (Constructing Excellence, 2009) able to implement principles of business partnership and performance improvement. A narrative of cost transparency was presented as part of an ethos of partnering:

*“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: a. Making fair and proper reimbursements, b. Understanding the value and benefit of proposed and incurred costs”*

*(T5 Handbook, 1998, p346)*

The bespoke T5 Agreement guaranteed reimbursement of ‘within scope’ costs. Incentives were developed to reward opportunities for programme-level performance improvement and cost savings. Riskwork practice encouraged ‘actively working the interfaces to remove hidden agendas’ (T5 Handbook, p10) for the benefit of the whole programme. Rather than preserving boundaries, suppliers were encouraged to proactively solve problems to mitigate emergent risks and performance shortfalls;

*“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”*

*(T5 Handbook, p8)*

By 2009 the economic downturn had increased the prevalence of insolvency. An important policy report ‘Never Waste a Good Crisis’ described commercial tensions in the construction sector:

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

*(Constructing Excellence, 2009, p20)*

In this harsher commercial environment increased supplier litigation claims affected the willingness to enter into partnership agreements.

#### 4.2 The ‘Right Kind of Bribe’ at Heathrow Terminal 2

During this period plans to build a 180,000m<sup>2</sup> terminal building (T2A), multi storey carpark and a satellite pier (T2B) on the eastern campus of Heathrow were signed off in the Heathrow masterplan in 2007. In 2009 Complex build integrators (CBIs) were appointed to oversee the management of the supply chain for the programme. The commercial framework for T2 reflected a major departure from the partnership ethos of T5.

The Capital Delivery Director commented that:

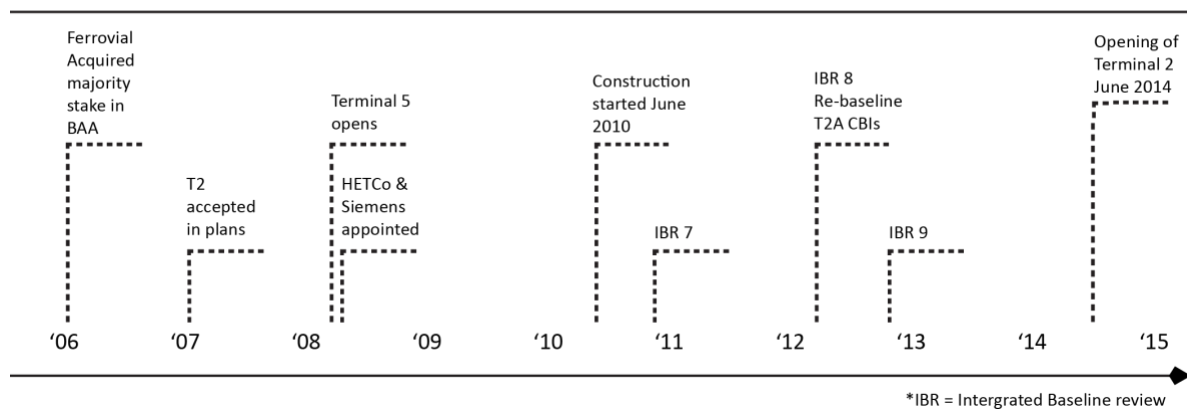
*“...Partnerships work well in small businesses and marriages, but billion-pound capital programmes are too big to work around well-meaning best intentions”* (Morgan 2009)

On T2 emphasis was placed on auditable oversight by the client holding contractors to account against clearly articulating plans. The move to an industry-standard new engineering contract (NEC) with roles assigned ‘up front’ was considered a better way to manage change. Quoting the American poet Robert Frost, the Heathrow Capital Director noted that “Good fences make good neighbours” (Morgan 2009).

HETCo was commissioned to design and construct the T2A terminal building and Siemens to oversee the Eastern Campus Baggage Programme. The CBIs shared risks and gains with Heathrow through a

fixed percentage “pain-gain” formula<sup>9</sup>. A large incentive pot for safety and quality initiatives was set aside as an award fee, known as the “right kind of bribe”. This award fee supplemented the pain-gain calculation by £10m creating an incentive for performance improvement beyond the containment of costs.

