The London School of Economics and Political Science

Translating the concept of sustainability into architectural design practices: London's City Hall as an exemplar

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Declaration

I certify that the thesis I have presented for examination for the PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified).

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To my parents

Christina and Wolfgang

Abstract

This thesis is a Science and Technology Studies (STS) inspired exploration of the design practices that brought London's City Hall (1997-2002) into being. The minister responsible for finding a suitable building for the Greater London Authority (GLA) ambitiously declared it to be an exemplar project of "environmentally progressive objectives, the principles of sustainability". Since there is much contestation about how to enact such an ambitious agenda, I as a form of theory in practice retrospectively follow architects, engineers, clients and others through the complexities of design process to investigate how the concept of sustainability and environmental problems were interpreted from the outset and then transformed into environmental (and other) design challenges and targets in order to guide and align the diverse practitioners who worked towards materialising City Hall.

In order to develop a better understanding of how environmental challenges were addressed during City Hall's contingent and unpredictable practices, I draw on the concept of translation to analyse how design problems were defined in the joint action plan to house the GLA, how design practices expanded through the concurrent production of design knowledge and association of additional heterogeneous elements, and how City Hall increasingly took shape through negotiations, choices, conflicts, transformations and adaptations. Through many translations the design briefing, building forms, landmark building requests, technological devices, specific interests, environmental performance targets, facade specifications and many other issues became reciprocally modified, reordered and stabilised.

I then use post-occupancy data to explore City Hall in operation (2002 to 2011) to develop an understanding of how its facility management produced knowledge about the headquarters' environmental operations. Thus I develop an account to what extent environmental performance targets were translated from the world of the design studio to the world of actual building operations.

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I owe particular thanks to those involved in my research who invited me to their offices and workplaces, who dedicated much time to discussions with me, who offered me access to comprehensive design materials, and who allowed me to reproduce their design visualisations in this thesis.

Many thanks to my entire family close and far, particularly to my parents Christina and Wolfgang Schröder, and my brothers Frank-Christian and Hanns-Herwig Schröder for their enduring encouragement, generosity and diverse forms of support. I also want to thank my partner Anne-Sophie Robinet for being there, for the patience, for the perpetual personal support, for the love she gave me and for embarking with me on new exciting projects.

Table of contents

List of figures

List of acronyms

AHU	air-handling unit
ANT	Actor-Network-Theory
BMS	building management system
BRE	Building Research Establishment
BREEAM	Building Research Establishment Environmental Assessment Method
CAD	computer aided design
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COP	coefficient of performance
DETR	Department of the Environment, Transport and the Regions
DOE	Department of the Environment
DTI	Department of Trade and Industry
DTLR	Department for Transport, Local Government and the Regions
F+P	Foster+Partners
FM	Facility Management
GHG	greenhouse gas
GLA	Greater London Authority
GOL	Government Office for London
HVAC	heating, ventilation and air conditioning
IEA	International Energy Agency
IGBP	International Geosphere-Biosphere Programme
IPCC	Intergovernmental Panel on Climate Change
KFEA	Knight Frank Estate Agents
PPM	parts per million
PVs	photovoltaics
REGO	Renewable Energy Guarantee Origin
RIBA	Royal Institute of British Architects
SOR	statement of requirements
STS	Science and Technology Studies
TTPM	Turner & Townsend Project Management
UNFCCC	United Nations Framework Convention on Climate Change

Chapter 1

Introduction

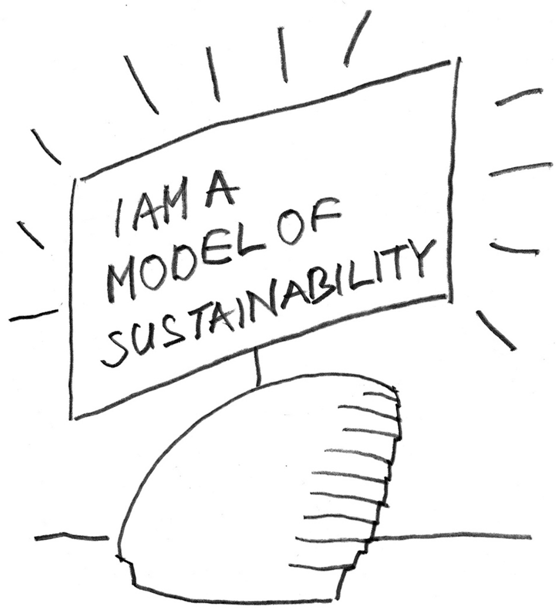

Figure 1.1 Foster+Partners attempt to ascribe and label City Hall unequivocally through a press release: "City Hall has been designed as a model of democracy, accessibility and sustainability" (Foster+Partners, 2002) (Drawing: Author, 2014)

1.1 Framing and translating the 'environmental problem'

More than three decades ago the 'environmental crisis' began to occupy important places in architectural debates and practices (cf. Hajer, 1995). The crisis has been increasingly addressed in association with 'sustainability' since the late 1980s - a "term [that] has come to stand for everything and nothing" (Crysler, Cairns, & Heynen, 2012b, p. 27). Architects, engineers, clients, politicians and others at least seem to agree that this crisis must be faced. However, behind this apparent consensus many ambiguities, contradictions and open questions emerge, while the environmental problematic seems to grow even more acute. There are still many uncertainties regarding how to understand and conceptualise the role of buildings in relation to 'environmental crisis' and 'sustainability'. Nevertheless, buildings can be understood as major environmentally destructive forces. It is through buildings that humans to a large extent impact on the planet and on the vital conditions of human existence. Through construction, operation and demolition, the impact of buildings on the environment is multifaceted in scope and includes a far-reaching geography of resource extraction, processing and related environmental damage.

Opinions largely vary on how to understand the problem of the environment 'out there', on how to define the environmental challenge that architectural design is to respond to, on how to align the (diverse interests of) various stakeholders involved, as well as on how to transform these questions into design strategies, spatial configurations and materialisation. These practices cannot just be confined to technological problem-solving as they essentially mesh a range of cognitive, cultural and material elements. The concept of translation presents a valuable analytical frame with which to understand the composition and continuously transforming architectural design challenges in response to particular interpretations of the 'environmental crisis'. Rather than limiting the scope to rigid analysis, instrumental debates or concentrating on best-practice guidelines only, I follow Simon Guy and Steven A. Moore in exploring what architects, engineers, clients and others "actually do in the everyday context of the studio and on site" (Guy & Moore, 2007, p. 16).

1.2 Case study: London City Hall

I use London City Hall to explore how architectural design practices gave meaning to the concept of sustainability and a declared ambitious environmental agenda. City Hall's architects describe this project unambiguously:

> One of the capital's most symbolically important new projects, City Hall [… is] expressing the transparency and accessibility of the democratic process and demonstrating the potential for a sustainable, virtually non-polluting public building (Foster+Partners, 2014).

City Hall was designed collectively by Foster+Partners architects, Arup engineers, More London developers, the Government Office for London (GOL) and others between 1997 and 2002. Nick Raynsford, the minister responsible for finding a suitable building for the Greater London Authority (GLA), declared:

> I was very conscious of the importance of the new building to be a statement about the new authority including its commitment to environmentally progressive objectives, the principles of sustainability. […] And it was important therefore that the building that the authority occupied should be compatible with that (Interview Raynsford, 2010).

The project's design practices are a unique object of research for a number of reasons. In the first instance, City Hall is the headquarters of the GLA, the regional government administrative body for Greater London that was established in 2000. This authority has a constitutional responsibility to promote the concept of sustainable development (UK Government, 1999, pp. 35-36). Secondly, Raynsford was not only the minister responsible for finding a suitable building for the GLA; he was at once Minister of State of the Department for Environment, Transport and the Regions (DETR) between 1999-2001 and in charge of the UK's Building Regulations, including *Part L* (conservation of fuel and power). The case study at hand is therefore of additional value to explore Raysnford's role and activities in exemplifying and enacting a supposedly ambitious environmental agenda through City Hall's design practices. Third, City Hall was designed by (amongst others) Foster+Partners architects, a prominent international practice that is attempting to brand itself as a credible leader in environmental design (see quote above). City Hall is one opportunity to explore this claim through the analysis of Foster+Partners' specific design activities during that building's making. In addition, City Hall's unique building form was given a key argumentative role within their environmental design strategy, an interesting claim that requires interrogation. Fourth, City Hall's design was celebrated in several magazines and books. But it was also controversially discussed between architectural design critics, newspapers and laymen. It thus presents a contested project of that is of wide interest. Fifth, although City Hall is not a large or tall building, many might perceive it to be one important landmark of London. And finally, the availability of post-occupancy data allows for analysis of the GOL's and design team's ambitious environmental agenda since completion of City Hall in 2002.

City Hall was designed between 1997 and 2002. The latest update to the Building Regulations *Part L* (Conservation of fuel and power – introduced in 1985) in 1995 focused largely on energy efficiency. James Thonger, Arup's Engineering Project Manager of City Hall, stated that a step change was only introduced later in 2002 (Interview Thonger, 2011), which shifted attention to building-related CO_2 emissions. At the beginning of City Hall's design practices, the Building Research Establishment Environmental Assessment Method (BREEAM) had not yet been widely established (Interview Spring, 2010) and was significantly modified with the then new *BREEAM 98 for offices*. And since the Brundtland Report "multiple versions of sustainability" were brought forward in policymaking and, particularly in the 1990s, the "simplistic managerialism of many initiatives […] left much to be desired" (Leach, Scoones, & Stirling, 2010, p. 39).

From the outset, the building was expected to lead by example. This implied a form of autonomy, since City Hall was set to outdo then standards in environmental building code requirements. The design collective was required to set in motion innovative practices and to define the problems of the environment and in turn translate these into design goals and strategies. Exemplar projects present important targets of research; John Law conceived them as particular "lessons on how to see and understand the world" (Law, 2004, p. 43). Susannah Hagan suggested that architectural exemplars "have a potential value out of all proportion to their numbers. It is for this reason one might be justified in devoting attention to them: architectural production can influence the rest of the building industry" (Hagan, 2001, p. xi).

In Chapter 7 I explore City Hall in its operation from 2002-03 to 2010-11. I analyse how the GLA facility management team produced knowledge about City Hall's environmental operation through recorded results, and how they attempted to evaluate to what extent environmental predictions that were defined during design development were translated in City Hall's actual operations and performance.

1.3 Approaching the pragmatics of City Hall's design practices

In this section I introduce the theoretical framework and methods through which I explore how City Hall was assembled in its specific design practices (see Chapter 2 and 3 for in-depth explanation).

My research builds on a broad conception of architecture. In my understanding, architecture organises forms, volumes, materials, signs and symbols and thus engages in processes of function, perception and communication. Architecture creates insides and outsides, directs material flows and suggests blueprints of occupation (Hauser, Kamleithner, & Meyer, 2011, p. 9). Architectural design brings together various forms of knowledge, diverse vocational actors and multiple spatial and temporal scales. These fluctuating worlds do not emerge through the strict application of simple rules and guidelines, but through conceptions, initiatives, interpretations, negotiations and choices. I therefore explore City Hall's design process as forms of heterogeneous assemblages. These explicitly reject a mode of thinking that rests on separately layered realities (e.g. the technical, the social, the material), including assumptions about the sole/autocratic influence of creative masterminds, and instead welcomes and encompasses the idea of heterogeneous characters and relational associations co-shaping each other. These elements are drawn together in the design practice through many translations.

Figure 1.2 Foster+Partners' Riverside Studio in 2002 (Photograph: Nigel Young and Foster+Partners, 2002)

To explore City Hall as freeze-framed through the glossy photographs of design magazines, through representations of Euclidean space (plans, section, elevations) or through the accounts of design processes by outsiders would be to ignore all the struggles, negotiations and compromises involved in bringing it into being. Instead, I consider City Hall as a "moving project", which emerges through "a series of transformations" (Latour & Yaneva, 2008, p. 80).

In order to develop an understanding of how the heterogeneous elements in City Hall's design process were assembled, I take a pragmatic approach and examine what architects, engineers and the wider design collective actually did in the daily context of their design studios, offices and on site (Guy & Moore, 2005; Yaneva, 2009). This allows me to question the hype and hyperbole surrounding this development and show it to be the heterodox production of an assemblage of different forces.

By moving in time and space, I open the black box of City Hall's design process and retrospectively follow architects, engineers, clients at work as I enter their several construction sites of facts, forms, strategies and technologies. Foster+Partners' Riverside Studio (Figure 1.2) was the architectural laboratory at centre in which City Hall was, in contingent and unpredictable processes, gradually assembled through diverse experiments. Through interviews with the practitioners involved and through design documents (plan sets, diagrams, charts, and presentation material), I examine the design process of City Hall along selected key design presentations and stages of the building design and construction process. The approach taken in retracing the design practices was to be as open as possible to any unexpected actors, elements and sites that might become drawn into the process.

My focus of attention is on design practices. I draw on selected ideas brought forward in the field of Science and Technology Studies (STS) as a way of exploring how City Hall became constructed through particular design knowledges, methods, classifications, interests, materialities and (non-textual) visual representations. In order to better understand the transformations actually occurring during the design process, I use an adaptation of the concept of "translation" (Callon, 1986) as my central analytical frame. Through translation, I can conceive how shared design goals (e.g. the concept of sustainability) were defined, human beings and devices enrolled, interests and roles (re-) aligned, transformed and reordered. Translations are not neutral: the concept of translation is a way to examine how power is located within the design process (Callon, 1986), to foreground "the struggle between the objectives and strategies of human actors and the performance of technical and natural actors" (Beveridge & Guy, 2009, p. 72), and to trace how "settlement on the often conflicting priorities of a variety of actors" (p. 73) was generated. The concept of translation further allows a retracing of the ways in which the world, as it is imagined and anticipated by designers, relates to the world of the actual design object and its operation (Akrich, 1992).

Translation allows the foregrounding of the concept of sustainability as interpreted for City Hall's design practices – how it was given meaning, how in a complex and dynamic process the concept became associated with other design requirements and thus was increasingly co-shaped by a heterogeneous set of parameters (a budget, time constraints, etc.). The transformations and displacements of the concept must be explored in relation to these other parameters.

1.4 Aims, research questions and limitations

In my investigation I give a detailed description of how London's City Hall developed through its design practices (1997 to 2002). Then I explore City Hall in operation, 2002-03 to 2010-11. My thesis intends to address a readership that is interested in questions of architectural design practices, design research, politics of design and the interrelationships between technology, society and environment.

My thesis does not explore how *outsiders* who were not directly involved in the design process – for instance architectural journalists, politicians and citizens – perceived and interpreted City Hall once it was a materialised artefact. I do not attempt to provide a universal definition of what "sustainable architecture" might entail. I avoid assigning the adjective "sustainable" to specific assemblages, for instance design strategies, technologies, materials or buildings. Instead, I suggest to step back and enter a more careful mode of reflection – I argue for the importance of shifting attention to the ways the concept becomes *transformed* and *displaced* (that is, translation) within specific practices targeted towards materialisation. Following the political scientists Maarten Hajer and Frank Fischer, I crucially understand *sustainability* to be a concept that in City Hall's design practices needed to be interpreted by giving meaning to it (cf. Hajer & Fischer, 1999). In other words, as just a concept sustainability could not be built - it essentially requires translation into contextualised definitions, strategies and more, since City Hall's design practices are specific and localised.

The scope of my thesis is defined by three research questions. Starting from the presumption that environmental design processes "critically depend on the specific social construction of environmental problems" (Hajer, 1995, p. 2)[1] and that the client commissioning City Hall needed to devise design challenges that could be addressed by the design team, I ask:

1. At the outset of the project, how were environmental problems constructed as an issue for design, and how were these transformed into particular targets and goals to instruct and align the architects, engineers and developers in making their design proposals? (Chapter 4)

This first question aims to capture an early moment in the translation process in which a shared problem for the design team is constructed as collective departure point and action plan. These problem formulations are constructed in response to particular understandings of the 'environmental crisis' and its relation to City Hall's design practices.

My second question focuses on how the design team interpreted and gave meaning to these design targets and goals and how design knowledge was produced and additional heterogeneous elements were associated within the design activities in order to progress the design development. To understand the many transformations and displacements, negotiations, choices, conflicts and adaptations through which City Hall increasingly took shape, my second question is:

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[1] I adapt this argument from Hajer who develops it for environmental politics.

2. How did the design team translate the environmental challenges and targets defined in the design briefings into design strategies, building technologies and the materialising building? (Chapters 5 and 6)

Following the completion and handover to the GLA, my third research question (set of questions) aims to explore City Hall's occupation process from 2002-03 to 2010-11. In May 2002 the GOL's initial plan to find, design and accommodate the GLA, which was associated with a proclaimed ambitious environmental design agenda, had been completed. The design team had in principle fulfilled their tasks, and initially about 500 GLA members assumed work in the new headquarters. The evolving design briefings were translated into hypotheses, design strategies, building forms, technological choices and materialisations through transformation processes. These translations were then put on trial in actual operation. Crucially, predicting environmental performances during design development was risky, since actual performance depended on a variety of rather unpredictable elements, for instance forms of occupancy, management and methods of measurement.

Finally, my third (set of) question(s) is/are:

3. How did City Hall's building infrastructure management conceive its main role and how did they attempt to create knowledge about the headquarters environmental impact of actual operation?

   What were the key results recorded?