Figure 1: The Terminal 2 Timeline of Key Events



A Heathrow-wide process called the “Integrated Baseline Review” (IBR) provided the strategic forum to evaluate programme-level risks. By the winter of 2010 IBR7 focused on testing the integrity of the schedule and modelling alternatives. By 2012 IBR 8 was a thorough review resulting in a new capital plan for HETCo and Siemens, described as ‘re-baselining’. This represented a major reframing of the priorities for T2 and the following review, IBR9, was the site for intense debates to agree programme recovery plans.

The monthly performance reviews provided a space to consider risks worthy of protection. Overtime performance reports were modified:

*“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 (reports) 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.”*  
(ANO 2014)

Reviews evolved from responsibility audits to a patchwork of interwoven zonal maps to assess the impact of possible delays. Initially work package data from suppliers was aggregated to create a baseline plan and control accounts assigned accountability for specific work packages to CBI project managers. CBIs were held to account by comparing actual expenditure against control account budgets.

Later attention moved to assessing systemic risks by interrogating the schedules using zonal maps to consider the network of activities necessary to achieve the IBR9 recovery plans. In the next section we consider in more detail the patterns of temporal evolution in riskwork as the programme progressed.

<sup>9</sup> Formula 60:40 Heathrow Airport Limited: HETCo; 70:30 Heathrow Airport Limited; Siemens

### 4.3 Phases of riskwork

#### *One Version of the Truth (2010-2011)*

An open-book ethos permitted the controls team to test the integrity of assumptions underpinning task durations, handover points and interfaces. If the plans were robust and accurate it was possible to run risk models to stress test alternative schedules based on different operational configurations. However, the design of the pain-gain formula encouraged the CBIs to initially inflate the baseline plan. To act as a deterrent, suppliers were expected to justify actual performance and refine the cost and schedule forecast. A formal monthly reporting process was developed that emphasised one consistent version of the truth:

*“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”*

(ANO 2014)

The narrative of account-giving required suppliers to have the capability to tell a coherent story. Incomplete explanations triggered a latent concern of strategic misrepresentation where suppliers might mislead Heathrow with ‘safe’ plans packed with hidden contingencies. Emphasis on telling one version of the truth encouraged suppliers to offer up more realistic forecasts that would stand up to intense interrogation. Monthly performance meetings became a central forum to critically review monthly and year to date performance data. Over time the monthly performance reports (MPRs) were refined;

*“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”*

(ANO 2015)

Gradually a more structured infrastructure of account-giving was developed for the CBI to act towards. CBIs were already incentivised to contain baseline costs and meet safety and quality targets. The new MPRs attempted to open-up a discussion about strategies to improve efficiency. Productivity indices were developed to track shortfalls in cost and schedule versus the baseline plan. A range of completion dates were modelled using a sophisticated ‘quantified schedule risk analysis’ (QSRA) technique. However, although it was hoped that the MPRs would invite discussion about ways of improving value, the master narrative still focused on complying to safety and quality targets levels and justifying performance shortfalls. At a project level local riskwork continued to focus on tracking change to the original baseline line commitments. By 2012 productivity significantly fell behind the plan.<sup>10</sup>

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<sup>10</sup> HETCo’s planned spend was below 50%. The main risk was associated with HETCo schedule for the terminal. At this point delays also manifest in lags and misalignment in ICS

### ***The T2a Dashboard (2012)***

The dashboard created a space to problematise ways of improving productivity whilst making judgements about risk mitigation strategies. It compressed strategic priorities into a one-page report, that provided concurrent visibility of past performance and possible future risk objects worthy of protection.

*“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?”* (ANO, 2015).

The “pull” came from interrogating the schedule to consider strategies to mitigate delays whilst evaluating the impact of weaknesses and hotspots. The “focus” involved retaining high standards of safety and quality conformance whilst managing the risk exposure implied by the estimated cost at completion.

*The dashboard is shown on the next page.*



Figure 2: The T2A Dashboard

Source: Vine R (2018), Quattrone P (2017)

Central Section

The central section quantified how far the year to date schedule and costs were behind (red) or ahead of budget alongside safety (accident frequency) and quality compliance metrics. Risk measures considered the programme-level risk “pressure” based on how far risk contingencies covered the expected cost of risk.

Table 1: Summary of the features in each quadrant

Quadrant	Charts and Key Metrics	Description
<b>Schedule</b> <b>'Progress &amp; Weaknesses'</b>	<ol style="list-style-type: none"> <li>1.Float and trends in criticality</li> <li>2.Work Performed vs budget</li> <li>3.Total schedule variance</li> </ol>	<ol style="list-style-type: none"> <li>1. Weaknesses in the schedule were scrutinised by comparing % of critical activities versus a time contingency described as a 'float'</li> <li>2. Tracking trends in productivity to assign accountability and evaluate the absolute size of the variance to date (actual work performed compared with the budget.)</li> <li>3. Variance was broken down between HETCo and Siemens.</li> </ol>
<b>Cost</b> <b>'Overruns, Savings and Risk'</b>	<ol style="list-style-type: none"> <li>1.Baseline estimate at completion (EAC)</li> <li>2.Work performed v budget</li> <li>3.Pain/Gain = Target-EAC</li> <li>4.Trend charts tracked progress and persistent shortfalls</li> </ol>	<ol style="list-style-type: none"> <li>1.Latest cost estimate at completion.</li> <li>2.CPI and cost variance calculate the actual cost of work performed versus the budget.</li> <li>3.The pain/gain calculation assigned the differences between the baseline target and the latest estimates at completion to HETCo and Siemens</li> </ol>
<b>Safety/Quality</b> <b>'Conformance'</b>	<ol style="list-style-type: none"> <li>1.Accident Frequency Rates, Time Losing injuries</li> <li>2. Metrics assurance based on building control and sampling indicators</li> </ol>	<ol style="list-style-type: none"> <li>1. Safety was measured through tracking accident frequency rates and man hour activities per month.</li> <li>2. Quality and assurance activities indicated conformance to operational standards as a marker for waste and potential delays.</li> </ol>
<b>Risk</b> <b>'Risk appetising'</b>	<ol style="list-style-type: none"> <li>1.Risk Pressure based on expected level of risk</li> <li>2.Quantitative Cost Risk Analysis Values (QCRA)</li> <li>3.Change Order tracking and pipeline of Change requests</li> <li>4.Top risks by sub project</li> <li>5.Trends in P50</li> </ol>	<ol style="list-style-type: none"> <li>1.Risk pressure in the month considered the shortfall between the current financial risk provision and the expected levels of exposure.</li> <li>2. QCRA modelled risk forecast to track the level of risk contingency required and estimate the forecast at completion</li> <li>3. Change requests indicate the degree of change to agreed commitments</li> <li>4. Specific top risks</li> <li>5. Tracking of the 50% confidence levels that estimated costs will not overrun</li> </ol>

The schedule quadrant showed productivity trends. It analysed how far work performed was delayed or ahead of the levels committed in the budget. Specific weaknesses and exposure in the schedule were scrutinised by comparing the % of critical activities versus the contingency set-aside to mitigate problems (describes as a 'float'). The cost quadrant provided the detail to consider costs strategies to recover persistent over runs or opportunities to re-invest efficiency savings. The actual cost performance to date was considered alongside the latest cost forecasts to create an estimate at completion. The pain/gain calculation assigned the differences between the baseline target and the latest estimates at completion between HETCo and Siemens. Several trending charts tracked progress and persistent shortfalls over time. Safety was measured by tracking accident frequency rates and man hour activities



per month. Quality and assurance metrics indicated conformance to operational standards. Here a rising trend could be an indicator of persistent waste or operational problems that required the delivery directors to raise queries with the CBI.