   Based on these recordings, in how far did City Hall's completed design in actual operation achieve the projected environmental performance targets that were defined during design development to guide and align the multifarious translation processes targeted towards design materialisation? (Chapter 7)

1.5 Chapter outline

In Chapter 2 I expand and discuss my research approach to explore the design practices of City Hall. This chapter consists of three interrelated sections that inform my research. The first part, “Architectural practices and the ‘environmental crisis’”, highlights how within architectural design practices there seem to be widespread disagreements about how to define environmental problems to be tackled, which pathways to take, and how to assemble and materialise buildings in response. The second part, “Framing the ‘environmental crisis’”, lays out my approach to a conception of the environment and forms of environmental degradation as a prerequisite for my explorations. The environmental problematic is hardly ever debated in its entirety and discourses tend to prioritise particular conflicts over others. I discuss different concepts of environmental crises by focusing on the emblematic concepts of climate change and sustainability. The third part, “Exploring architectural design practices”, introduces the Science and Technology Studies (STS) inspired theoretical framework through which I retrospectively follow practitioners and elements through the heterogeneous and contingent design practices of City Hall. I begin situating this approach by briefly introducing STS origins and central ideas and by introducing two key thinkers – Bruno Latour and John Law. I then discuss how STS approaches have been transported to architectural studies, mainly through the work of Albena Yaneva. Finally, building on selected elements of Yaneva’s work, I explain the STS-inspired theoretical framework I have chosen, and how I use Michael Callon’s (1986) concept of “translation” as my main analytical frame of investigation.

While Chapter 2 outlines my investigations through a selection of specific perspectives and approaches, in Chapter 3 I describe how I gathered, analysed and represented the heterogeneous information I collected during my fieldwork. The two chapters are closely interlinked and inform each other. Within the STS-inspired approach, I combine a set of methods comprising case studies, semi-structured interviews and informal conversations, visual methodology and the production of graphical mappings. This set of methods demonstrates the choices and decisions I made as I carried out my fieldwork and data analysis, and as I wrote up my findings. The particular knowledge that I produced depended on and was created through these choices.

Chapters 4 to 8 present my research findings. In Chapter 4 I begin to open the black box of City Hall’s design process. I start to retrace the origins of City Hall before the architects and engineers entered the design process. I begin my exploration around 1997 by introducing Minister Nick Raynsford as a key actor who was responsible for establishing and housing the future GLA. Then I retrace how the associations around him expanded: how new actors joined his team and how they set up a unique type of procurement process for the GLA headquarters in which they drafted several design briefs in August 1998 to inform and align the design teams, then to come, in their activities.

Chapters 5 and 6 continue to retrace the emergence of City Hall. In them I explain how the design team, through the production of design knowledge and the construction of associations, developed design strategies and building technologies in response to the initial design briefing. In Chapter 5 I describe how many new actors and elements became involved to develop architectural design proposals for the future GLA headquarters. In late August 1998 the design team started their work, shaping their proposals in order to win the competition to find a suitable property for the GLA headquarters. Those involved comprehended the design development as a series of transformations in which four transitory key schemes could be identified. This chapter explores the first two key schemes presented to Nick Raynsford for developing City Hall, the first in September 1998, the second in November 1998. The principles of City Hall's environmental design strategy were largely stabilised with the later scheme. I focus on the debates and controversies involved in the development of City Hall's unique building form, orientation and envelope. These design elements were given a pivotal role within the environmental design strategy for the building. This chapter ends with the announcement in February 1999 that Raynsford's advisory team had selected the More London, Foster+Partners and Arup scheme to build City Hall. Following the successful selection of the More London scheme, Chapter 6 explores the continued design development of City Hall's third and fourth key design schemes, the *Planning Application* scheme (July 1999) and the *Schematic Design* (November 1999), which were produced together with comprehensive design documentations. In this chapter I describe how the building form and orientation were redesigned and made buildable, and how the facade design was further expanded. Finally, I explore the BREEAM 98 for Offices assessment that was made mandatory in the initial design briefing process.

Chapter 7 investigates City Hall in operation. In May 2002 roles and responsibilities were handed over to the new occupants: most design participants left the scene of City Hall's development process, some stayed, and a huge number of GLA staff entered as occupiers. Since actual operation and environmental performance is contingent upon a number of elements and practices, I reflect on how the building infrastructure management attempted to create knowledge about the headquarters environmental impact and explore recorded results for the period from 2002-03 to 2010-11. I explore four key building updates that were introduced to City Hall in this period with the aim to further reduce energy consumption. Using these recordings for the year 2010-11, I then attempt to evaluate to what extent City Hall's completed design achieved the projected environmental performance targets that were defined during design development in actual operation.

In Chapter 8, the closing chapter of this thesis, I first reflect on the STS- and translation-inspired theoretical framework adopted in this thesis. Secondly, I revisit central questions and present key findings from my empirical chapters in order to draw out wider contributions for architectural design research and practice. I do this by foregrounding three selected mechanisms that are central to translation processes.

Chapter 2

Architectural practices and the ‘environmental crisis’ (literature review)

2.1 Introduction

In this chapter I outline the positions from which I explore City Hall's architectural design practices, which were set to enact an ambitious environmental design agenda. This literature review is organised in three interrelated parts that inform this research and help me to address the questions set out in the previous chapter.

The first part of the chapter, "Architectural practices and the 'environmental crisis'", begins by introducing the important role that buildings play in relation to environmental challenges – as major environmentally destructive forces, but also as practices that have huge potential to mitigate the negative impact of human activity. I point out that within architectural design practices there seems to be widespread disagreement on how to define environmental problems to be tackled, which pathways to take, and how to assemble and materialise buildings in response. I argue for the necessity to engage in these controversies, rather than overlook the fact that conflicting interests, competences and responsibilities between differently involved actors are not part of these practices.

The second part, "Framing the 'environmental crisis'", lays out my approach to a conception of the environment and forms of environmental degradation as the basis for my explorations. The field of environmental discourse comprises diverse, fragmented and partially contradictory approaches towards the environment, proposed by a wide range of actors, including scientists, politicians, entrepreneurs, campaigners, journalists and laymen. Their debates contest what the environmental problem actually entails and I attempt to shed some light on the political struggle around key terminologies. The environment 'out there' can only be grasped and discussed through particular constructed understandings of it, which essentially rely on symbolic forms, discursive formations and media representation. The full range of the environmental problematic is hardly ever debated, and discourses tend to prioritise particular conflicts over others. I discuss different concepts of environmental crises by focusing on the emblematic concepts of climate change and sustainability. I outline the development of issues and concepts in the 1980s in order to situate the design process of City Hall in relation to them. Human-induced environmental change has a degrading impact on the life support systems provided by our planet. Humans therefore increasingly face self-imposed threats that require urgent acts of mitigation and adaptation.

The third part of this chapter, "Exploring architectural design practices", introduces the Science and Technology Studies (STS) inspired theoretical framework through which I retrospectively follow practitioners and elements through the heterogeneous and contingent design practices of City Hall. I begin by briefly introducing the origins and central ideas of STS with reference to two key thinkers: Bruno Latour and John Law. I then discuss the transfer of STS approaches to architectural studies, mainly through the work of Albena Yaneva. Finally, I explain the STS-inspired theoretical framework, which builds on selected elements of Yaneva's work, and on Michael Callon's (1986) concept of "translation".

2.2 Architectural practices and the 'environmental crisis'

2.2.1 The role of buildings

It is through buildings and the associated practices of design, construction, operation, refurbishment and demolition that humans largely impact on the planet and the vital conditions of human existence. This relationship is not a new theme to architecture: "every act of building betrays the environment, as it requires the displacement of 'natural' relationships" (Ingersoll, 2012, p. 574). I argue that, today, (the majority of) buildings can be understood as major environmentally destructive forces.[2] The impact of building-related practices on the environment and on the conditions of human life involves a complex dynamic that is multifaceted in scope and involves a far-reaching geography of resource extraction, material processing and environmental damage produced. Seen this way, "architecture's materiality acquires a new, ethical significance […] Materials have returned to a position of the greatest social and cultural importance" (Hagan, 2001, p. 76).

It is argued that building construction consumes more materials and produces more waste than any other industrial sector (Hegger, 2008, p. 7). As they are constructed, buildings

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[2] I adopt this argument for buildings from Saskia Sassen's (2004) related approach to *The Central Role of Cities in our Environmental Future.*

require huge amounts of building materials and technological devices that (partially) emerge out of long production process chains that span continents. During the manufacturing process, these products require large amounts of materials and energy input. They have therefore become associated with particular environmental conflicts like resource depletion, greenhouse gas (GHG) emissions, contamination and toxication.

With regard to the operation of buildings, the International Energy Agency (IEA) suggests that globally the "buildings sector, which uses energy for heating, cooling, lighting, refrigeration and for powering electrical appliances, is currently the single largest final end-use consumer" (IEA, 2012, p. 61). The energy used in buildings still comes largely from fossil energy sources, which have become increasingly scarce and expensive, and are considered to be one of the main causes of climate change and other environmental degradation. In the UK the operation of buildings is thought to account for 46% of total energy use and 47% of related carbon dioxide (CO_2) emissions (BRE, 2002). Studies on London attribute the share of CO_2 emissions related to building operations as being 67.7% (Siemens & McKinsey, 2008, p. 18) or even 80% (GLA, 2004a, p. 7) of London's total CO_2 emissions.

Furthermore, the refurbishment and demolition of buildings requires additional energy inputs and often poses the challenge of how to treat and recycle composites and hazardous building elements (e.g. asbestos, formaldehyde).

In principle there seems to be widespread agreement that buildings and their associated practices play a crucial role in the way humans impact on the environment. But there are a lot of questions that remain unaddressed in attempts to conceive the interrelationship between buildings and the 'environmental crisis'. The perspectives described above of operational energy consumption and related CO_2 emissions are very important. Peter Droege argues that "[a]tmospheric CO_2 concentrations exceed safe levels by more than one third" and that nothing less than "[n]aked survival is at stake" (Droege, 2012, p. 590). Nonetheless, these perspectives must be understood as the predominant ways of framing the interrelationship between buildings and the 'environmental crisis', which by necessity suppress many other perspectives. This aspect needs further investigation. The interrelationship between buildings and environmental crises is extremely complex and differs in and across specific contexts and practices.

While buildings can in principle be conceptualised as major environmentally destructive forces, they can potentially also be understood as strategic practices helping to mitigate the destructive impacts of human activity. For instance, the Intergovernmental Panel on Climate Change (IPCC) suggests that the building sector has a bigger potential than other sectors to reduce GHG emissions at the lowest cost (IPCC, 2007b, p. 59). Within building practices the design process has huge potential to reduce practices' destructive effect on the environment and human wellbeing.

2.2.2 Pluralistic architectural design practices

More than three decades ago the 'environmental crisis' began to occupy important places in architectural debates and practices (cf. Hajer, 1995). From the late 1980s, environmental conflicts were increasingly addressed from the perspective of 'sustainability'. Architects, engineers, clients, politicians and others seem to agree that this crisis must be faced. However, behind this apparent consensus many ambiguities, contradictions and open questions have emerged, while the environmental problematic is becoming even more acute.

Since architectural discourses and practices began to respond to the 'environmental crisis' and 'sustainability', a vast range of pluralistic approaches has developed. For instance, some have promoted energy efficient high-tech, low-tech or vernacular strategies; others have addressed health, well-being and quality of life issues (Guy & Farmer, 2001); some took inspiration from the "analogy to natural forms" (Ingersoll, 2012, p. 576) or from processes in 'natural' systems (Ursprung, 2007, p. 19); some emphasised "performance over appearance, and some appearance over performance" (Hagan, 2001, p. 4); some developed 'intelligent' and 'responsive' materials, some renewable, recyclable and biodegradable materials (McDonough & Braungart, 2002), and some sensory perception (Sattrup, 2009). Some thematised social justice and design, participatory processes and affordable housing (Bell & Wakeford, 2008), and others ecological footprinting and consumerist lifestyles (Droege, 2012). Other actors discuss universal best practices guidelines: some argue we need more technology, others think we need less; some call for more archaic behaviour or to challenge comfort levels; and others suggest we should "develop clearer definitions or standardizations" (Guy & Moore, 2005, pp. 1-2). Guy and Moore suggest that the pluralism of discourses and practices in response to the 'environmental crises' and 'sustainability' defies "simple categorization" (2007, p. 15).

The multiplicity of architectural practices has importantly led to different interpretations of what the actual challenges are that need to be addressed, as well as numerous discourses and engagements, diverse actions, design and technological strategies, in order reach particular theoretical positions and diverse pathways of materialisation. It is characterised by "disagreement about design priorities, the role of technology, the importance of aesthetics, the relationship of natural and built environment and the degree of optimism and pessimism that the current state of sustainable architectural practice should invoke" (Guy, 2012, p. 561).

In order to comprehend how the diverse issues, aims, strategies and actions emerge, Guy and Moore "encourage a deeper engagement with sustainable architecture, one that doesn't shy away from broader sociological or philosophical questions or merely indulge in the narrowly instrumental debates that characterise so much of the green architecture literature" (2005, p. 2).

2.2.3 Stepping back

The attitude that, for instance, Foster+Partners present in their attempt to brand City Hall a "sustainable, virtually non-polluting public building" (Foster+Partners, 2014) can be found in the majority of commercial architectural practices. 'Sustainability' has become a well- established lens through which to conceptualise the environmental challenges in architectural design. Today, building practices as means to reduce environmental crises present a significant commercial market, with which critical engagement seems largely absent. Through confident project descriptions and expansive claims, many conceal the contestation and uncertainty over pathways to less destructive futures. Sometimes attributes such as "sustainable", "environmental", "energy efficient", etc. are deployed as if they would be identical. As a label, "'sustainability' […] has come to stand for everything and nothing" (Crysler, Cairns, & Heynen, 2012a, p. 27). While acknowledging that these terms are difficult to frame, I argue that it is important not to pretend that related meanings are clear, but instead to engage with and emphasise the controversies and interpretations over their meanings.

In exploring City Hall, my conviction is to step back in order to reconsider how environmental problems and the concept of sustainability have been given meaning within City Hall's blackboxed and contested design practices.

I recognise that the environmental challenges can be approximated through different concepts (such as sustainability). I conceive sustainability first and foremost as a concept. By necessity, the concept requires transformation to materialisation. I avoid using the adjective "sustainable" to describe material artefacts like building technologies, building materials or buildings themselves. Instead I focus on how the concept is interpreted and transformed in City Hall's specific design practices.

City Hall was set to become an exemplar project of the Greater London Authorities' "commitment to environmentally progressive objectives, the principles of sustainability" (Interview Raynsford, 2010). This commitment presented an opportunity and necessity for its design collective to outdo existing environmental Building Regulations, which present the minimum legal requirement regarding environmental design challenges for most commercial practices. The client commissioning City Hall had to become autonomous and construct their own environmental design challenge. This required reconsidering predominant thinking on how building practices relate to and impact on 'the environment' - a question, I argue, that is largely absent in many practices. This would expand architectural design knowledge and reconnect architectural practice with particular understandings of a wide range of environmental crises, rather than define environmental design targets through established guidelines, assessment methods or Building Regulations. The next main part of this chapter, I describe how I approach the 'environmental crisis' and the concept of sustainability.

2.3 Framing the 'environmental crisis'

It can hardly be contested that the 'environmental crisis' has occupied an ongoing place on public agendas and within architecture debates and practices in recent decades. In response, the architectural field has produced a vast body of literature, diverse practical approaches, and has held conferences and building fairs. Nonetheless, there are many ambiguities in the struggle to understand the very idea of environment and environmental conflict (cf. Hajer, 1995, pp. 1-2). I argue that the key question for architectural practices is essentially how environmental problems are defined as an issue for design, and how they are translated into specific localised design processes.

In the following I attempt to draw attention to the confusion that surrounds the foundational concepts of environmental discourses. The *environment* is a vague concept that resists any attempt to be defined in an unambiguous way (cf. Schlosberg, 1999). Within my explorations I conceive the environment to be a transitional product that may (amongst others) be the physical and material environment, an environment conceived by humans, and one transformed through human practices. During my explorations I recognise - rather than deny - this multifaceted comprehension of environment. For the purposes of this thesis, it is helpful to attempt to define which environment is being described (particular facets or the sum of all environments, including their facets). In the following sections I elaborate on my conception of the environment, as outlined above. Today, humans are faced with a vast set of environmental conflicts, which need to be recognised since environmental debates tend to prioritise particular conflicts over others.

2.3.1 Understanding the environment 'out there'

To explore architectural practices in relation to environmental challenges it is necessary to understand that the environment or world 'out there' resists any accurate representation and we might only be able to approach it through individual conceptions. Hajer emphasises the difference between the 'thing-in-itself' and our conception of the 'thing-in-itself', or the 'real' and 'reality'. He points out:

> Both distinctions are based on the idea that what we know is being framed by experiences, by languages, by images, or even by human fantasies […] we see all our knowledges of nature (and indeed, society) as essentially metaphorical.
> […] Reality, then, is always particular, it is always dependent on subject-specific framing or time-and-place specific discourses that guide our perceptions of what is the case (Hajer, 1995, p. 17).

He argues that this insight should not relativise the existence of severe environmental problems, but that it seeks to qualify statements concerning the status of the environment. In a related point, Neil Evernden emphasises: "We must bear in mind that the current understanding of pollution is just that: the current understanding" (Evernden, 1992, p. 4). The challenges of the environment 'out there' can only become "'topical' through the extent that they are anticipated. Without techniques of visualization, without symbolic forms, without mass media etc. [they] are nothing at all" (Beck, 2011, p. 12).

My explorations build on the perspective that today humans are faced with a vast set of co-produced (anthropogenic) environmental crises through which humankind increasingly threatens its own conditions of existence. Humans depend on this planet and the very life support systems that they increasingly put at risk.

In the last 50 years, scientific activities have deepened the understanding of the earth transformed through human action. Environmental discourse has developed in fragmented and contradictory forms as

> an astonishing collection of claims and concerns brought together by a great variety of actors. […] Environmental discourse is time- and space-specific and is governed by a specific modelling of nature, which reflects our past experience and present preoccupations (Hajer, 1995, p. 17).

For my exploration of architectural practice, it is necessary to point out that the framing of respective environmental challenges, guidelines or policies – to which architecture needs to respond – is not value free. While many actors might present their arguments as truth claims or undisputed facts, Andrew Jamison (2001) urges us to pay attention to the *Making of Green Knowledge*, which is the particular composition and perspective of knowledge production*:*

> There have emerged a number of competing academic, or analytical, responses to the new environmental challenges […] based on different ideals of scientific knowledge, different 'epistemic' criteria, as well as different varieties of scientific practice (in Guy & Moore, 2007, p. 16).