#### *Dashboard risk*

The dashboard considered the programme-level risk pressure in the month calculated as the shortfall between the current financial risk provision and expected levels of cost exposure (based on a P50 levels of confidence). Factors that could increase variability in expected costs to completion were modelled in the quantitative cost risk analysis. Greater exposure could create financial pressure that might require additional provisions or action through the schedule to mitigate effects. Tracking the pipeline of change requests and speed of progression from early warning to the risk register, gave some indicator of the intensity of unexpected changes to the baseline. The top ten risk breakdown assigned accountability to specific sub-projects. This enabled the directors to consider strategies to either manage risks and or increase the contingency set aside to offset their effect. Trends in the P50<sup>11</sup> were linked to confidence that estimates at completion would not overrun.

Although the dashboard acted as a space to hold the leadership team to account, it was also a strategic space to reflect on progress to date and potential objects at risk. It was used as a forum for “risk appetising” to settle competing concerns for resources. Here the leadership team considered opportunities to generate savings to offset cost over runs or reinvest cost efficiencies. Innovative risk management techniques were developed from these debates. For example, operational scenario planning described as ‘shock absorbers’ were created to examine ways of provisioning for additional time in the schedule. These strategies de-stressed schedule hotspots where interdependencies might amplify the effect of delays. Float techniques were considered to facilitate time-pacing within the schedule to reconfigure the intensity and direction of efforts. Quantitative schedule risk analysis (QSRA) was used to statistically test the parameters of variation embedded within the schedule. The analysis could also be used to audit and test the critical path whilst assessing impact.

#### *Lack of ‘local’ relevance of the dashboard*

Gradually more sophisticated risk exposure techniques considered alternative plan and milestone configurations. Many of these activities took place centrally in the lead up to the integrated baseline review – IBR8. Modelling of variability required a robust definition of scope.

*“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 good cost plan and I can’t give you a good schedule. And I certainly can’t manage your risks*

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<sup>11</sup>A P50 refers to confidence levels based on a Monte Carlo scenario simulation of costs

*because all of those things all stem from here. And if that's flawed and then we don't move on in a very constructive way."* (ANO, 2015)

Suppliers were responsible for providing the assumptions underpinning HETCo's scheduling priorities, task durations and work package interdependency. Here risk could arise out of oversimplified phasing and timing assumptions. However, providing an accurate forecast required suppliers to be included in cross-organisational risk talk. Despite this the CBI continued to emphasis auditwork with little incentive for suppliers to be involved in the proactive management of risks.

In summary, throughout 2012 the dashboard provided a visual space to problematise plans to improve productivity whilst assuring acceptable levels of safety and risk. However, there was no opportunity or forum to share this dialogue with the wider supply chain. The dashboard provided a strategic space to develop new baseline targets that were agreed in November 2012 through Heathrow's Integrated baseline review (IBR9). From this point onwards a new riskwork infrastructure emerged to steer suppliers towards the recovery plan.

#### ***Golden Thread (2013-2014)***

The golden thread describes the final phase where riskwork aligned programme-level recovery plans with a schedule of 9000 incomplete activities. In the past, performance meetings had focused auditwork with lists of tasks and completion dates that provided proof of who should be held responsible for blockages. During this initial 'Sprint' phase there was a rapid move away from unfocused lists to carefully designed reports:

*"How do you look at a drop-line list and say whether it's good, bad or indifferent in different geographies of the building."* (C3, 2015)

The new reports described what was considered "good, bad or indifferent" by evaluating the impact that delays might have on cost and schedule milestone outcomes. Fortnightly meetings provided a forum to discuss local blockages and action to mitigate delays. Performance reports were developed to steer the dialogue towards delivering the critical path. Top ten critical supplier rankings celebrated suppliers who were able to deliver ahead of schedules. Critical path analysis was supplemented with metrics, such as the Schedule Performance Index (SPI) to monitor persistent delays. The Sprint programme was replaced by the 'Programme for Success' and by 2013 suppliers were finally offered financial incentives to reward specific schedule and cost milestones.