The framing of environmental challenges is closely related to the particular conception of the environment in itself. David Harvey argued that "the contemporary battleground over words like 'nature' and 'environment' is a leading edge of political conflict, precisely because of the 'incompletely explicit assumptions, or more or less unconscious mental habits,' which surround them" (Harvey, 1996, p. 118). Ulrich Beck argues that the "seemingly self-evident concepts of 'nature', 'ecology' and 'environment' […] cannot be the analytic reference" for the ongoing crisis, because they have their ground in a long-standing ideological distinction between nature and society, which often leads to the domination and marginalisation of nature. It is not nature that has a problem in itself, but the produced challenges and dangers can only be understood and approached as the consequences of our predominant modes of operation, of our societal activity (Beck, 1999, pp. 19-21).[3]

By way of a response to this predicament, Bruno Latour (1993) and Donna Haraway (1991) proposed to drop the nature–society dualism in favour of a "sociology of artefacts or – as they put it – of hybrids" (Beck, 1999, p. 27), which affirms their unity and "indistinguishability". The philosopher Peter Sloterdijk argued that human history is a history of changers of milieus (2009). Since human actors have arrived as distinct species some 100,000 years ago, they have altered their local environments as hunters, gatherers, fire-makers, farmers or city dwellers. Consequently, humans have always had an impact on the environment in which they are vitally embedded and which through their activities they constantly transform.

2.3.2 Many environmental crises

Paul Crutzen argues that the force with which humans commenced as major actors on the global stage – a force previously associated with the geotechnical violence of volcanism, ice ages or similar – is a recent phenomenon.[4] He believes the magnitude, spatial scale and

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[3] The terms "nature" or "natural" immediately pose the question, what is the cultural model of "nature"? Ulrich Beck remarks: "Nature itself is not nature: it is a concept, a norm, a recollection, a utopia, an alternative plan. Today more than ever. Nature is being rediscovered, pampered, at a time when it is no longer there. […] What is there, and what creates such a political stir, are different forms of socialization and different symbolic mediations of nature (and the destruction of nature)" (Beck, 1999, p. 21).

[4] Crutzen is an atmospheric chemist who received the Nobel Prize in 1995 for his work on atmospheric chemistry and stratospheric ozone depletion.

pace is unprecedented, and has therefore proposed the term "'Anthropocene' – a new geologic epoch in which humankind" has in only a few hundred years emerged as an unprecedented significant force capable of transforming the global face of the planet (Clark, Crutzen, & Schellnhuber, 2004, p. 1). He suggests that the Anthropocene epoch began in "the latter part of the 18th century, when the global effects of human activities became clearly noticeable" for the first time. This date largely coincides with the beginning of the industrial revolution, a time when the human population massively increased in number, and (some) began entering modes of inhabiting the world in increasingly excessive ways, thereby creating a self-imposed threat towards their conditions of existence (Crutzen, 2011, p. 4). Crutzen stated:

> Hopefully, in the future, the "Anthropocene" will not only be characterized by continued human plundering of the Earth's resources and dumping of excessive amounts of waste products in the environment, but also by vastly improved technology and management, wise use of the Earth's resources (Crutzen in Brauch et al., 2011, pp. 3-4).

Since the early 1970s these changes have been framed within the concept of *Global Environmental Change,* which was accompanied by a related increasing "multidisciplinary scientific field of study" and the "development of a new major policy field of international (environment) policy" (Brauch, 2009, p. 21). *Global Environmental Change* focuses on "human-induced perturbations in the environment" which encompass:

> "a full range of globally significant issues relating to both natural and human induced changes in the Earth's environment, as well as their socioeconomic drivers" (Munn, cited in Brauch, 2009, p. 22).

This change in increasingly unpredictable manner affects and puts at risk vital ecosystem services providing various substantial benefits for humans:

> An ecosystem is a dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit. […] These include *provisioning services* such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; *cultural services* that provide recreational, aesthetic, and spiritual benefits; and

> *supporting services* such as soil formation, photosynthesis, and nutrient cycling (Millennium Ecosystem Assessment, 2005, p. v).

Today, human-induced "environmental deterioration includes a long and expanding list of major and multiple dysfunctions that feed on each other", triggering abrupt and potentially irreversible changes (Brauch et al., 2009, p. 3). They affect every earth component – cities, land, coastal zone, atmosphere and oceans (IGBP et al. 2004).

Humans are faced with a vast range of different environmental challenges. Hajer thus argues, "The problematique is hardly ever discussed in its full complexity ('in the round'). Environmental discourse tends to be dominated by specific emblems: issues that dominate the perception of the ecological dilemma in a specific period." The last 150 years brought forward environmental debates about, for instance, "deforestation in the nineteenth century […], soil erosion in the 1930s, pesticide pollution in the early 1960s, resource depletion in the early 1970s, nuclear power in the late 1970s, and global issues like the greenhouse effect and the diminishing ozone layer in the 1980s" (Hajer, 1995, pp. 19-20).

Both Marten Hajer and Andrew Jamison consider the UN Brundtland Report *Our Common Future* (1987) to be a centrepiece of the environmental debate as it "laid the conceptual foundations for environmental politics in the 1990s" (Hajer, 1995, p. 9). Jamison sees a change from flagging particular problems and discussion on a small scale to "integrating environmental concerns into all other kinds of social, economic, and political activities"(Jamison, 2001, p. 176). As one consequence of the "general endorsement of the Brundtland Report […] many Western countries published comprehensive documents outlining national environmental policy plans from around 1990" (Hajer, 1995, p. 9). While before the 1990s the majority of debates focused on issues of direct sensory perception (e.g. exhaust gases), later attention shifted "in terms of scale, time, and techniques. They take what has become known as the 'global biosphere' as their level of analysis, and portray problems that do not yet exist and will not materialize for many years from now" (p. 10). Environmental knowledge became increasingly compiled through complex scientific data collection and modelling, and consequently disseminated by small groups of scientific experts (e.g. the IPCC) "who assess the urgency of one problem vis-à-vis other possible problems, and who implicitly often conceptualise the solutions to the problems they put forward" (p. 10).

2.3.3 The concept of climate change

Today, one of the most emblematic manifestations of the diverse environmental crises is framed through the concept of climate change. This concept (also discussed as global warming) has come to dominate many global agendas and is contested from different perspectives. There are people who question whether the global rise of temperature is induced by human activity. This form of climate change denial is a potent political strategy in many parts of the world.[5] The IPCC emerged as one of the key actors gathering, interpreting, modelling and disseminating climate science knowledge. Besides climate change deniers, there are also researchers who contest the findings of the IPCC expressing "disagreement with the […] Fourth Assessment, which they charge is unwarrantedly optimistic in its geophysics and social science" (Davis, 2010, pp. 31-32). Today, people do not claim to be absolutely certain that their knowledge about the climate is correct, but instead treat their knowledge on the subject as relatively reliable. The phenomenon of climate change needs to be discursively constructed, since it largely eludes direct sensory perception of the human body and is projected to unfold full force predominantly in the future.

Since its inception in 1988 the IPCC has published four major reports on climate change (in 1990, 1995, 2001 and 2007) and a fifth is being completed in 2014 to disseminate its findings. The IPCC defines climate change as:

> [A] change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity (IPCC, 2007b, p. 30).

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[5] In the UK one of the leading climate sceptics is Nigel Lawson, Baron Lawson of Blaby. In 2009 he founded the Global Warming Policy Foundation (GWPF) as a think-tank claiming to "restoring balance and trust to the climate debate" (accessed 28 October 2012 from http://www.thegwpf.org).

This framing deviates from that used by the United Nations Framework Convention on Climate Change (UNFCCC), which treats climate change as “a change of climate that is attributed directly or indirectly to human activity”(IPCC, 2007b, p. 30). Crucially, both organisations agree that “[e]nough is known about the earth’s climate system and the greenhouse effect [...] to know that urgent action needs to be taken” (UNFCCC, 2009). The IPCC declares:

> Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level. [...] Many natural systems, on all continents and in some oceans, are being affected by regional climate changes. Observed changes in many physical and biological systems are consistent with warming (IPCC, 2007b, p. 72).

It is suggested that from 1970 to 2004 the global total annual anthropogenic GHG emissions grew by 70%. In pre-industrial times, GHG concentrations in the atmosphere were very likely 285 parts per million (ppm) CO_2e (carbon dioxide equivalent) and in 2012 they reached 445ppm, the highest level recorded over the last 650,000 years.[6] The rate of annual CO_2 increase is rising, from 1.5ppm between 1970 and 2000, to 2.1ppm since 2004. Nicholas Stern claims: “We are adding at a rate of over 2.5ppm per year (likely to accelerate with little or weak action)”(Stern, 2012). Different CO_2e concentrations are projected to cause global temperature rises (compared with pre-industrial levels). The distribution of 450ppm CO_2e is associated with an increase of approximately 2^{o}C, 550ppm with 3^{o}C, 650ppm with 4^{o}C and 750ppm with 5^{o}C (Stern, 2012). Many analysts predict that average temperatures may rise within a few decades between 3^{o}C and 6^{o}C, but others suggest we could even face a staggering 10^{o}C rise (Urry, 2011, p. 9).

The IPCC considers that “anthropogenic warming over the last three decades has *likely* had a discernible influence at the global scale on observed changes in many physical and biological systems” (IPCC, 2007b, p. 41). As a consequence of climate change, humans are likely to confront rapidly melting glaciers, an increased risk of outburst floods, “changes in

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[6] CO_2e (carbon dioxide equivalent) is the total impact on the climate due to various GHGs: carbon dioxide, methane, nitrous oxide and refrigerant gases.

some Arctic and Antarctic" flora and fauna, changing seasons, and "poleward and upward shifts in plant and animal ranges" (IPCC, 2007c, p. 2).

Ecosystems on all continents are being affected and these systems become increasingly unpredictable. Climate change manifests an uneven geography of causes, consequences, originators and sufferers. While it is widely acknowledged that the excessive practices and lifestyles of Western nations since the beginning of industrialisation are, to a large degree, the main cause of the environmental problem, the regions and populations most affected are those close to the equator and in the southern hemisphere.[7]

The Stern Review commissioned by the UK government states that "climate change presents a unique challenge for economics: it is the greatest and widest-ranging market failure ever seen" (Stern, 2007). Despite much evidence suggesting that many humans and regions are already affected today (see above), Antony Giddens argues that unlike the political issues societies and civilisations have had to confront in the past, the key challenge and difference now is that climate change is regarded mainly as a future risk. CO_2 emissions released today will remain in the atmosphere for about 100 years. It is very hard for humans living in cities in the Western world to relate to an apparent abstract risk in the future, which right now does not impinge on their everyday life. The difficulty is that humans have to take action today: when emissions become visible and perceivable, it is likely to be too late (Giddens, 2009).

2.3.4 The concept of sustainability

Within the last two decades discussions concerning "sustainability" have become mainstream and "they have also given rise to a great deal of confusion and fuzziness, in which easy rhetorical use masks lack of real change and commitment" (Leach et al., 2010, p. 4). The term may be interpreted as a proxy for a cohesive collection of actions, principles and visions, or be deployed as an *ideological shield* to distract from particular ideas, projects and practices that tend to follow 'business as usual'.

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[7] For an assessment of climate change impacts see *Climate Change 2007: Impacts, Adaptation and Vulnerability* (IPCC, 2007a), and for an assessment of the regions most affected by climate change see *Global Climate Risk Index 2013* (Harmeling & Eckstein, 2012).

In the late 1980s the concept of *sustainable development* was largely brought to public attention through the Brundtland Report and this definition has been cited many times:

> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987, p. 41).

Crucially, the Brundtland Report reframed environmental politics "by arguing explicitly that goals for protecting the Earth's lands and wildlife could not be realised except through strategies that also addressed the improvement of human well-being in conservation areas" (Schellnhuber et al. 2004, pp. 2-3). Hence sustainable development indicates an interrelated concern of diverse issues associated with protecting the environment, for instance:

> promoting human welfare; satisfying basic needs; […] considering the fate of future generations; achieving equity between rich and poor; and participating on a broad basis in decision-making (Lafferty and Meadowcroft, cited in Giddens, 2009, p. 62).

Seen this way the concept of sustainability provided a facilitating metaphor around which heterogeneous elements like social, economic and environmental issues could assemble. Hajer suggests that sustainable development should be experienced as a "story-line" that:

> shares a way of talking about environmental matters but includes members with widely differing social and cognitive commitments. The paradox is that this coalition for sustainable development can only be kept together by virtue of its rather vague story-lines at the same time as it asks for radical social change (1995, p. 14).

Thus sustainable development emerged as a popular approach within which to frame the challenge of environmental politics and this popularity was largely based on its all-embracing focus. Despite calls to "break out of past patterns" and "change, now" (Brundtland, 1987, p. 22) sustainable development has since its emergence generally not brought about the fundamental organisational restructuring that it initially aimed for and that would appear to be necessary (Hajer & Fischer, 1999, p. 3). The concept is especially criticised by some for its notion of development which suggests that ecological, social and economic goals could be reconciled. Giddens and others have pointed out that the two central notions of *sustainability* and *development* point in conflicting directions: the first "implies continuity and balance", the second "dynamism and change". The concept's rather elusive nature has triggered further critical responses. One has simply been "to avoid defining it and instead to substitute a cluster of goals instead" (Giddens, 2009, p. 62). Since the Brundtland Report "multiple versions of sustainability" were brought forward and especially in the 1990s the "simplistic managerialism of many initiatives […] left much to be desired" (Leach et al., 2010, p. 39).

Yet Hajer and Fischer also argue that "it would be wrong only to conceive of sustainable development as an evident non-starter" (1999, p. 2). Importantly they argue that:

> it is not the metaphor of "sustainable development" in itself that leads environmental politics astray. Rather, it is with the *interpretation of its meaning*, in particular the fact that it does not compel institutions to reconsider the normative and cultural assumptions underpinning their operational practices (p. 4, emphasis added).

In other words, the ways in which design collectives put theory into practice is of crucial importance for architectural practices.

On questions of interpretation and enactment, Jan-Peter Voß and Rene Kemp (2006) suggest interpreting sustainability "as a specific kind of problem framing that emphasises the interconnectedness of different problems and scales, as well as the long-term and indirect effects of actions that result from it." They point out that the "multidimensional and dynamic concept of sustainability" has fundamental implications for societal practices because the

> systemic and long-term nature of social, economic and ecological development brings complexity and uncertainty to the fore as key issues for sustainability. Sustainability cannot be *translated* into a blueprint or a defined end state […]. Sustainability calls for new forms of problem handling (pp. 3-4, emphasis added).

They deduce that problems cannot be addressed in "a linear way" or through "rigid analysis". Rather, they suggest that:

> sustainable development is more about the organisation of processes than about particular outcomes. It is about the modes of problem treatment and the types of strategies that are applied to search for solutions and bring about more robust paths of social and technological development (p. 4).

Melissa Leach, Ian Scoones and Andy Stirling (2010) also draw attention to the ways in which sustainability is enacted. Their response to some who have suggested abandoning "the term sustainability 'altogether'", is to avoid treating "sustainability in a general, colloquial sense, implying the maintenance of (unspecified) features of systems over time"(p. 5). Instead they emphasise the importance of the concept of sustainability through re-casting it in a "more explicit normative (and so overtly political)" interpretation:

> Sustainability refers to the explicit qualities of human well-being, social equity and environmental integrity, and the particular system qualities that can sustain these. All these goals of sustainability are context-specific and inevitably contested. This makes it essential to recognize the roles of public deliberation and negotiation - both of the definition of *what is to be sustained* and of *how to get there* (p. 5, empahsis added).

Leach, Scoones and Stirling not only "make normative questions central" (p. 171) but go a step further by arguing that "it is useful to distinguish between different normative views of sustainability, recognizing that there are multiple sustainabilities which decisively need be defined quite precisely for particular issues and groups"(p. 42). Consequently they highlight the importance "to specify clearly, for particular issues and settings, what is to be sustained for whom, and who will gain or lose in the process" (p. 171).

These debates, negotiations and definitions "must be seen as a highly political (rather than technical) process"(p. 5) to suggest that "sustainability must be recognized as a contested, discursive resource […] that facilitates argument about diverse pathways to different futures"(p. 42). Hence they infer that approaches to sustainability must be:

> centrally about focusing on framings of systems and their properties - recognizing divergent epistemological (ways of knowing) and ontological (ways of being) positions, associated with different actors and interests. It must also involve negotiating the trade-offs across diverse pathways (actual, potential and imagined)

> in relation to the political-normative positions, goals and values of diverse actors (p. 65).

Following this brief discussion, and building loosely on the perspectives of Leach, Scoones and Stirling outlined above, I interpret sustainability to be a concept in which normative implications are central: "to specify clearly, for particular issues and settings, what is to be sustained for whom" (Leach et al., 2010, p. 171). In the core chapters of this thesis, I compare and contrast my interpretation with the ways that City Hall's design protagonists gave meaning / enacted sustainability in practice. I interpret City Hall's design practices as a sort of positioning in respect to the 'environmental crisis': specific actors produce specific types of knowledge, emphasise certain issues and suppress others, focus attention, employ particular assumptions and privilege particular pathways (Wolfgang Sachs, in Jamison, 2001, p. 176).

These elements that are central in the practices of giving meaning to sustainability lead on to the third and last part of this chapter in which I introduce the STS-inspired theoretical framework and adaptation of "translation" as a particular analytical frame within which to explore the architectural design practices that I have chosen.

2.4 Exploring architectural design practices

Figure 2.1 Architects at work assembling City Hall at Foster+Partners' studio (Photograph: Nigel Young and Foster+Partners, 2002)

The third main part of this chapter outlines the Science and Technology Studies (STS) inspired approach I use to explore the design (and operation) practices of City Hall in which different practitioners, heterogeneous entities and particular activities became associated and continuously transformed. Central to my study of City Hall's design practices are the questions of how environmental problems and design challenges were constructed, and how design knowledge, design strategies and technologies were assembled and enacted. I thus developed my theoretical framework to draw on selected ideas from STS. I begin by situating my approach within existing literature through a brief overview of central ideas in the diverse field of STS and by introducing two key thinkers: Bruno Latour and John Law (Section 2.4.1). I then discuss how STS approaches have been transported to (urban and) architectural studies, mainly through the work of Albena Yaneva (Section 2.4.2). I explain my STS-inspired theoretical framework that, loosely interpreted, builds on selected elements of Yaneva's work, and on Michael Callon's (1986) concept of "translation" as my main analytical frame (Section 2.4.3).

Based on a broad conception of architecture (see Chapter 1), I apprehend City Hall to have been produced through series of heterogeneous assemblages.[8] The focus of my explorations is on the specific design practices that brought City Hall into being. These practices have been unpredictable, contingent and messy. In City Hall's design practice, multiple heterogeneous elements became associated: Diverse vocational practitioners, conceptions, compromises and negotiations, a London site, projected carbon emissions, computer models, a tight budget, a brief requiring a symbolic building, diagrams, a borehole cooling system, a renewed model of governance, the projected behaviour of 450 GLA members, 30 months of development time, 18,734m^2 gross internal floor area, 13,100m^3 of concrete, 2,100 tonnes of structural steel and many more.

It does not come as a surprise that architectural design involves heterogeneous elements, but a challenge is to find frameworks that support understanding how the heterogeneous elements are assembled. Architectural design practices can be explored through different theoretical perspectives that contain profound differences of how to conceptualise the relationships between practices, society, materiality, and agency (e.g. Reckwitz, 2003). A theoretical discussion of these conflicting perspectives is beyond the scope of this thesis.

In order to develop an understanding of how the heterogeneous elements in City Hall's design process became associated and transformed, I take a pragmatic approach by exploring what architects and the wider design collective actually did in (and around) the everyday context of Foster+Partners' Riverside Studio and on the More London site (cf. Guy & Moore, 2007, p. 16). This approach avoids exploring City Hall through interpretations of the materialised artefact, instead shifting attention to "prioritizing the pragmatic content of actions" of "architecture *in the making*" (Yaneva, 2009, p. 197). The focus on design practice is of crucial importance since it is in City Hall's practices that problems get constructed, tackled, things transformed, strategies enacted, and architecture is materialised.

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[8] I draw on Law who describes assemblage as "a process of bundling, of assembling, or better of recursive self-assembling in which the elements put together are not fixed in shape, do not belong to a larger pre-given list but are constructed at least in part as they are entangled together" (Law, 2004, p. 42).

2.4.1 Introducing Science and Technology Studies (STS)

STS can be described as the "study of science and technology in a social context". A central concern is that "scientific knowledge and technology do not evolve in a vacuum", but that they take part in the social world, "being shaped *by* it, and simultaneously *shaping* it" (Law, 2004, p. 12). In principle STS analyse how knowledge and things are constructed. Today STS has developed into a broad interdisciplinary field that emerged from intersecting perspectives of sociologists, anthropologists, philosophers, historians and others.

2.4.1.1 Origins

The origins of STS can be traced to the 1960s and Thomas Kuhn's *Structure of Scientific Revolutions* (1962), which signalled a radically new perspective towards the understanding of science. Kuhn makes his arguments through case studies. He challenges empiricist and positivist foundations of science and rejects the belief in a general standard of rationality. Scientists are rejected as neutral observers but come "with a whole package which he calls a *paradigm*. This includes law like generalisations, implicit assumptions, instrumental and embodied habits, working models, and a general and more or less implicit world-view" (Law, 2004, p. 43). According to Kuhn, scientific knowledge is dependent on these paradigms and its generation involves a lot of work that is not achieved by systematic approaches but through creative, informal and improvised ways of scientific puzzle solving. Kuhn's work inspired many researchers to adopt novel approaches in the study of science as a practice and form of culture.

In the 1970s new directions emerged. For instance, the *Sociology of Scientific Knowledge* (SSK), associated with David Bloor and Barry Barnes and their formulation of the "strong program", committed to investigate the causes and conditions of scientific knowledge-making based on a methodological rejection that treats false and true knowledge claims asymmetrically (Sismondo, 2008, p. 14). In the late 1970s the laboratory ethnographies (eg. Latour & Woolgar, 1979) presented a new approach exploring the cultures of scientific practices, by moving into scientific laboratories to follow scientific experimentation, data collection, analysis and the construction of claims through participant observation. Their exploration of scientific knowledge production had a radical impact on the social study of science. These studies suggested that not "only data but phenomena themselves are constructed in laboratories […] and what is found in them is not nature but rather the product of much human effort" (Sismondo, 2008, p. 15). Related to that the constitution of scientific methods and epistemologies became another focus of attention.

The 1980s saw increasing perspectives on technology and its artefacts. With the *Social Construction of Technology* (SCOT), Trevor Pinch and Wiebe Bijker transfer insights from the "sociology of science" to the "sociology of technology" (1987, p. 17). They characterise the latter as a then still underdeveloped field, suggesting that both fields can benefit each other. Despite recognising potential differences between science and technology they reject any *a priori* distinction and propose to study both through the same "social constructivist view", interpreting the "science-technology relationship" as interactive, reciprocal and integrated (p. 21). Through "interpretive flexibility" they emphasise that scientific and technological findings are "open to more than one interpretation" by different social groups, suggesting to follow the mechanisms and controversies leading to interpretative closure (p. 27). SCOT approaches the process of an emerging technological artefact "as an alternation of variation and selection" that "results in a 'multidirectional' model" rejecting linear models of technological innovation (p. 28).

Today, within its loose boundaries, STS has developed diverse streams of thought with partially conflicting theoretical and methodological positions. STS can no longer be confined to areas of science and technology as it has ventured into other empirical fields, for example medicine, markets, information technologies and gender studies (Law, 2008, p. 638). Despite STS having a programmatic suspicion towards the validity of universal claims, the "metaphor of construction, in its generic form" might be seen as what ties together different strands of STS (Sismondo, 2008, p. 17).

John Law pointed out that things are indeed "constructed" but that the metaphor is misleading since they are not stable, and that the heterogeneous relations have to be continuously re-enacted in order to persist. He suggests instead to use "performance" or "enactment" (Law, 2008, p. 635). Through an "integrative understanding of the origins, dynamics, and consequences of science and technology" STS also engages in questions of politics and social change. It is argued that "the distinctive insights and sensibilities of STS" can contribute to resolving contemporary conflicts and prompt societal transformations (Hackett, Amsterdamska, Lynch, & Wajcman, 2008, pp. 1-5).

Before I discuss how Albena Yaneva has transported STS perspectives to the 'laboratories' of architectural design, I briefly introduce two specific STS (ANT) perspectives: Firstly, Bruno Latour's work, which is a reoccurring reference in Yaneva's writings; secondly, the ideas of John Law who developed, amongst others, the perspective of "heterogeneous engineering ".[9]

2.4.1.2 Bruno Latour

Latour developed his theoretical approach through ethnographic studies of the scientific laboratory. *Laboratory Life* (1979), written with Steve Woolgar, conceives the laboratory as an institution in which scientific knowledge is socially constructed through specific, localised practices. Their attention is geared distinctively towards the materialities of the laboratory, the spatial settings, physical organisations, substances, its apparatuses and inscription devices that participate in the production of new scientific facts. Findings are manipulated, translated, and turned into papers that turn claims into facts which, in turn, hold and become recognised. The divide between technical and social elements is rejected.

In *Science in Action* (1987) Latour expands his laboratory studies findings to a wider methodological reflection of both Science and Technology through ethnographic approaches and reinterpretations of historical cases. He develops a set of "rules of method" and "principles" of how to follow scientists and engineers. To follow scientists and engineers at work, he suggests researchers should enter several construction sites of "facts and machines". He claims that "opening the black box is made feasible […] by moving in time and space until one finds the controversial topic on which scientists and engineers are busy at work" (p. 4).

Latour continued to develop the Actor-Network approach through the principle of "generalized symmetry" with Michel Callon (cf. Callon, 1986, p. 200). It extends David Bloor's principle of symmetry that encourages analysis of successful and unsuccessful

[9] In the following I will use STS (ANT) to show that I conceive ANT as a specific method of STS.

claims of knowledge in controversies in the same way. In *We have never been Modern* (1993), Latour launches a critique of the modern conception of the relation between nature and society. His hypothesis consists of two different modern practices, one of "translation" that multiplies hybrid constellations of the human/non-human and nature/culture, and the other of "purification" that seeks to maintain these divides (pp. 10-12). This paradox embedded in modern constitution obstructs understanding nature and society symmetrically (Schäfer, 2013, p. 259). In *Reassembling the Social* (2005), Latour expands his account of Actor-Network Theory (ANT) into an "alternative social theory"(p. 128). Based on a radicalised variable ontology, he rejects common-sense understandings of the social and he instead conceptualises the social by a number of uncertainties. For him, ANT's objective is to retrace the heterogeneous associations of actors and elements in the form of actor networks. Latour defines the concept of network as a tool to help describe and trace associations (p. 131). Networks are not stable; they have to be sustained or rebuilt. In order to to retrace associations, he defines the following analytical moves: "Keep the Social Flat", "Localizing the Global", "Redistributing the Local" and "Connecting Sites"(pp. 165-246). One central shift in Latour's ANT is a radically modified understanding of how agency, actors and the social are constituted. He conceives agency as being influenced, hybrid, distributed, dislocated, non-local and ephemeral, constituted in heterogeneous actor-networks. For Latour, things and materialities play a crucial role in the efforts required to stabilise actor-networks.

2.4.1.3 John Law

The work of John Law is based on a "shifting ground" that comes "first and foremost from STS" (Law, 2004, p. 12). He has focused on questions of understanding the material heterogeneity of practices and how to explore these through research methods. Along with Bruno Latour and Michael Callon, Law has been central in developing ANT.

In the 1980s Law studied 15th-century Portuguese maritime expansion (Law, 1987) through the gradual reciprocal shaping between individuals, innovations in the design and construction of vessels, improved navigation strategies, maritime conditions, strategic problems and more. He calls these practices "heterogeneous engineering" that form, adapt and stabilise technological artefacts as "a function of the interaction of heterogeneous elements as these are shaped and assimilated into a network" (p. 113). These elements might "range from people, through skills, to artifacts and natural phenomena" (p. 128). Law defines technology as a set of methods "for associating and channelling other entities and forces, both human and nonhuman. It is a method […] for the construction of a relatively stable system of related bits and pieces with emergent properties in a hostile or indifferent environment" (p. 115).

Law develops this perspective through a reflection of two approaches. First, from the field of the sociology of science, he develops a critique of "social constructivism". He rejects giving a principle explanatory privilege over "social groups" or "social interests" in the construction processes of technological artefacts, but acknowledges that their contingent and constructed form is co-constituted through controversies and the closure of negotiations. Second, he draws on Thomas Hughes' "systems approach" from the history of technology. Here, he borrows the argument that the builders of artefacts are "system builders" as they manoeuvre multiple variables in the attempt to bring them into a lasting whole. Thereby they cannot focus on artefacts in isolation, but "must also consider the way in which the artifacts relate to social, economic, political, and scientific factors" (p. 112). The system-builder perspective does not give any element *a priori* privileged explanatory status; it rejects at once social, technological or natural reductionism.

Law - with reference to Callon - brings in the actor-network term as an adaptation of Hughes' system-building perspective. The network approach differs by drawing attention to the conflicts central in the expansion and stabilisation of network building in technological innovation. Law explicates two methodological principles to study heterogeneous networks. First, he borrows "generalized symmetry" from Callon (1986) to analyse all elements in a system in the same way, whether they are human or not. The second he calls "reciprocal definition" to state that actors have an effect on the network and that elements of a network define each other (pp. 130-132). Paralleling work by Latour and Callon, this study is Law's early outline of ANT, developed in the 1990s as a particular method within the expanding field of STS.

During the course of the 1990s, Law defended STS research against criticisms that considered the perspective would lack political relevance (1991, p. 2). In defence of STS, he developed three arguments to highlight the analytical contributions of 20 years of the field: first, he drew attention to the "character of knowledge […] the problem of epistemology" (p. 3). According to Law this could lead to "an important form of intellectual caution: the sense that all knowledges are shaped, contingent, and in some other world could be otherwise" (p. 6). Second, Law shifts attention to "the character of society. Here the problem has been to characterise the stuff that binds society together […] the problem of heterogeneity" (p. 3). In contrast to subject- or discourse- centred explanations of society (p. 7), Law emphasises STS's "serious commitment to heterogeneity, and, in particular, to the heterogeneity of the sociotechnical" (pp. 15-16). His criticism of most "sociology", which he sees as tending either to technological determinism or social reductionism, is the "absence of a method for juggling simultaneously with both the social and the technical" (p. 8). He continues to argue that STS must "find ways of exploring the character of distributive strategies - of the different kinds of discursive and non-discursive effects instantiated and reproduced in the processes of heterogeneous engineering" (p. 15). For Law the "genius of STS" is that it has "understood that heterogeneous engineers are […] arranging, ordering, shaping, regulating and (to be sure) seeking to profit from such overlaps" and that "heterogeneous engineers - agents, whether human or not – are constituted in the arrangement of these materials" (p. 16). This argument leads him to a third opportunity raised through STS: the then emerging agenda of the "problem of distribution"(p. 3) that he formulates as an "intuitive feel for the ordering of heterogeneity, the construction and reconstruction of overlaps, the constitution of agency: that is the strength of STS" (p. 16). Having laid out these three sensibilities of STS, Law rejects criticisms from "sociology" regarding any lack of political relevance.

Over the years Law has explored many empirical cases, for instance, of scientific laboratories (1994), aircraft developments (2002), and a significant part of his work is dedicated to exploring and advancing theories and methods in STS (2004, 2008, 2009). For him, the emergence of ANT as a distinct method of STS occurred between 1984 and 1994 (2009, p. 146).

Law describes ANT as a way of analysing sociotechnical artefacts and practices "as enacted and relational effects, and explores the configuration and reconfiguration of those relations. Its relationality means that major ontological categories (for instance, 'technology' and 'society', or 'human' and 'non-human') are treated as effects or outcomes, rather than as explanatory resources" (Law, 2004, p. 157).

Law's recent work adds further perspectives to the wider STS project, advancing its "analytical and (post?) critical possibilities" (2008, p. 634). I briefly review three of them: First, Law pointed out that things are indeed "constructed" but that the metaphor is misleading since the focus of STS is on processes and not stability. In order to persist, heterogeneous relations have to be continuously re-enacted. He suggests instead to analyse the world as "performance" or "enactment" (p. 635). Second, a further perspective is "multiplicity", which refers to the simultaneous enactment of artefacts in different practices that are believed to be the same, do not create different perspectives on the same artefact, but do create different artefacts and realities. (p. 636). Third, through the perspective of "ontological politics", Law argues that if realities are enacted (e.g. through a representation of a reality), then they are not singular but multiple. This leads him to questions of "politics" and " intervention", since decisively particular realities might be more preferable than others (p. 637).

In this section, I have situated my approach within existing literatures through, first, a brief overview of the central ideas in the diverse field of STS. A central achievement of STS and ANT is the integrative analytical approach to both the social and technical. STS in principle rejects grand narratives, subject-centred explanations, models of socio-technical developments, social reductionism and technological determinism. STS has contributed to the "abiding concern for the circumstances of knowledge production" (Hackett et al., 2008, p. 4). Critics of STS "draw special attention to the sometimes overlooked question of who has the power to shape technology" (Gieryn, 2002, p. 68). ANT, as a special method of STS, distinguishes itself through the symmetrical treatment of human and nonhuman actors in networks (Sismondo, 2008, p. 16). Both Law's and Latour's theoretical proposals of ANT sparked controversial debates and received vehement criticism that mostly centred on a flat ontology between human and non-humans actors in analysis. One frequent misunderstanding is that ANT does not understand the role of elements in networks as equally relevant, but instead seeks to empirically develop the specificities of these heterogeneous associations (Schäfer, 2013, p. 305).

2.4.2 Transporting STS (ANT) approaches to architectural design practice

Over the last four decades STS scholars have ventured to explore the most diverse practices (scientific laboratories, technology transfer, medical services, etc.), yet STS approaches to architectural design practices remain exceptional. This is somewhat surprising since the built environment presents a significant co-constitutive element of life. Nevertheless, the last decade brought an increased interest in using and advancing STS approaches to architecture, as evidenced in various publications (Delitz, 2009; Guy & Moore, 2005, 2007; Guy & Yaneva, 2008; Latour & Yaneva, 2008; Moore & Karvonen, 2008) and conferences (Gisler & Kurath, 2013; Müller & Reichmann, 2013).

2.4.2.1 STS (ANT) in urbanism

Cities and their particular arrangements have been the empirical focus of a limited number of STS accounts (e.g. Aibar & Bijker, 1997; Coutard & Guy, 2007; Hommels, 2005). Recently there has been an intense debate concerning the contributions of STS and ANT approaches tailored to urban studies, sparked by Ignacio Farías and Thomas Bender's (2010) "Urban Assemblages". Bender advocates scaling up the method from the successful "micro-analysis" of the laboratory and other well-defined situations to the spatial scale and intensity of the city: "As a method ANT is not hostile to the notion of larger social patterns of the scale of a city or beyond" (p. 311). He argues that what

> ANT offers is unusually rich heuristic device rather than a formal method for studying cities. It is a metaphoric approach that encourages a highly developed sense of urban complexity, of the unities and disunities, of the stabilities and instabilities, and especially the complex and heterogeneous networks of connection and association out of which the city as asocial and as a physical entity is formed and sustained (p. 317).