At this stage of the programme there were significant issues with the door fit-out. Although a door seems like a basic construction, its production requires a complex network of tasks. Various issues delayed the completion of doors linked to fire tests, laminate types, positioning of metal strips and manufacturing delays. Programme-wide monitoring of the door SPI created a visibility of progress. Fortnightly meetings provided a forum to agree the root cause of delays and set mechanisms in place

for resolution. The door example illustrated how the rapid development of an infrastructure of reports, metrics and meetings finally provided a ‘golden thread’ of everyday practices to mitigate further delays. Reports and meetings rendered progress more visible whilst enrolling suppliers into a new form of interactive risk talk. Suppliers were finally engaged as riskworkers making judgements about the relationship between the impact of their decisions on the delivery of the critical path. In this final period, the attention of suppliers was steered away from boundary preservation and defending individualised schedules. Instead the modified riskwork infrastructure created a master narrative inviting the supply network into interactive debates about how to sustain the delivery of the golden thread.

#### 4.4 Evolution of the riskwork infrastructure over the life of the programme

The riskwork infrastructure evolved in three phases described below:

Table 2: Riskwork Infrastructure (2010-2014)

	Phase 1	Phase 2	Phase 3
	<p>“One version of the truth”</p> <p>The regulatory apparatus emphasised auditwork to verify the reliability of plans. The monthly performance reviews &amp; IBRs provided a space to develop confidence in the integrity of the baseline data as the single version of the “truth”.</p>	<p>“The Dashboard”</p> <p>The monthly reviews became a forum for client oversight. The dashboard aggregated past and future performance into a programme-level map. It acted as a strategic space to agree pathways to improve productivity whilst mitigating safety hazards and risks.</p>	<p>“Golden Thread”</p> <p>Suppliers were finally engaged as riskworkers responsible for performance recovery. The golden thread tied recovery plans to supplier priorities through a network of incentives, metrics and reports. This steered attention towards the critical path to completion.</p>
<b>Master Narrative for Riskwork</b>	<ol style="list-style-type: none"> <li>1. Blame avoidance: passing accountability for performance shortfalls to others.</li> <li>2. Unreliable forecasts: tendency towards “safe” forecasts packed with contingencies to hide risks.</li> </ol>	<ol style="list-style-type: none"> <li>1. Risk exposure: insufficient risk provision to offset over run to date.</li> <li>2. Justifying past: ex-post focus on shortfalls rather than future recovery.</li> </ol>	<ol style="list-style-type: none"> <li>1. Further delays: urgent need to engage suppliers in ‘risk talk’ to develop the new recovery programme</li> <li>2. Poor visibility: of critical activities and supplier responsibilities on the critical path.</li> </ol>
<b>Mediatory Instruments</b>	<ol style="list-style-type: none"> <li>1. Contract responsibilities: clearly defined “good fences make good neighbours”.</li> <li>2. Pain-Gain formula shared risk of over runs with the CBI.</li> <li>3. MPRs, IBRs to hold CBIs to account for schedule/ cost shortfalls and safety and quality compliance.</li> </ol>	<ol style="list-style-type: none"> <li>1. Dashboard compressed ambiguity to focus on strategic choices.</li> <li>2. Monthly reviews provided a forum to agree compromises</li> <li>3. IBR8/9 became an oversight forum to re-baseline priorities and develop programme recovery plans</li> </ol>	<ol style="list-style-type: none"> <li>1. Suppliers were offered financial incentives to deliver critical milestone outcomes.</li> <li>2. Fortnightly meetings provided a space to search for credible reasons and agree solutions for delays.</li> <li>3. Reports and metrics steered supplier attention towards critical activities.</li> </ol>
<b>Residual Risks</b>	<p>Lack of strategic focus: Master narrative focused on proving integrity of the plan. Lack of opportunity to consider strategies to recover performance</p>	<p>Lack of direct supplier engagement: Dashboard debates about programme-level risks and opportunities had little local relevance. There was no forum to interactively engage suppliers.</p>	<p>Programme wide complexity: Initially the golden thread did not prioritise interdependent activities, such as the door fit-out. In response, the riskwork infrastructure was adapted to close the gap.</p>

##### *Phase 1 – ‘One version of the truth’ (2010-2011)*

Since the economic downturn there was a persistence of underbidding and overpromising to win new contracts. However, once the contract was signed, there was a tendency to force contractual extensions and legal claims. To mitigate this, auditwork emphasised testing baseline plans and closely monitoring progress. A timetable of reviews was developed to provide a space to hold the CBI to account. The

emphasis here was on the development of a reliable baseline plan. Although the award fee was designed to steer the CBIs attention towards improvement in safety and quality improvements, it did not deter “safe” forecasts. The contract, pain-gain formula, MPRs and IBRs mediated auditwork enabling the client to test the integrity of the baseline forecasts to ensure that it was sufficiently robust to judge progress. However, there remained a lack of space for the client to develop programme level strategic oversight and deter the CBI from hiding risk. Over this phase a residual category of risk emerged associated with a lack of opportunity to agree programme-level strategies.

#### *Phase 2 – ‘The Dashboard’(2012)*

There was now a need to agree recovery plans whilst addressing schedule weaknesses. The lack of space for the leadership team to search for options to recover productivity led to the creation of the dashboard. The dashboard compressed ambiguity in to four quadrants to encourage critical inquiry into strategies to mitigate schedule shortfalls whilst limiting the exposure to risk. Risk provisions were scrutinised to ensure that anticipated cost over runs were offset by programme-level contingencies. Programme-level risk appetising involved modelling savings using shock absorbers and time pacing techniques to consider how to speed up and destress the schedule. By IBR8 these activities enabled the client team to develop a recovery strategy, however, there was limited opportunity to engage suppliers in a wider narrative of discovery or reflect on reasons for delays.

#### *Phase 3 – ‘The Golden Thread’ (2013-2014)*

Finally, suppliers were engaged as riskworkers and invited to make judgements about how to turnaround performance. A golden thread of financial milestone incentives, fortnightly meetings and performance metrics steered attention towards collective recovery rather than individual schedules. Urgency and poor visibility of programme-level progress resulted in refined performance reports that shaped shared purpose towards delivering the critical path. However, residuals risks associated with programme-wide activities such as the door fit-out required a rapid adaptation of the riskwork infrastructure and the scrutiny of targets (such as the door SPI) which were previously outside of the master narrative.

In summary, the riskwork infrastructure evolved from a regulatory apparatus that emphasised the giving of consistent accounts as a ‘one version of the truth’ to a period of search mediated by the ‘dashboard’. In the final stage, the master narrative emphasised urgency and local visibility primary risks. A ‘golden thread’ of incentives, reports, meetings and metrics were developed to mirror aspirations for programme recovery within the routines of local suppliers.

## 5.0 Discussion

The purpose of this study was to understand how the T2 risk apparatus accommodated unforeseen and emergent risks. To do this we studied the changing composition of the regulatory apparatus. The findings describe a flexible risk management apparatus strategically adapted to manage the emergence of residual risks. Initially the master narrative of risk management emphasised testing the integrity of baseline plans to deter strategic misrepresentation. Gradually performance reports and forums provided strategic spaces to agree how to adapt plans and reallocate responsibility. However, over phase 1 client teams became more capable of asking critical questions which revealed a divergence in priorities. By phase 2, the dashboard provided a space to examine the strategic relationships between risk exposure and improved productivity. Although it did not provide a forum to engage a performance dialogue across the whole programme. Instead, the IBR provided the space where the CBIs were expected to formally account for deviations in plan. By IBR 8 the CBIs conceded the need for a recovery plan. In IBR 9 the client forgave performance shortfalls and responsibilities were re-assigned to those most capable of generating incremental revenue. By Phase 3 the master narrative emphasised urgency and a timetable of fortnightly performance meetings created an interactive forum to agree priorities. Reports and new performance indicators rendered supplier contributions comparable to programme-wide priorities whilst visibly tracking progress on the critical path. Emergent risks, such as delays in the door fit-out were mitigated by adapting the risk infrastructure to make residual risks visible within the “golden thread” of reports, metrics and participatory forums.