The book received harsh criticism (Brenner, Madden, & Wachsmuth, 2011; Tonkiss, 2011). Fran Tonkiss' critique of ANT approaches to urban studies refers to, *inter alia*, the flat ontology between human and non-human actors. She considers ANT to lack significant insights and to miss the important role of human agency, thus producing merely descriptive accounts. While I am sceptical of ANT's proclaimed symmetrical role of human and non-human actors to explain practices, I do endorse an approach that includes heterogeneous "relationality" and that calls into question "distinctions between global and local, close and far, inside and outside" (Farías & Bender, 2010, pp. 3-13) and thus proposes an alternative conception of space and ontology of the city. I position myself to this contention below in section 2.4.3 where I outline the STS-inspired approach of architectural practices that I deploy.

2.4.2.2 STS (ANT) in architecture

David Brain (1994) was amongst the first to develop the opportunities that STS perspectives can offer for interpreting architectural practices. He conceives the design of architectural artefacts as a form of "society in the making"(p. 193). He rejects theoretical models (of social and cultural studies) that attempt to explain architectural practices as being determined by "social structures" or "interpretive accounts [… as] the distinctive vision of the creative subject or the influence of a common style" (pp. 192-193). Instead Brain infers that in "any artifact, there is an apparent arbitrariness of form that cannot be reduced to external conditions, the demands of representation, or subjective motives"(p. 193). To find out how practices of "engineer-sociologists […] make sense *with* things" he emphasises the sensibilities of STS to trace "what social relations, institutional practices, strategies of action, and possibilities for transformation are built into cultural artefacts" of architecture (Brain cited in Coutard & Guy, 2007, p. 717).

Thomas Gieryn (2002) argues that STS approaches can offer the "conceptual tools sharp enough for picking apart the empirical realities of buildings […] as simultaneously shaped and shaping", and he sets out three approaches to understand architectural design: "heterogeneous design, black boxing, and interpretative flexibility" (p. 41). With reference to Andrew Pickering, Gieryn argues: "Neither the social (power, interests) nor the material (physical, mechanical) are so stable that they can serve as bedrock causes of design trajectories. As an artifact takes shape, designers transform the physical and mechanical worlds […] and each other's goals and interests" (p. 42). Surprisingly, thus Gieryn's declares "design is heterogeneous", his account of architectural practices bears no traces of the influence of engineers, from the design studio itself and from the diversity of design tools used.

2.4.2.3 Yaneva

The anthropologist Albena Yaneva was born in the Republic of Bulgaria. In 2001 she received her PhD in Sociology at the *Ecole Nationale Supérieure des mines de Paris*. Yaneva has collaborated with Latour on a number of projects, for instance the exhibition *Making things public* at the Centre for Art and Media in Karlsruhe in 2005, and the Europe-wide research project *Mapping Controversies on Science for Politics*.[10] Her work bridges the interdisciplinary boundaries of political philosophy, anthropology of art and design, STS and architectural theory. Yaneva has been central in transporting methodological and conceptual achievements of STS to empirical explorations of architectural design practices. In 2005 she claimed that "science and technology studies (STS) have closely followed scientists, engineers and physicians in and out of their workplaces; but architects have not been followed" (2005, p. 869). In order to develop her understandings of architectural practices, Yaneva entered the architectural studio "in the same way that Science and Technology Studies (STS) have approached the laboratories and the practices of scientists" (2009, p. 4), referencing the laboratory ethnographies of Bruno Latour and Steve Woolgar (1979), Michael Lynch (1993), and Karin Knorr-Cetina (1999).

While one of her earlier articles (2005) builds on STS, two later books (2009, 2012) draw on "ANT as a method of STS" (2009, p. 25), as well as several other perspectives (e.g. cognitive anthropology, design studies). Her work engages with architectural design practice through the method of design studio ethnography (2005, 2009), and non-participatory approaches such as interviews, archival, and media research (2010, 2012).

In Yaneva's writings on STS approaches to architecture it is difficult to pin down what it means to transport STS to architectural design practice, and whether or how STS approaches need to be adapted in order to capture the specificities of "actual dynamics of architectural design process and its material, cognitive and cultural dimensions" (2009, p. 4). Although her work hints at these questions, Yaneva does not systematically outline (e.g.

[10] see http://www.mappingcontroversies.net

rules of method, principles) how her STS modus of analysis of architectural design differs from the laboratory ethnographies that she refers to (see above).

Still, Yaneva offers a research approach to "offer architects an *entry* into a work of theory" (2012, p. 4, my emphasis) and as an approach "*towards*" an alternative interpretation of architectural practices (2009, p. 195, my emphasis). Yaneva's research approach comes in three different versions that largely overlap: "Towards a Pragmatist Approach to Architecture" (2009), "The architectural as a type of connector" (2010, 2012) and "Mapping Controversies in Architecture" (2012).[11] The latter is distinct in its ambition not only to trace and analyse the dynamics of "architecture in the making" (2012, p. 72), but to also map and represent them visually through recent dynamic visualisation computer software.

Resonating with many (contemporary) STS perspectives, Yaneva rejects forms of inquiry that rely on simplistic cause-and-effect explanations (2012, p. 1), on divides between nature and culture, architecture and society, or technology and meaning (2012, p. 1). She repudiates ideas of "architecture and society as static entities" (2012, p. 42), any "'social explanation' of architectural projects" (2009, p. 195), the idea of a given or fixed context into which architecture is placed (2009, p. 16), and neglecting to include materials and building technologies (2012, p. 32). Instead, she emphasises the reciprocal shaping of society and architecture (2012, pp. 25-46) and diverts attention to the pragmatic activity of design practices to enter into a modified interpretation of *what acts* to shape and constitute architectural practices.

Yaneva's research approach can be understood as an architectural and simplified version of Latour's ANT approach (e.g. 2005), who is continually referenced in Yaneva's work. The wider project that she attempts to develop is an alternative theory of architecture.

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[11] Yaneva states that the "Mapping Controversies" method was initially developed by Latour as an ANT-based inquiry into diverse disciplines (Yaneva, 2012, p. 68).

Yaneva's calls for a "pragmatist approach to architecture" (2009, p. 195).[12] This approach aims to describe the diverse elements and heterogeneous associations that are built within architectural practices. "It follows what architects, […] developers, designers, engineers, and clients do in their daily routine actions, in spite of their interests and theories, thus constantly prioritizing the pragmatic content of actions"(2009, p. 197). She argues that the performative dimension of architectural practices has the capacity to connect heterogeneous human and non-human actors. Architectural design is an unpredictable and tedious process of continual transformation that is characterised by negotiations, controversies and trials that may add, alter or abandon associations. Yaneva conceives her approach as a research method to explore architectural practices and "a new task for architectural theory" (2009, p. 202).

I draw on three perspectives that Yaneva developed in transporting STS (ANT) to architectural practice. They are especially useful for my explorations of City Hall. First, Yaneva's concept of a building conceives a building as an unstable, interpretable assembly that entails many contradictory issues: "a contested assemblage, […] a complex assembly of contradictory issues" (2009, p. 202). Yaneva rejects assumptions of stable "relationships between signified and sign". Say a building has a symbolic attribution of being, for instance, 'sustainable' or 'green', a spectator "assumes a simplicity of essence" which excludes alternative ways a building could be interpreted. In this symbolic assignment "we presume it to have a stable form" (2012, p. 20). With reference to Nigel Thrift she argues there "is no need to fix categories, styles and essentialist labels" (2012, p. 23). In Yaneva's view, a building has itself the capacity to act and do things (e.g gather diverse actors and provoke disputes).

Second, I outline Yaneva's conception of the *design process*: the (shifting) associations of heterogeneous elements:

> Instead of progressing in a linear fashion from a state of zero information to a completely known and defined object, the new building appears in the

[12] Thereby Yaneva draws on the "radical empiricism" project by William James. It implies a form of empiricism that concentrates on "what is given to experience and the numerous connections that are revealed in it" (2009, p. 196).

> architectural office in two presentational states; it always exists as a little-known, abstract and fuzzy entity, and at the same time a well-known, concrete, and precise object, as a bunch of elaborated models and a schematic diagram (2009, p. 21).

Design "relies on a cognitive and experimental move of going back, rethinking carefully and re-collecting, re-inventing, re-interpreting, re-looking, re-doing everything once again in a new combination of conservation and innovation" (2009, p. 200). Yaneva emphasises "the experimental dimension of design" which is built on explorations, discoveries, numerous detours, mistakes, and unpredictable events (2010, p. 143). In the process a building becomes more and more known as gaining new knowledge follows the principles of *accumulation* and *addition*. New data becomes incorporated through updating present states of drawings, models and other tools (2009, p. 128). Yaneva uses the term "design move, instead of design decision" to indicate that the "design venture is led by a variety of experimental assumptions, a number of 'what if …' queries, which configure a particular repertoire of actions of the building designed" (2009, p. 76). Yaneva emphasises the importance of "negotiations" referring to Louis Bucciarelli who argues that the "design venture is a process of achieving a consensus among the various participants with different 'interests' in the design, which derive from their technical expertise, experience, and responsibilities" (2009, p. 154). Crucial moments of the design process are controversies that point "to the series of uncertainties that a design project […] undergoes; a situation of disagreement among different actors over a design issue" (2012, p. 72). Architectural practices often include an "option process" in which "design moves" are changed, redefined and compared to rethink and evaluate the emerging design proposal. Yaneva highlights that they imply two steps: "multiplying the scenarios for a building" that are most probable and reducing options following discussions, new inputs and feedback. A process of elimination and stabilisation through "small evaluations, reductions, and reassessments that leads slowly to a smaller number of good options, and with time, triggers a better scenario for the building" (2012, pp. 168, 172-173).

Third, I highlight how Yaneva conceives the making of design knowledge. Architecture requires different forms of (sometimes conflicting) knowledge, which is in practice interpreted, synthesised and modified (e.g. Hauser et al., 2011, pp. 11-12). Yaneva points to Donald Schön's concept of "reflection-in-action" of designers which rejects a "scientific, linear way of knowing" by focusing on the knowledge "already embedded in skilful practice" (2012, p. 68). She highlights two dominant framings of knowledge: "explicit knowledge", for instance disseminated through academia, and "tacit knowledge", knowledge that cannot be adequately communicated and which is "learnt by doing", as pointed out by Michael Polanyi (Yaneva, 2009, pp. 117-118), Yaneva draws attention to the knowledge that is gained in design practice by architects through their everyday tools: drawing, scaling, modelling and circulating plans. The extensively used visual and material tools differ from the tools in scientific laboratories. Models, drawings and diagrams "are important tools for thinking about, imagining and designing a building […] and a crucial 'means of studying the impact of design'" (2009, p. 119). Yaneva argues that they are not only descriptions, but that they are "gestural, spatial and operational tools of investigation, which help architects learn more about [… a project] and interpret its features" (2009, pp. 119-120). For Yaneva, different visual tools (sketches, drawings, models, etc.) are interconnected and knowledge is gained through their examination, interpretation and translation from one medium to another: "Acting complementarily and in cooperation, the 2D-to-3D and 3D-to-2D translations shape a process of continuous knowledge transfer, in which the building gradually becomes known" (2009, p. 127). She concludes that gaining knowledge follows the principle of accumulation. In sequential processes of assumption making, modifying, testing and re-interpretation, new dispositional knowledge is added that slowly leads to the final design. The collaboration and mutual exchange between architects and their consultants is another form of gaining knowledge that she highlights. Plans and other forms of visual tools are circulated and discussed. Consultants "*learn* about the architectural assumptions, and in exchange the architects *learn* from these [… consultants], each of which has a different competence, about the structural, mechanical and construction parameters" (2009, p. 152). Shared brainstorming and discussions are processes of mutual learning "about the strength of their design schemes and makes more intelligible the project's advantages and disadvantages" (2009, p. 152).

In this section I have continued to situate the approach within existing literatures through a brief discussion on the transfer of STS approaches to (urban and) architectural studies, mainly via the work of Albena Yaneva. An open question remains in Yaneva's as to how and to what extent STS and ANT approaches need to be adapted to explore architectural design practices. Yaneva's research approach rejects social or subject-centred explanations of design practice, includes materiality as co-constitutive forces, to arrive at an approach that includes heterogeneous elements as symmetrical forces that explain action and constitute architectural practices. Yaneva has developed several accounts in this developing field but has not formulated a systematic modus of analysis adapted to architectural design processes. Her conception of both cognition and knowledge remains simple, but to bring in more elaborate perspectives is beyond the possibilities and scope of this thesis.

2.4.3 Outlining the STS-inspired approach of architectural practices used

I am fascinated by the contributions that the field of STS can make to the exploration of architectural design practices, especially in the field of environmental design. Having worked as an architect for many years, I am relatively new to the world of STS explorations and consider myself an emerging STS researcher. I therefore develop an approach that is inspired by STS thinking.

This approach draws on Yaneva's work as outlined above, but with one elementary difference. Despite recognising that artefacts, things and materials have an important co-constitutive role in architectural practices, I distance myself from the view that they in a literal – and not in a metaphorical - sense have the capacity to act (the symmetry of human and nonhuman actors). For instance, Yaneva claims that "the building makes the controversies" (Yaneva, 2009, p. 112). Instead, I follow Ross Beveridge and Simon Guy who (drawing on Ian Hacking and Jonathan Murdoch) argue that humans in comparison to non-humans have the unique capacity of "communication and reflection" that "shape motivations for actions". Despite acknowledging the importance of heterogeneous associations shaping design practices, it is the distinctive human capacity that "often be seen to act as a 'driver' for change in the socio-technical-natural world" (Beveridge & Guy, 2009, p. 72).

2.4.3.1 Translation

I also expand Yaneva's approach adopted above. In order to develop a better understanding of how environmental challenges were constructed as design issues in City

Hall's design practices, and how heterogeneous elements became associated and continuously transformed, I make selective (thus simplified) use of Michel Callon's (1986) concept of "translation" as my central analytical frame.

The metaphor of translation was put forward in the 1970s as a major theme in the early writings of the philosopher of science Michel Serres, who conceived translation as "an act of invention brought about through combining and mixing varied elements" (Brown, 2002, p. 6). Latour and Callon built on Serres' metaphor and developed it into a central concept of ANT (Law, 2009, p. 144). The notion of translation is distinct in the field of STS (ANT). It has been used to explore sociotechnical innovation processes (e.g. Beveridge & Guy, 2009)

Callon (1986) has articulated an elaborated concept of the mechanisms of "translation" in the "sociology of translation". In his well-known study of harvestings scallops, Callon sets out an analytical framework to study the formation of heterogeneous associations, controversies and power relations.

As his starting point, Callon critiques sociologists' impartial approach to "scientific and technological content" (p. 197), content that he considers principally "uncertain, ambiguous, and disputable." He claims that sociologists have taken an asymmetrical perspective, since they have not applied the same openness to "society and its constituents" (p. 197). Callon extends insights from the sociology of science and technology to society in order to consider both as "equally uncertain, ambiguous, and disputable" (p. 199). This way he rejects explanations of emerging scientific and technical practices by existing "social norms" or "social forces such as classes, organizations or professions" (p. 198), but as being in principle uncertain, shifting and shaped through practice. Callon deduces that "translation is the mechanism by which the social and natural worlds progressively take form" (p. 224). Callon's "sociology of translation" pointed towards a then newly emerging conception of the social. This understanding suggests a model of

> society which is considered to be uncertain and disputable. Within the controversies studied, the intervening actors develop contradictory arguments and points of view which lead them to propose different versions of the social and natural worlds (pp. 199-200).

Based on the idea that society and nature are not presupposed, but "rendered as uncertain and disputable", Callon argues this methodological approach "reveals an unusual reality which is accounted for quite faithfully by the vocabulary of translation" (p. 222). Latour contends Callon's study of scallops to be one of the foundational texts that led to the articulation of ANT (Latour, 2005, p. 10).

Callon builds his translation approach on three methodological principles: First, "agnosticism (impartiality between actors engaged in controversy)"; second, "generalized symmetry (the commitment to explain conflicting viewpoints in the same terms)"; and third, "free association (the abandonment of all a priori distinctions between the natural and the social)" (pp. 196-201).

In a loose interpretation inspired by Callon's first principle, I attempt to impartially follow technological and scientific arguments used by practitioners and properties attributed to entities, as well as the descriptions and interpretations of their own and others' roles and relationships. From the second principle, I attempt "not to change registers when we move from the technical to the social aspects of the problem studied" (p. 200). Society, nature or technology cannot be used to explain why controversies concerning protagonists or entities are closed, since their association is the outcome of practices. I acknowledge the important co-constitutive role of artefacts, things and materials in practices, but distance myself from Callon's claim that "actors are all equally important" (p. 222), whether human or non-human (see my argumentation above). The inspiration that I draw from the third principle is the attempt to abandon any hypotheses of presupposed definite boundaries that separate natural, technical or social events (relations). "These divisions are considered to be conflictual, for they are the result of analysis rather than its point of departure" (pp. 200-201). Furthermore, I follow the protagonists "in order to identify the manner in which these define and associate the different elements by which they build and explain their world" (p. 201). I consider roles and relationships as principally unpredictable, fluctuating, and stable only for certain times and locations. They take their course within practices.

2.4.3.2 Mechanisms

Inspired by Callon, I adopt the following concept of translation to analyse how environmental challenges, targets and goals were formulated in the design practices of City Hall and how, in an unpredictable iterative process, they were transformed into design strategies, building technologies and the materialised building (cf. research questions posed in Chapter 1). In a loose interpretation adapted to architectural design practices, I interpret translation to be a fluctuating unpredictable process, through which heterogeneous entities (e.g. architects, interpretations, arguments, world views, materialities) become associated and forged into a conflictual, unpredictable alliance. Proceeding from the initial problem and plan towards architectural materialisation necessarily depends on the simultaneous production of new design knowledge and additional association of heterogeneous entities. Crucially, this process is not neutral, but performed by two inseparable mechanisms (structuring power relations): on the one hand, various sorts of "displacements and transformation[s]"; on the other hand, controversies, choices, "negotiations, and adjustments that accompany them"(p. 224). During this process the initial problem, "the possibility of interaction and the margins of manoeuvre"(p. 203), the role of actors, the properties of entities, and their relationships are reciprocally shaped, modified and re-ordered.