### *5.1 Riskwork implications for traditional models of project control*

Riskwork on T2 moved away from the traditional conceptions of risk management in large-scale projects as a practice to eliminate incertitude and deviations from plan. The initial delivery model emphasised the client, as a procurer, overseeing the execution of delivery responsibility by others. However, over time client teams adjudicated tensions between executing and adapting plans. Here the standard apparatus of reviews, reports and reporting forums was adapted to act as a mediatory instrument to enrol deliberation. This apparatus provided a space to evaluate the threat of residual risks and weigh up how to sustain continuity.

On T2 rather than executing the plan within the boundaries of a fixed appetite for risk, we observed an iterative model of project control. This approach departed from the commonly observed one-size-fits-all model described by Lenfle and Loch (2010). Instead, the master narrative was progressively adapted to capture residual risks. The iterative nature of this process led to the gradual conditioning of normative conduct of suppliers to accept responsibility for managing new and emergent risks. This process partly echoes Levitt and Scott (2017) description of how relational governance mechanisms can reinforce cooperation. However, in the case of T2 it was the riskwork apparatus rather than contractual clauses that progressively instrumented a changing appetite for risk over the project life.

The riskwork literature warns that if agents focus on managing risks to themselves, then performance results are likely to be disappointing. Riskwork studies associate success with continued efforts to manage risks deemed most worthy of protection. On T2 riskwork activities were adapted to mitigate emergent risks. However, initially the tail of “accountability and blame” did wag “the dog of risk management” (Power, 2016, p281). However, once the CBIs conceded the need for a recovery plan, IBR9 provided a forum to wipe the slate clean and re-assign accountability for recovery to those most capable of generating incremental revenue. Here the IBR provided a legitimate space to forgive unsustainable plans. By phase 3 the golden thread of meetings, incentives and metrics provided an infrastructure to enrol suppliers as riskworkers engaging in interactive risk talk. Gradually over the life of the programme the client purposefully managing a progressive drift from auditwork to effortful riskwork to mitigate emergent risks.

Empirically this case contributes to project studies by describing how the initial rigidity in a delivery model can be compensated for with a flexible control approach. Although the initial governance structure moved away from business partnering, gradually the infrastructure of reports and reporting forums reinforced the institutional conditions for contemplative inquiry and discovery. The adaption of the riskwork narrative created opportunities for innovation by learning from incertitude and responding to the emergence of residual risks. The findings echo Davies et al (2017) description of the role of dynamic capabilities in reconfiguring routines to survive the effects of change. However, the T2 case specifically highlights the importance of enrolment spaces (IBRs, MPRs) in enabling integrated debates about risk and accountability management. Rather than placing suppliers into a defensive narrative to justify performance deviations, reporting forums provided mediatory spaces to enrol others into agreeing which risks were most worthy of management and protection.

### *5.2 Managing emergence, residuals and drift*

This paper contributes to previous T2 dashboard studies by describing the trade-off tensions underpinning the context for its use. Quattrone (2017) describes the dashboard as a performable space that enabled users to simultaneously *see* and *imagine* performance concerns. Here the client leadership team acted as overseers balancing concerns whilst engaging in a productive debate to plan recovery strategies. However, by extending the study beyond the site of the dashboard’s use, we observe a performance crisis in 2012 and a replacement of the dashboard by the IBR as a forum to hold the CBI to account. By augmenting temporality beyond the dashboard phase, we observe what was included in the dashboard narrative and what was left out. A key point here is that a visualisation will represent the risks that are deemed worthy of attention at that time. However, on T2 the existence of residuals risks and specifically the lack of representation of local suppliers provided an opportunity to modify the riskwork infrastructure to better suit the continuity needs of the programme.