Callon describes the translation process through four specific moments "which can in reality overlap"(p. 203) and that mark a progression in the ongoing negotiations (p. 224). First, "problematization" in which a group of protagonists (e.g. clients) first defines a problem and action plan. The protagonists then depend on other practitioners and elements, attempting to invoke a set of diverse entities, and seek to assign particular roles to and relationships between them in order to build alliances of supposedly shared interests. Particular movements and detours must be accepted to avoid "obstacle-problems" (p. 206). The initial problem thereby becomes transformed. Roles are negotiated in the translation processes, they are defined through the system of "alliances, or associations, between entities, thereby defining the identity and what they 'want'" (p. 206).

Second, “interessement“ in which the protagonists seek to stabilise entities, roles and relationships in the initial plan. By negotiating envisaged associations they develop and interpose several strategies and devices (e.g. mathematical calculations, diagrams, proposed technologies) to enable practitioners and material entities to identify with their roles. These strategies and devices “extend and materialize” previous hypotheses made (p. 209). Elements might “refuse the transaction by defining its identity, its goals, projects, orientations, motivations, or interests in another manner” (p. 207).

Third, “enrolment” in which the protagonists seek to further stabilise relationships to “enable them to succeed” (p. 211). The aim is to transform hypothetical assumptions into more certain arrangements. These envisaged relationships, strategies and devices are tested, renegotiated and reordered to make them perform as predicted. This is a conflictual process in which it is important to trace how “settlement on the often conflicting priorities of a variety of actors” (Beveridge & Guy, 2009, p. 73) was generated.

Fourth, “mobilisation”: As proposed strategies gain wider acceptance and the associations increasingly include absent (simulated) entities (e.g. occupants, actual kilowatt hours), a crucial question becomes how representative particular assumptions and predictions are. Many absent (simulated) entities become associated (e.g. occupants, actual kilowatt hours) and the question is whether they will actually perform (and be accepted) as represented in previous predictions. Analysing “representation in terms of translation […] seeks to undermine the very idea that there might be such a thing as fidelity. Faithful translation. Which stresses that all representation also betrays its object” (Law, 1999, p. 1). “A series of intermediaries and equivalences” are established to render displacements easier (Callon, 1986, pp. 216-218), as if the world projected in the design studio would be the same as the world of actual operation. Assumptions and strategies “inscribe” a particular “vision of (or prediction about) the world” into the emerging practices and artefacts (Akrich, 1992, p. 208). Sunbeams, irradiation and heat become represented in the architectural studio through graphical representations and computer analysis – they are displaced.

In summary, I adopt a concept of translation that first emphasises the persistence of transformation and displacement (a flow of many translations) that occur in architectural design practices: “displacements of goals and interests” (e.g. concept of sustainability), as well as architects, engineers, design strategies, building technologies, sunbeams and inscriptions, "displacements [occur] at every stage. Some play a more strategic role than others" (Callon, 1986, p. 223).

The notion of translation is well suited to analysing the expansion through simultaneous association of new entities, construction of additional relationships and production of design knowledge, which are a precondition for the development of the initial problem and action plan. This process constantly mixes together a variety of heterogeneous entities (e.g. statements, preferences, numbers, materials) which co-shape each other. These heterogeneous assemblages of architectural design are essentially built on the simultaneous mechanisms of "displacements and transformation" and negotiation and adjustment. (p. 224). The notion of translation foregrounds the conflicts between diverging perspectives, objectives and strategies of different practitioners and "the performance of technical and natural" entities (Beveridge & Guy, 2009, p. 72). The "vocabulary of translation" allows us to examine the two questions: "Why and in what conditions do controversies occur? How are they ended?" (Callon, 1986, p. 219), without giving any *a priori* explanatory to status to particular aspects (e.g. opinions, calculations, material properties).

The vocabulary of translation as interpreted above highlights the complex processes that constantly mix a diverse set of heterogeneous entities (arguments, symbolic interpretations, material properties). Furthermore, the many struggles and displacements constantly reorder the practice of architectural design. Initial design goals need to be translated into particular intermediary and mediated parameters, strategies and technologies in the complex materialisation of new buildings. The form that these ongoing transformations take is crucial.

I follow Callon's suggestion that the concept of translation may offer "a better understanding of the establishment and the evolution of power relationships because all the fluctuations which occur are preserved" (p. 201). I thereby build on a simplified understanding of power in two forms: first, power as a precondition of action transiently associated within the practices (a building code, an agreement); second, power as the result of action (Beveridge & Guy, 2009). Power relations then occur, for instance, through “the way in which [practitioners and entities] are defined, associated and simultaneously obliged to remain faithful to their alliances” (Callon, 1986, p. 224). They can occur through closure of controversies, through strategies and devices (by compelling entities to align, while excluding others), through the control of some entities by others, and through the ways in which some are allowed to represent (or suggest equivalences between) other absent entities that they have displaced during the design activities.

Within the translation approach the role of visual representations - one form of inscription devices - is important to align the various practitioners. Latour and Woolgar highlight the importance of inscription devices “as a set of practices for shifting material modalities” (Law, 2004, p. 29). Diagrams and drawings connect the “visual and material” (Rose & Tolia-Kelly, 2012, p. 1). I shift attention to the role that these visual representations play within City Hall’s design practices. I focus on diagrams, drawings and 2D computer visualisations - all instrumental in the design process of City Hall. In the field of engineering design, Kathryn Henderson argues that because visual representations “are developed and used in interactions, these […] act as the means for organising the design-to-production process an serve as the social glue both between individuals and between groups” (1999, p. 6).

A few simple questions help me to understand the processes of translation in City Hall’s design practices: How (and by whom) is the initial problem and action plan formulated? How is a set of practitioners and entities associated in this plan? How is the initial action plan transformed? Which additional elements are associated to expand initial hypotheses (e.g. actors, entities, strategies, devices, detours and problems)? How are they negotiated and adjusted, how reciprocally displaced and transformed? How are design strategies stabilised?

2.5 Conclusions

This chapter outlines the positions and theoretical framework through which I explore City Hall’s design practices in order to address my research aims.

The first main part argued that building-related practices can play an important role in mitigating the environmentally destructive effects of human activity. I pointed out that architectural design practices are characterised by vast disagreement and divergent perspectives on how to define environmental design challenges at the outset, which pathways to follow in response, and how to materialise projects. By stepping back, I suggest a reconsideration of how architectural design practices define environmental problems and translate these into materialisation. Furthermore, I argued that architectural design practices be reconnected with particular understandings of a wide range of different environmental crises, rather than defining environmental design targets through established guidelines, assessment methods or Building Regulations.

In the second main part of the chapter, I introduced a constructivist perspective in order to interpret the environment 'out there'. Starting from the presumption that the achievements of environmental design "critically depend on the specific social construction of environmental problems" (Hajer, 1995, p. 2), I suggested that the problems of the environment 'out there' cannot be understood in all their complexity, but can be approached through particular concepts. I argued against the treatment of "sustainability in a general, colloquial sense"(Leach et al., 2010, p. 5) and instead through a normative understanding "to specify clearly, for particular issues and settings, what is to be sustained for whom, and who will gain or lose in the process" (p. 171).

The last main section set out the STS-inspired overarching framework, in which I make selective use of Yaneva's approaches to architectural design practices and Callon's concept of translation. This framework guides my exploration of how environmental design problems became continuously transformed, heterogeneous elements associated, diverse vocational practitioners aligned and reordered, design hypotheses negotiated and extended into design strategies, and how these became increasingly stabilised. Building on this, I will explain my choice of methods, how I carried out the research and gathered empirical material in the next chapter.

Chapter 3

Exploring architectural design practices (methods)

3.1 Introduction

In the previous chapter I outlined my theoretical framework and specific analytical frame with which I research the design practices of City Hall. In this chapter I describe the methods I used to gather, analyse and represent the heterogeneous materials from my fieldwork. This chapter and the previous one are closely interlinked.

As explained in earlier chapters, although I began my research with a building, my research interest was less placed on the presence and materiality of London's completed City Hall, but more towards the contingent practices that led to its manifestation. Since the heterogeneous activities, struggles, transformations, and back and forth that brought the building into being are largely concealed in the City Hall assemblage, I approached the different parties centrally at work in its creation in an attempt to speak to the actors and gain access to the design documents involved. I took a pragmatic approach and tried to retrace the design practices retrospectively by exploring what actors involved *did* within the making of architectural design. This way I attempted to capture "the actual dynamics of architectural design and its material, cognitive and cultural dimensions" (Yaneva, 2009, pp. 3-4) in order to develop an understanding of the ways in which City Hall had gradually been assembled.

My Science and Technology Studies (STS) inspired approach that, in a loose interpretation builds both on Yaneva's (2009, 2012) approaches of architectural explorations and on Callon's (1986) concept of translation, contains both theoretical and methodological aspects; this approach thus cannot be neatly divided into theory and method. For instance, Callon develops the concept of translation as an "analytical framework" that builds on a set of "methodological principles" (1986, pp. 197, 200). The STS-inspired approach allows to abandon thinking in layered realities (e.g. technical, natural) and instead welcomes and encompasses hybrid characters. It is specifically suited to exploring how design issues are constructed, design knowledge produced, and design strategies assembled.

I have identified my adaptation of the concept of translation as my key analytical frame. Thus I make selective use of vocabulary and framings introduced by Callon to organise and analyse the empirical material that I collected, for instance the problem formulation, the aligning of practitioners and elements, necessary detours, conflicts, deployed devices, the stabilisation of design strategies and more.

The STS-inspired approach taken in this thesis - like many others in the diverse field of STS - is routed in the exploration of a particular case study. I explore the design practices of City Hall and its heterogeneous elements through a mixed-method approach that includes case study, semi-structured interviews, visual methods and graphical mapping.

My research of City Hall as a proclaimed exemplar of sustainability depends on a series of choices and decisions made during the process of preparation, fieldwork, data analysis and in writing up my findings. Throughout these stages I had to go back and forth in order to reflect on and adjust to unexpected events that I encountered. The particular knowledge that I produce depends on and is constructed through these choices. These included a broad set of questions: ontological ones about the nature and existence of the elements explored, epistemological premises on how I, as a researcher and architect, acquired knowledge through interaction with actors and the data I gathered, and also pragmatic questions such as accessibility.

3.2 A mixed-method approach

The worlds that I explore in my research are heterogeneous and not understandable through a single frame of reference. During the research process I therefore decided to use different methods that interlock and complement one another. I understand my exploration as a reflexive process of going back and forth between listening (to my interviewees), reading (design documents, transcripts), beholding (diagrams, pictures), reconnecting, interpreting, describing, mapping and writing.

When exploring design processes it is difficult to make simplistic divides between, say, briefing, designing and constructing since these activities partially take place simultaneously and reciprocally shape each other. I explored City Hall's practices from its inception around 1997 until operation in 2011, when I stopped my fieldwork.

3.2.1 Case study of City Hall's design practices

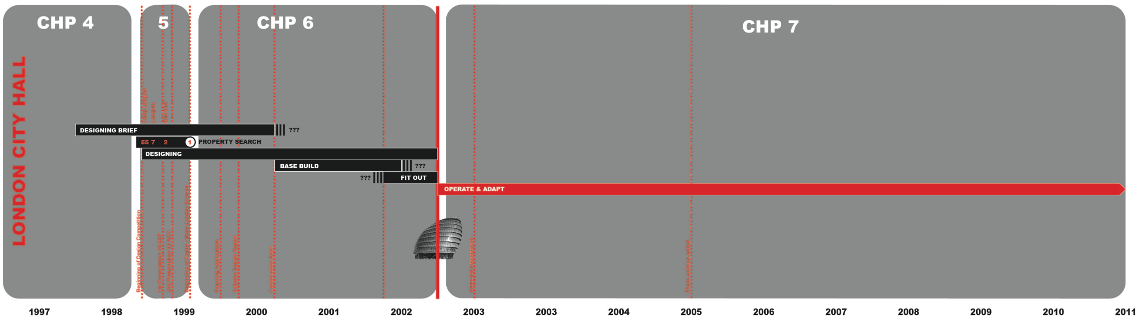

Figure 3.1 Timeline of City Hall's design and operation process from 1997 to 2011 and Chapter structure of this thesis (Timeline: Author, 2014)

Note: Black horizontal bars map the design processes, red bar the operation (and updating) processes and grey fields indicate the chapters that address parts of these processes.

As previously explained, my research explores the case study of London City Hall, which was produced by specific and localised practices (rationale for the case selection see Chapter 1). City Hall was designed mainly in collaboration between the Government Office for London (GOL), CIT developers, Foster+Partners architects and Arup engineers between 1997 and 2002. City Hall was handed over to the Greater London Authority (GLA) in 2002 and I examine its operation process until 2011, when I concluded my fieldwork in order to write up my thesis. In Figure 3.1 I envision the timeframe of my explorations of City Hall's design and operation practices between 1997 and 2011 as a temporal process. The chapter numbers in which I explore and discuss parts of these processes are indicated in the grey fields in white text. I attempted to organise my chapters around the emergence or departure of groups of actors (e.g. designers and architects taking up their work).

To develop a better understanding of the design practices and their achievements in particular, I also explored City Hall in operation – comparing to what extent City Hall's completed design in *actual* operation achieved the *projected* environmental performance targets that were defined during design development to guide and align the translation processes towards design materialisation.

I explored the operation practices in a similar way to the design practices – by approaching key actors to probe their expertise and activities in the project. I focused on City Hall's facility management team. Initially I intended to explore the experiences of additional GLA occupiers besides the facility management team. Due to time constraints in the completion of this thesis, I refrained from collecting further data on occupation despite recognising the important role of others in evaluating design activities.

I began to develop my account of City Hall's design and operation practices by looking at key events, for instance the first draft design brief, the first ministerial presentation, the planning application submission and others. Most of these events were important stages in the architectural plan of work in which the design team members increasingly drew together the diverse elements and, at least momentarily, stabilised them. I wove additional materials into this emerging account such as interviews with project stakeholders, modelling processes, pictures, City Hall utility bills and more.

3.2.2 Semi-structured interviews and informal conversations

Unlike many STS ethnographers, I was not able to 'follow actors' at work through presence and observation. Instead, my account of City Hall's design practices crucially relied on the experiences, perspectives and retellings of the client, the architects and the engineers that were central in the 'making' (and operating) of City Hall. I accessed this information through semi-structured interviews and informal conversations. As such I relied on and produced a selective account of City Hall.

Within the mixed-method approach, semi-structured interviews and informal conversations with participants were crucial to retrace the design processes and to collect rich data about the design development of City Hall. Between April 2009 and October 2012 I conducted 16 interviews in total. All of my interviewees participated within the design process of City Hall. I spoke to most of them once, to some of them twice or three times. The range of actors I interviewed was diverse, coming from various vocational backgrounds and differently involved in the project. They included the Minster for London, a project sponsor, an engineering project manager, architects, a construction manager, a building infrastructure manager, and more (see full Schedule of Interviews in the Appendices). I have minimally edited transcripts (indicated through square brackets) of the quoted parts of my interviews in order to maintain actual spoken accounts and individual voices.

My questions sought to explore the actors' backgrounds, their role in the design process, their statements, their interpretations of the process, the diverse elements they connected, how design knowledge was gathered and transformed, how they navigated through the heterogeneous possibilities of environmental design, and their rationale for the choices they made. My interviews presented me with the opportunity to delve into these complex processes. It was sometimes difficult for my interviewees to retell particular events since the design process dated back approximately ten years. Some nuances might have been lost with time and particular actions may have been transformed into storylines that seemed more desirable for them. Where possible I attempted to match the retellings between different interviewees (and other materials) in order to avoid singular narratives. In addition to the semi-structured interviews and informal conversations, I exchanged many emails with the diverse design practitioners, mainly to follow up on questions that only emerged after meetings.

I began interviews in August 2009. I contacted Foster+Partners and they arranged a meeting for me with the architect David Kong, one of the few architects still at the office that participated in City Hall's development. I had explained my research project to him by email before a personal meeting that lasted about two hours. Kong explained City Hall's design process by PowerPoint presentation. He later dug out from Foster+Partners' archives several design documents: a design statement, the planning application scheme and others. I received these documents in hardcopy. Aside from the information in existing literature on City Hall, I began to follow and retrace City Hall through this initial meeting with Kong. He explained to me who, from his point of view, were the key participants in City Hall's design processes and I expanded my circle of interviewees accordingly. I contacted the GOL, Arup, More London and others to set up interviews to expand my account. I thereby accumulated more and more knowledge of City Hall's design practices. By accessing the worlds of the architectural design process, I encountered particular statements, stories and arguments in oral, textual, pictorial and mixed form. This often led me to other practitioners or entities, sometimes outside Foster+Partners' Riverside Studio, sometimes further back in history, and sometimes to matters of a very different character (e.g. kilowatt hours per square metre). For me, then, "following the actors" meant not only following practitioners (humans), but also to follow heterogeneous materials and understand their effects as "product of a set of alliances"(Law, 1991, p. 12).

While interviews and conversations (and design documents) are language-based and "discursive strategies" play an important role, it is important to understand that architectural design practices cannot be reduced to these strategies since practitioners "interact with 'things' around them, technologies and nature, that such interactions have constitutive effects on both people and things" (Beveridge & Guy, 2009, p. 72). In my face-to-face interviews and conversations, non language-based forms of communication played a significant role too. Visual materials (e.g. drawings, diagrams, photographs) were often part of conversations, introduced either by my interviewees or me. Their involvement posed a challenge for audio recording and transcribing since they could hardly be captured by these media (only conversations about them).

I drew myself many different timelines in an attempt to understand City Hall's design practices in the past (see also Section 3.2.4). These timelines depicted my understanding of facets of the design process as it was then, and provided a basis for discussion in the interviews. The temporal dimension of the timelines allowed me to develop a better understanding of what actually happened within the design process. My interviewees then commented on and partially drew on these mappings to describe the process. Following the interviews I updated the diagrams in accordance with my interpretation of the information received. These mappings accumulated more and more information through the increasing number of interviews I conducted. The timelines co-developed in and through these conversations and helped to better understand what happened when, since my retrospective explorations deprived me of the possibility to perceive the flow of time and events myself.

3.2.3 Visual methods

The architectural domain depends heavily on the production, appropriation and circulation of visual representations (drawings, diagrams, renderings, sketches, photos on paper and on screen). According to Kester Rattenbury, they have moved centre stage as key tools in decision-making processes. She examined the mutual relationship of images and pictures in an architectural context: "Architecture's relationship with its representations is peculiar, powerful and absolutely critical" (2002, p. XXII).

Today, image practices are "central to the cultural construction of social life in contemporary Western societies" (Rose, 2007, p. 2). In the social sciences the key concern for studying images is not only that they construct social differences, but also that they visualise, include and exclude social categories. In the mid-1990s, W. J. T. Mitchell (2005) argued there should be a fundamental change in approaching the relationship of Western societies to the representations, pictures and images that they produce and are surrounded by. Mitchell's formulation of the "pictorial turn" did not simply seek to endorse the cultural predominance of the visual.[13] Rather, he sought a new picture theory that breaks with the ease with which we bring forward our interpretations of images and the ostensible ability with which we decode the ideological agenda behind an image narration. For him, visual representations are at once autonomous and constructed, found and crafted, imitations and products. Today, picture practices are rooted in broad and interdisciplinary contexts. Tom Holert understands their role as "communication boosters", "evidence machines" and "switching devices". Cultural, economic and scientific processes, which would otherwise be incomprehensible, are rendered plausible through pictures (Holert, 2000, pp. 32-33). Architectural practices are confronted with the paradox of pictures being appropriated as legitimating tools and having an independent life of their own beyond truth content.

The word "image" is notoriously ambiguous. Latour defines an image as "any sign, any work of art, inscription, or picture that interacts as a mediation to access something else" (2002, p. 16). An image can denote both a physical object (a printed photograph or a painting) and a mental, imaginary, psychological entity. Mitchell describes the picture image relationship as "the picture as a concretely embodied object or assemblage, and the image as a disembodied motif, a phantom that circulates from one picture to another and

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[13] W. J. T. Mitchell questions the predominant influence of the 'linguistic turn', under which the arts, media and other cultural forms are largely interpreted by linguistic, semiotic, rhetoric and other models of textuality (Mitchell, 1994, p. 12). Instead he argues for the importance of a 'pictorial turn' as an independent picture theory.

across media" (p. 72). Correspondingly, Wittgenstein pointed out that "an image is not a picture, but a picture can respond to it" (in Mitchell, 2005, p. 84).

Pictures deployed in architectural design processes (e.g. collages, renderings) are peculiar, paradoxical creatures. They are amalgamations that (might) reflect specific myths, facts and discourses. To explore how these pictures engage in perception processes and produce meaning, it seems crucial to attempt to shed some light on the mutual tie of the picture itself, the picture producer, the beholder, the real thing that is the built environment and its surrounding discourses. To question the picture-beholder relationship we have to acknowledge that the image consists of multiple sites or scales. Gillian Rose emphasises that images have multiple sites and modalities. To explore visual images she suggests that there are (at least) three sites through which the meaning of an image is coproduced: "the site of the production", "the site of the image" and "the site of the audience" (Rose, 2007, pp. 6-13).

Pictures are evocative formats and therefore have the potential to evoke awareness; the visualisations of architectural projects are strategic sites to address and negotiate the challenges of the 'environmental crisis'. In my research, the function of images is not simply to illustrate what has been said about them, but to be used as independent sources of information. I look at pictures not through the interpretative statements that have been made about them, but rather I match pictures, documents (interpretative statements) and conversations against each other. The aim is to examine statements and pictures in relation to each other, as well as to understand how pictures are or were produced through many stages of inscription of the design process.

3.2.4 Mapping facets of the design process

In addition to the drawings, diagrams and pictures produced within the design processes of my case study, I also produced drawing in an attempt to map facets of the design (and operation) process. Based on my experiences as an architect, I am interested to test drawing as a tool for this research. These mappings are partially conceived as timelines that draw together multiple elements to explore temporal processes, which are characterised by particular events. These include, for instance, the presence and absence of actors in the design process and the related potential to exercise power; other mappings depict how the building process drew together different geographic scales through associations; others map various material flows (e.g. gas consumption).

The mappings helped me to develop my understanding of the design process and the timelines were particularly crucial tools in the attempt to reconstruct past design practices. I discussed some of them (especially timelines) with interviewees, which significantly helped with their development. My mappings also served as alternative ways of understanding the design and operation process. Generally, the pictures circulated by the designers legitimise and promote the project. An architectural project is always complex, and what is missing from the neat published representations is an impression of the many controversies and struggles that emerge during the design process. Through juxtaposition I attempted to explore how my mappings differed from the "official" drawings produced by my actors. They emerged as alternative, not necessarily congruent, accounts. I aimed to open up differences for discussion, to uncover controversies, and to search for potential alternative routes the design process could have taken. My approach of drawing processes, heterogeneous elements, events and actors together on a single sheet of paper was one way of seeking to understand their entanglements and types of connection.

3.3 Experience of doing the research

Given my personal experiences in architectural practice, I am familiar with particular routines, approaches and instruments, although they vary between individual practices. In part, this is an advantage in attempting to understand relationships, issues and processes. But this familiarity might at some point have hindered my exploration since I did not interrogate associations that a non-architect perhaps would have. I found the interviews with non-architects – especially engineers — most inspiring since they opened access to an alterative perspective on architectural design practices.

I am interested in questions of how architectural design is associated with politics. This relationship became in part evident to me through negotiating fieldwork access. I started my PhD in October 2006. In October 2008 I began my fieldwork on the case of Battersea Power Station that set out to become a zero-carbon (re-)development, initiated by Treasury Holdings and Rafael Vinoly Architects. This project promised to be an interesting case in its environmental design ambitions. I began my explorations of this case through a six-month participant-observation period in the architect's office on site. During this time the project encountered increasing economic and political difficulties and the initial environmental agenda was consequently dropped. I underestimated the political sensitivity of being involved in a live project, especially regarding access to sensitive information in meetings and design documents. I therefore lost the support of the developers in my role as an observer of the ongoing design process. I was increasingly seen as an intruder and potential threat to the multimillion-pound project. Access to information became more and more restricted and the developer did not want me to write about the difficulties. As I was forced out of the participant role, I gave up on the case after six months. I learned a valuable lesson in confidentiality: that it seemed easier to gain access and critical perspectives when projects were completed or actors were not involved anymore. This experience also informed my choice of City Hall as a research case.

I started my fieldwork on London's City Hall in May 2009 with the aim of giving a detailed description of how environmental design approaches were conceived, negotiated and implemented within the actor networks. To retrospectively trace the multiple narrations of the design process that brought London's City Hall into being is a difficult enterprise since the beginning of that process dates back 13 years. Project files were archived or have vanished, and some actors have left the country. Around 1999, communications between stakeholders on the project gradually switched from fax to email, which made the archival search more difficult than it had been on account of the diverse formats of documents.

In January 2011 I expanded my fieldwork to include a supplementary case study on the recent PricewaterhouseCoopers (PwC) headquarters next to City Hall and part of the same More London masterplan. While City Hall was the first building of the More London masterplan, the PwC building was the final building developed between 2007 and 2011. PwC promoted their project as the "greenest building in the capital" (PwC, 2011, p. 2) and it was the first major office building in the UK to achieve the highest Building Research Establishment Environmental Assessment Method (BREEAM) rating of "outstanding". In the process of editing this thesis, I realised that a lot of additional work and (re-)editing would be necessary to develop my analysis of the PwC case into an in-depth comparison with the City Hall case. I consequently decided not to use the PwC case material gathered for this thesis.

3.4 Conclusions

My mixed-method approach presented a series of choices. From my research I provide just one possible representation of City Hall's heterogeneous design practices out of numerous possible ones. It was impossible to develop a singular, neat and unequivocal account of how City Hall's design practices were produced. Rather, the design processes were ongoing and assembled through multiple actors and elements. I was thus confronted with different and not necessarily consistent perspectives on City Hall's decision-making processes and development trajectories, depending on the particular vantage points of actors interviewed. Each particular account brought to life in my explorations and writing necessitated the exclusion of other possible accounts (Law, 2004).

Chapter 4

Drafting design briefs

4.1 Introduction

In this chapter I begin to open the black box of City Hall's design practices. I then describe City Hall's design process in Chapters 5 and 6, and in Chapter 7 I describe its operation process.

I start to retrace the practices that brought City Hall into being before the architects, Foster+Partners - the actors 'typically' called designers - entered the design process. In my account City Hall's design process began when the Greater London Authority (GLA) was conceived and its functions outlined. My explorations of this process begin around 1997 with the introduction of Nick Raynsford as one of the key actors entrusted by government with responsibility for establishing and housing the GLA.

I explain Raynsford's task by outlining the circumstances that led to the reintroduction of a new form of London-wide government. The body of this chapter retraces the contingent practices around his establishing the GLA, and how an increasing number of heterogeneous elements became associated in this mission – that is to say, how new actors joined his team and collaborated in legislating for the establishment of the GLA, then to introduce a unique type of procurement process, and finally to draft a number of design briefs to guide and align the developers, architects, engineers and others in their design proposals. I retell this process by chronologically examining the documents that were instrumental in bringing the GLA and City Hall into being. Into this, I weave material from my interviews with actors who took part in this process.

The objective of this chapter is to explore how the environmental challenge was set out at the beginning of the project, and how particular targets and goals were formulated to instruct the architects, engineers and developers in making their design proposals.

This chapter finishes by retracing the design process after the first three design briefs were drafted and several design collectives comprising developers, architects and engineers entered the design stage to take up their work.

4.2 Envisioning and outlining the new Greater London Authority (GLA)

4.2.1 The London power vacuum, 1986-2000

Before Raynsford began setting up the GLA, London had been experienced a power gap in local authority governance for 14 years. The first London-wide government was established in 1888 to deal with the various challenges of a rapidly growing but socially polarised metropolis (Gordon & Travers, 2010, p. 50). This government institution went through several reforms, reorganisations and renamings, but it existed for almost 100 years. In the 1980s, during the economic recession, a newly radicalised Greater London Council (GLC), led by Ken Livingstone, directly challenged the economic liberalism of Prime Minister Margaret Thatcher's national government. The two political institutions were located on opposite sides of the River Thames: on one bank, the national Conservative-led government in the Houses of Parliament and, on the other, the London Labour-led government in County Hall. This spatial divide between parliament and County Hall was increasingly matched politically as there were ever sharper conflicts between the two institutions. In Thatcher's eyes the activities that took place in County Hall were a challenge to parliament and national government. According to Ian Gordon and Tony Travers, it was the GLC's political activism challenging central politics which led the Thatcher government to respond by abolishing the GLC in 1986 (2010, p. 51).[14] As a consequence, most of the 22,000-strong workforce was made redundant and London County Hall was abandoned as the domicile of the former London-wide government (Figure 4.1). In 1993 the Conservative government sold County Hall to a Japanese entertainment company. For the next 14 years London had no London-wide government; there was a "power vacuum in the city" (Gordon & Travers, 2010, p. 49). Andy Thornley characterises these years as a phase of institutional "fragmentation, centralisation and weakening of local democracy" (1998, p. 163).

[14] Together with the GLC the Thatcher government abolished all its counterparts in other English cities.

Figure 4.1 Former London County Hall domicile of the Greater London Council (built between 1911 and 1939, Photograph: Author, 2010)

The roles and responsibilities of the abolished GLC were redirected to either the boroughs or to central government, but many required setting up special *ad hoc* organisations – for example, the London Planning Advisory Committee and London Regional Transport.[15] The inadequacy of the interregnum arrangements became more and more obvious and there was a rash of new organisations in the 1990s.[16] However, both government and the private sector seemed to realise that some kind of London-wide government approach was needed to coordinate the various agencies and actors, and to create effective governance for a competitive world city (Thornley, 1998, pp. 176-178).

Bringing back the London-wide government consequently raised the question of where and how to house the mayor and his or her assembly. It was in part because of the London power vacuum that a new city hall needed to be founded. Raynsford was endowed by the newly-elected Labour government with responsibility for the introduction and accommodation of GLA.

4.2.2 Nick Raynsford: the real 'architect'

> The real 'architect' behind the scheme was Nick Raynsford, the minister responsible for the project. It was his briefing and his desire to create a landmark building that inspired us to produce a structure unlike any other (Shuttleworth in Detail, 2002, p. 1091).

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[15] These were either joint boards with representatives from all the boroughs or organisations appointed by central government.

[16] For instance, the Government Office for London (GOL), London First, London Pride Partnership, etc.

Ken Shuttleworth was the partner at Foster+Partners' design practice with responsibility for developing the design of the GLA building. He attributes much credit to Nick Raynsford's role and I begin developing my account of City Hall's design practices by exploring Raynsford's role as commissioner of the headquarters for the new GLA. Shuttleworth's statement above endorses the point of view that this process starts before architects actually enter the design stage. Crucially, the design briefing entails many heterogeneous elements that co-shape architectural design in its form and materialisation (e.g. spatial requirements, schedule, cost and appearance). This chapter identifies key elements that informed the design briefing in order to analyse how the briefing constructed the environmental challenge as an issue for design at the outset, and how it formulated related goals and targets. I begin my account by retracing what Raynsford and his colleagues did in order to draw up the design briefs for City Hall. (Raynsford did not develop the briefing detached from contexts, but was entangled in many associations that were continuously in motion and reshaped his activities).

A standard account of Raynsford would begin with: Nick Raynsford was born in 1945. He received a MA in history from Cambridge University. Rather surprisingly, for a politician, he also studied fine arts at Chelsea School of Art and Design between 1968 and 1971 and received a diploma. Before Raynsford entered government he had several roles in the building industry and public sector.[17] In 1992 he became elected Member of Parliament for Greenwich, and in 1994 was appointed Shadow Minister for Housing and Construction. He joined the government when Labour came to power in 1997 and was appointed to the Department of the Environment, Transport and the Regions (DETR), first as Parliamentary Under-Secretary of State (1997-1999) and was later promoted to Minister of State for Housing and Planning (1999-2001). Between 2001 and 2002 he was Minister in the newly-created Department for Transport, Local Government and the Regions (DTLR).[18] In these roles he had wide-ranging responsibilities, for instance in UK Building Regulations,

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[17] From 1971 to 1975 Raynsford served as a councillor in the borough of Hammersmith and Fulham; from 1976 to 1986 he was Director of SHAC (the Shelter Housing Aid Centre); and between 1987 and 1992 he was Director of Raynsford & Morris Housing Consultants.

[18] Retrieved 1 July 2014 from http://www.parliament.uk/biographies/commons/mr-nick-raynsford/171

including *Part L* on the conservation of fuel and power. While the above information helps to give context to Raynsford I shift attention to the pragmatic content of his actions.
I met Nick Raynsford in September 2010 in his office at Portcullis House next to the Palace of Westminster. I asked him to explain to me the process that brought the GLA and its domicile into being, and his role in it. He answered:

> I was appointed Minister for London in May 1997 when Labour came into government and we had an electoral commitment, a manifesto commitment, to restore city-wide government to London. Prime Minister Tony Blair was very keen that this should involve the creation of a directly-elected mayor and that was the brief that I was given to oversee the introduction of the new arrangements (Interview Raynsford, 2010).

Having won the election in May 1997, the Labour government was determined to enter the new millennium with a renewed and innovative London-wide government structure, which had been one of their central election pledges, and which came along with the pledge to put "concern for the environment at the heart of policy-making" (Labour Party, 1996, p. 4). Appointed Minister for London, Nick Raynsford was tasked with the establishment of the GLA. As part of this process, before Raynsford and his team were able to draft the design briefing for the headquarters to come, he had to outline, consult and pass (stabilise) the functioning, responsibilities and housing of the new authority, as well as set up legislation to bring the GLA into being. Not much was known at that time about the anticipated new building: "a little-known, abstract and fuzzy entity" that began to accumulate more and more well-known characteristics (Yaneva, 2009, p. 21).

Architecture's being is necessarily heterogeneous, and this process began to increasingly draw together a vast set of heterogeneous elements. From early on Raynsford seemed to be keen that the project would become seen "by posterity as a symbol of what we tried to achieve around that period, the early years of the labour government" (Interview Raynsford, 2010). It was his role to mobilise these heterogeneities – Raynsford was a key translator. The headquarters to come was also, in turn, intended to exemplify an ambitious environmental agenda:

> I was very conscious of the importance of the new building to be a statement about the new authority including its commitment to environmentally progressive objectives, the principles of sustainability (Interview Raynsford, 2010).

Consequently, the definition of the GLA's environmental responsibilities, the setup process of the GLA, and the (later) design briefing to instruct developers, architects, and engineers of the new headquarters, required a form of alignment despite these elements having different forms and playing different roles in the emergence of the GLA building.

These activities were not started in a vacuum; rather, Raynsford's practices were embedded and shaped through specific contexts. In Figure 4.2, in an attempt to understand the many heterogeneous actors, activities and events that were central in bringing City Hall into being, I have created a series of timelines in which I map selected elements in temporal sequence from 1985 to 2012 in relation to City Hall's design practices (1997 to 2002). This allowed me to develop an understanding of the timing of particular activities, and to inquire whether they could have impacted on subsequent practices. These diverse elements included environmental conferences (e.g. the 1992 UN Earth Summit, the founding of key influential policy institutions (e.g.1988 the IPCC), the release of key environmental reports (e.g. 1987 Our Common Future by the Brundtland commission), international treaties (e.g. 1997 the Kyoto Protocol), UK governments in power (e.g. 1997 Labour Government), the release and update of national Building Regulations (e.g. 1995 *Part L*), the introduction and updates of BREEAM (e.g. 1998 BREEAM for offices), government announcements (e.g. 1997 plan to bring back elected major and assembly), the emergence and abolition of London-wide Governments, their related domiciles and others. These timelines served as the basis for discussion and communication tools during my interviews and conversations.