Arena et al (2017) describe a risk infrastructure as a fragile phenomenon tending to disintegrate when categories of risk deemed worthy of protection by some actors are excluded. The T2 findings describe a different response to the contested emergence of risk residuals. Instead of suppressing deviations, practices were adapted and the conventions underpinning the master narrative were refined. Here novel forms of risk provided a catalyst for learning. Risk residuals and their emergence were a generative driver for change and provided clues of how to improve the riskwork infrastructure.

This paper describes the importance of path dependency and temporality in shaping riskwork priorities. It observes a pattern of development where destabilising effects were managed through a sequence of deliberate interventions. This contributes to the riskwork literature by broadening the study beyond a single temporal transition. The findings reveal a diachronic pattern of interventions that managed the persistent drift from auditwork to effortful riskwork. This paper also illustrates the importance of context when studying the role of mediatory instruments within dynamic and complex environments. By observing the phases before and after the dashboard, the study uncovered more about the historical context for its use. This enabled us to uncover what was included in the dashboard narrative but also what was excluded and marginalised from dashboard debates.

## **6.0 Conclusion**

Initially the construction of Heathrow Terminal 2 seemed to be a major departure from the celebrated business partnering approach developed in the construction of Heathrow Terminal 5. The delivery model seemed to promote boundary preservation and compliance. Despite this T2 was delivered on time and to budget. This paper develops a longitudinal study of the regulatory risk management apparatus that enabled this success. By tracing the evolution of the programme through a diachronic sequence of phases it revealed an infrastructure of reports, forums and spaces that changed which risks were considered a priority. Here the functional role of the risk management apparatus went far beyond forecasting and measuring risks, to brokering consensus about which risks were made visible and who should be held to account. The iterative and collective nature of this process helped to gradually condition attention away from avoiding blame for emergent risks. By the end of the project, key suppliers were enrolled as willing riskworkers accepting responsibility for programme recovery. However, this was only possible because the emergence of novel forms of risk were not suppressed; instead they provided a catalyst for learning.

Project Studies literature document an unfortunate history of failure due to flawed plans and poor levels of cooperation. Recommendations include flexible governance structures with relational contracting mechanisms to inspire mutual adjustment when the project meets unforeseen changes. Innovation scholars note that the emergence of unforeseen problems can create opportunities for innovation and iterative learning. Here recommendations suggest strategically organising for change by developing capabilities capable of reconfiguring routines. However, much of the project studies literature is

focused on answering ‘what style’ questions (Burns, 2014) to provide advice to inform normative best practice. In contrast this paper focuses on the ‘how’ of situated adaption and the practices that transformed institutionalised control and risk management practices away from managing risk by transferring accountability to others.

This paper observes a departure from the traditional mechanised model of control based on a planned solution space and a known appetite for risk. Instead the T2 case reveals a plural and complex control environment. In this context, emergent risks became visible and actionable through the performance and risk management architecture. These findings open up a significant opportunity for future research to examine different forms of adaptive control architectures and the relationship between risk practice, innovation and learning from emergence. This could involve further research into the dynamics of enrolment spaces and their mediatory role in enabling learning through integrated debates about risk and accountability management. It is hoped that further understanding about the interplay between riskwork and auditwork will help to move away from managing risk by transferring accountability and demanding compliance.

Finally, this paper uncovers the importance of path dependency and temporality in the everyday management of project-based risk. The case describes how the dashboard was replaced by different forms of performable spaces to hold contractors to account, forgive past performance and engage suppliers in a more inclusive debate. It describes how a lack of visibility of residuals led to the augmentation and refinement of riskwork spaces rather than disintegration. These points are areas for further research, in particular more detailed studies into different patterns of formation and the generative nature of riskwork infrastructures as a catalyst for interactive debate.



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## Appendix 1

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 Policy Reform (autumn 2015)	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

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