Five years before Raynsford was tasked with the development of the GLA, and on a supranational scale, the 1992 *Earth Summit* (UN Conference on Environment and Development, UNCED) in Rio de Janeiro was a key event "to reshape the thematic landscape around the planet" (Beck, 1999, p. 25). In many studies on environmental politics it has been recognised as the marking "moment in which the awareness of global dimension of the ecological crises was 'finally' accepted and confronted politically around the world" (Hajer & Fischer, 1999, p. 1). The conference's *Rio Declaration on Environment and Development* set out 27 principles of sustainable development.

In response to the call made at *Earth Summit*, the UK Conservative government under John Major became one of the first countries to produce a national sustainable development strategy document (DOE, 1994). It declares the government's commitment to the goals of sustainable development and attempts to define a future agenda related to it. In the foreword, then Prime Minister Major stated, "Sustainable development is hard to define. But the goal of sustainable development can guide future policy. Making the choices necessary to deliver sustainable development requires a national and international debate. This strategy is the starting point for that debate" (DOE, 1994).

At about the time when Raynsford prepared to set up the GLA, numerous global representatives met in New York City for the *Rio+5* conference in June 1997. As the Parliamentary Under-Secretary of state responsible for environment, Raynsford presumably took notice of this conference and its central messages. The conference was intended to check the progress that had been made since the commitments made at the initial *Earth Summit* in 1992. Above all, the *Rio+5* conference was a "wake up call. It offered a very disturbing finding – none of the important commitments made in Rio were kept" (Hajer & Fischer, 1999, p. 1). Of potential significance to Raynsford, the *Rio+5* conference was a warning that the enactment of concepts presents a massive challenge.

These perspectives above have helped me to gain knowledge of environmental policymaking around 1997, but to in order to develop my account of City Hall's design practices I have chosen to 'follow' my interviewees and the design documents central to that development process. I shift attention to "prioritizing the pragmatic content of actions" (Yaneva, 2009, p. 197). I thereby consider the practices that shape the design briefing as a form of design, as the practices of architects, engineers and others. My aim was to let my design protagonists and key documents to bring in heterogeneous elements and construct associations. During the course of my fieldwork and analysis, I then attempted to examine the role of these associations in more detail.

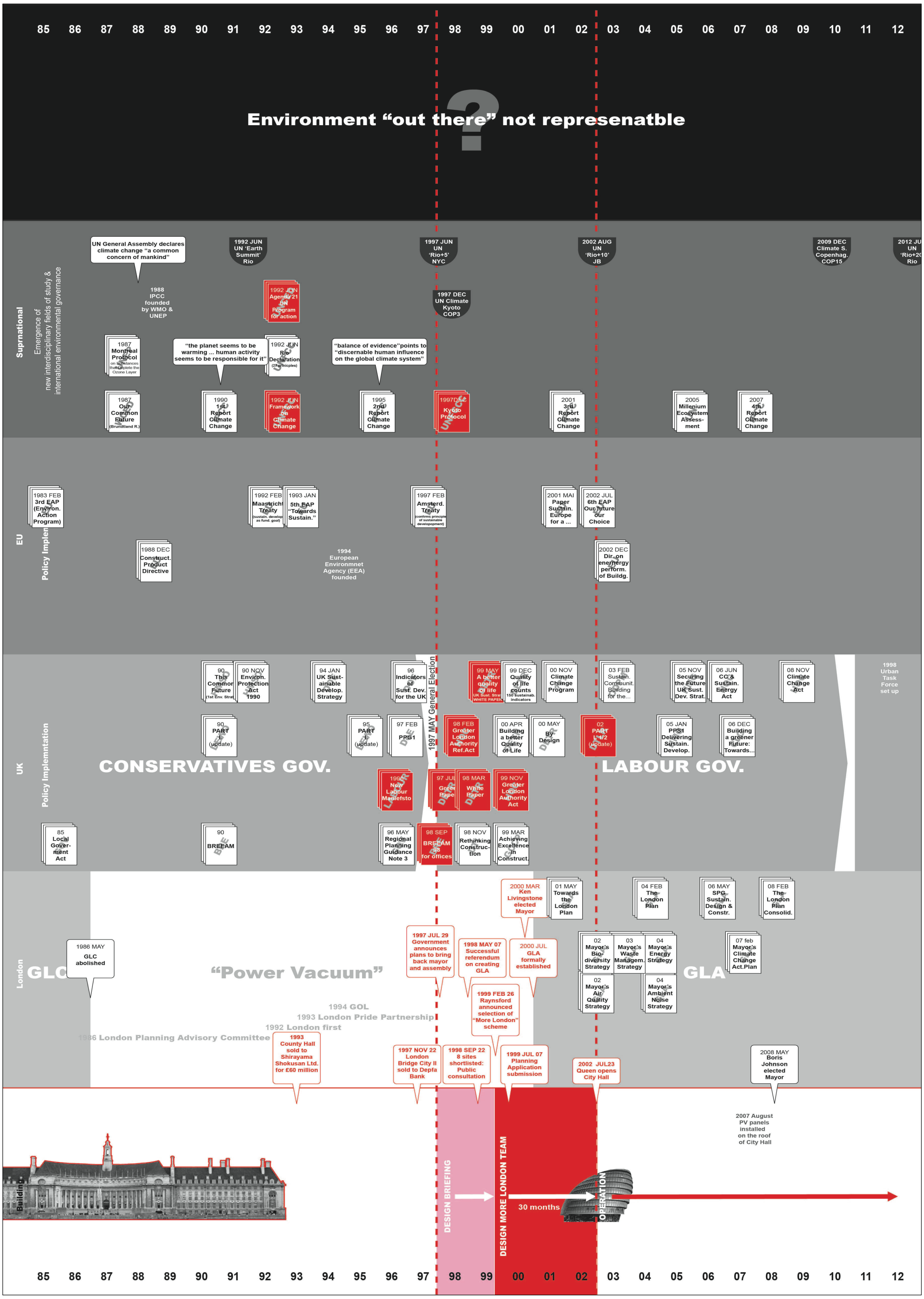

Figure 4.2 Timeline from 1985 to 2012 of key events on supranational, EU, UK, London and building scale around the design practices of City Hall (1997-2002) (Timeline: Author, 2014)

In order to emphasise and draw attention to these different approaches in constructing 'contexts' and associations, I mapped in black and white elements that I brought into the 'storyline' of my timeline (Figure 4.2) and which were not associated via the actors I 'followed'. Some of these elements were, for instance, the release of the Brundtland report (1987) and the *Second Assessment Report* (1995) on climate change by the IPCC, both of which I consider to be important events in environmental politics. I did not develop my account through these (un-associated) elements. Nevertheless I mapped them in black and white as 'alternative possible constructions' of histories.

In Figure 4.2 the heterogeneous elements that Raynsford, other key actors or key documents associated with City Hall's development are mapped in red. For instance, Raynsford mentioned the Labour Party's election manifesto (1996), the election of the Labour Party in May 1997, the former London City Hall (sold 1993) and two government papers (DETR, 1997, 1998b) that were central to outline the role, function and accommodation of then emerging Greater London Authority. I mapped these elements in the timeline that spans from 1985 and 2012 (left to right).[19]

4.2.3 Outlining the design requirements of the GLA headquarters

4.2.3.1 Green Paper: New Leadership for London (Jul 1997)

In July 1997 Minister Nick Raynsford and his colleagues at the DETR started a consultation (green) paper entitled *New Leadership for London* (DETR, 1997) to set out the fundamental thinking on how the new authority would work (Interview Raynsford, 2010). This paper was one of the central documents in the process of design knowledge accumulation that led Raynsford and his team to the first design briefing documents of the GLA headquarters' requirements in August 1998.

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[19] Vertically the timeline draws together a mix of different political and spatial scales represented through six horizontal fields: the black on top indicates the environment 'out there' (which in itself is not accurately representable, see Chapter 2). Below are the supranational, European, UK and London scales for key environmental policies, treaties, conferences and events. The horizontal field towards the bottom shows the buildings of the London-wide Governments at the present time. This graphical representation does not suggest to understand the world as layered in different scales. It was a particular choice of representation, convenient to develop my account during my fieldwork.

The purpose of this Green Paper was to “discuss the roles of the mayor and assembly and explain the relationship between them”, to “look at alternative electoral arrangements, the functions of the new authority and how it can be financed” (DETR, 1997, p. 3). With regard to particular proposals, the paper explicitly set out specific questions and invited comments as part of the consultation process.

The key proposals were that there should be a small streamlined authority with a directly-elected mayor and a small assembly of 24 to 32 members for overview and scrutiny, both elected by proportional representation in all the London boroughs. The mayor would be the executive, whose power would be concentrated on strategic matters that needed to be dealt with on a London-wide level. The paper set out ten key criteria to define the terms of the debate and to frame responses. The GLA should be: strategic, democratic, inclusive, effective, small, audible, consensual, clear about its role, efficient and influential (1997, p. 3).

The Green Paper did not directly address the question of how to house the new authority, but proposed a set of heterogeneous elements that began to shape the anticipated design process of the GLA headquarters. Four elements are important. Firstly, the paper began to determine the financial budget available for bringing the GLA into being:

> The Government’s overriding priority is the control of public expenditure within the planned totals. The arrangements for the GLA will need to support this priority. […] Any additional spending in setting up the GLA would need to be offset by savings (p. 39).

The proposal of restricted expenditure had significant consequences for the later procurement process in search of GLA accommodation. Secondly, the paper began to outline the spatial requirements by considering the number of expected occupants. The numbers remained vague: the mayor, an assembly of 24 to 32 members and a small but unspecified number of staff. Third, the paper attempted to assign some powerful characteristics to the new authority: “We wish to create a new model of government, appropriate to a great capital city in the new Millennium” (p. 2). Fourth, the paper assigned a wide range of functional responsibilities to the GLA. The overarching function was unequivocally defined as such:

> The functions we are proposing to give the GLA all come under the general heading of sustainable development – giving all Londoners an improved and lasting quality of life, combining environmental, economic and social goals (p. 17).

Raynsford, and probably others in the Labour government, were keen to have the anticipated headquarters represent both the "new model of government" (p. 2) and "its commitment to environmentally progressive objectives, the principles of sustainability". The emerging GLA headquarters was intended to be perceived as an architectural "symbol" and "statement" (Interview Raynsford, 2010). These characteristics that were later ascribed had to be translated into the design briefing and building design. The Green Paper touches on the question of representation, without further elaborating what consequences it could have for the GLA home to come.

The four elements described above associated heterogeneous elements: they pointed towards a specific model of financing (public-private partnership), towards an emerging space allocation plan (square metres and functions), and towards particular desired forms of anticipated perceptions of the building.

Raynsford intention was to use the headquarters as a device to represent the achievements of the government. This was as old as the emergence of government buildings and city halls as distinct building types; they usually had the function of communicating by architectural means particular world views and characteristics of the organisations that commissioned them (Pevsner, 1976, pp. 27-62). It later became the task of the More London design team to translate the idea of being a small, dynamic, and "sustainable" institution into a building design that reflects and communicates these activities. The question of how this emerging agenda be translated into physical appearance was a highly contested activity, which I will return to in Chapters 5 and 6.

The Green Paper also set out the next steps to follow. After the end of the consultation period in October 1997, views were drawn together to prepare a White Paper, which set out detailed arrangements for the new authority. Londoners were given the opportunity in a referendum on 7 May 1998 to decide whether they wanted a GLA, following the Greater London (Referendum) Authority Act 1998 (Houses of Parliament, 1998).

4.2.3.2 Commissioning a building on behalf of the new authority

Meanwhile Raynsford and his colleagues at the DETR had to decide whether they would take steps in government to provide a new building for the new authority or whether, as in Scotland and Wales, that decision should be left to the new body when it was created. Because the GLA was a small and strategic authority, they concluded that it would not be an appropriate burden for the emerging GLA to commission and procure a new headquarters building, which would be a very time-consuming responsibility, and that it would probably be sensible for the UK government to commission a building on behalf of the new authority (Interview Raynsford, 2010).

Raynsford explained three other factors that informed the decision to search for a new domicile for the GLA:

First, County Hall, the old GLC headquarters, was no longer available; some people suggested that the government ought to reacquire the building, but this was not a feasible option for financial reasons. In addition, County Hall was much larger (the GLC had approximately 10,000 employees) than it was needed for the GLA.

The second argument concerned the perception of the anticipated new headquarters. Raynsford emphasised

> the importance of the new building to be a statement about the new authority including its commitment to environmentally progressive objectives, the principles of sustainability (Interview Raynsford, 2010).

To perceive London County Hall (Figure 4.1) as the home of a radical and innovative new authority embarking on the challenges of the new millennium seemed difficult. The central part of the six-storey County Hall was designed and built between 1911 and 1922 under the sovereignty of King George V. The north and south wings were added between 1936 and 1939. The building has been described as being of Edwardian Baroque style. Its solid punched window facade is cladded in Portland stone. The building does not evoke interpretations of radicalness, innovation, a new form of government, and the concept of sustainability.

The third reason Raynsford put forward was the importance of the location of the GLA in relation to what he called the “changing geography of London”. Traditionally the centre of London has tended to lie to the west of the city, and certainly Westminster became a major focus. County Hall was created on the south bank, but very near Westminster. But east London was becoming more important with the regeneration of the docks and the Thames Gateway venture.

Raynsford and his team thus tended to search for a building that would not recall the architectural classical tradition (order, symmetry, closeness, weight, stone), as at County Hall, but would be a contemporary statement at the turn of the millennium.

4.2.3.3 White Paper: A mayor and assembly for London (March 1998)

Eight months after publishing the Green Paper, five months after the closure of its consultation period and two months before the referendum, Raynsford and his team published the White Paper *A Mayor and Assembly for London – The Government's Proposals for Modernising the Governance of London* (DETR, 1998b).

The Green Paper set out the government's view on the GLA, raised specific questions and invited comments. Raynsford's office received over 1200 responses from individuals and organisations all over London (DETR, 1998b, pp. 85-87). The purpose of the White Paper was to outline how the government developed its proposals for the GLA arrangements in detail. It further served as the basis on which Londoners were to vote in the referendum in May 1998. The White Paper expanded the content and structure of the Green Paper, thereby producing and accumulating more knowledge that shaped the design briefing issued five months later. Crucially the White Paper began the discussion on how to house the GLA and how to find an appropriate building for it.

Raynsford's superior at the DETR, then Deputy Prime Minister John Prescott, declared in the foreword of the White Paper:

> When this government was elected less than a year ago, we embarked on a programme of democratic renewal in Britain. An essential part of this is modernising government in London to equip our capital city to meet the challenges

> of the next Millennium. […] Our plans for London are radical and innovative (1998b, p. 5).

Prescott aimed to establish the constitution of the GLA as a radical and groundbreaking political manoeuvre, which was intended to be read as a marker of the Labour party's political achievements. Raynsford made clear that the new headquarters was given a crucial role in this strategy through its physical form, materiality and design. This ambition was later translated into one of the design briefs.

The White Paper accumulated further information and many decisions taken. It set out how the mayor and the assembly would work, how they would be elected, how the GLA would be funded, and concluded by laying out the work needed to prepare for its establishment. The GLA proposal thus became increasingly refined. Consequently also at the emerging building design brief further took shape. Six aspects were significant in the continued accumulation of design knowledge that co-shaped the path of procurement and design briefing content.

First, since Raynsford declared that the new headquarters of the GLA was required to "exemplify […] the ideals behind the new authority" through its design, I emphasise how the functions of the GLA were composed in relation to the 'environmental crisis'. The main functions of the GLA were defined under the headline of an "Integrated and Sustainable Approach"(DETR, 1998b, p. 36) that brings together responsibilities for transport, strategic planning, economic development, environment, metropolitan police, fire and emergency planning, culture, media and sport, and health:

> The Mayor will have a major role to play in improving the economic, social and environmental well-being of Londoners and will be expected to do this by integrating key activities. Sustainable development is about ensuring a better quality of life for everyone, now and for generations to come, and encompasses environmental, social and economic goals (p. 36).

The White Paper declared that the new government would begin a consultation exercise to develop a new national sustainable development strategy to be published by the end of 1998:

> This will provide a practical framework for sustainable development and a backcloth against the Mayor and the Assembly […] will be expected to act. […] The Mayor will be placed under a statutory duty to promote sustainable development in London (p. 36).

The Labour government only published the national sustainable development strategy in May 1999, titled *A better quality of life* (DETR, 1999). It was not in place when the first design briefs were finalised as it was a parallel development within DETR. The strategy later set out the government's vision of how to simultaneously deliver economic, social and environmental outcomes and how to measure them through a series of headline indicators. The White Paper hinted at the challenge of translating the concept of sustainability into specific localised "strategies and priorities" (DETR, 1998b, p. 36).

Under the umbrella of "sustainable development", the White Paper constructs the GLA's environmental responsibility through selected environmental crises that need strategic action: "climate change", London-wide air pollution, noise pollution in relation to ground- and air-traffic, waste generation and "other issues" predominantly framed as the loss of biodiversity. The paper links the GLA's environmental objectives to activities, agreements and documents on supranational and UK level (see 'red' elements in Figure 4.2). These include the promotion of sustainable development through the "Local Agenda 21", which was one of the corner stones introduced at the 1992 Earth Summit in Rio de Janeiro.

"Climate change" and the reduction of greenhouse gas emissions are associated with the UK government's December 1997 ratification of the Kyoto Protocol.[20] The paper stresses that "there are strong links" between climate change and greenhouse gas emissions and areas where the GLA "will have a role" (1998b, p. 59). The GLA would have to make contributions towards both the national climate change programme and the government's commitment to reduce GHG greenhouse gas emissions under the UN Framework Convention on Climate Change (UNFCCC) introduced 1992.

[20] "The UK's legally binding target under the Kyoto Protocol to reduce its greenhouse gas emissions to 12.5% below 1990 levels by 2008-2012" (DETR, 2000, p. 5).

The second element, newly accumulated to shape the procurement process and design briefing, was that the financial allowance to establish the GLA was limited to "up to £20m" (p. 83) if Londoners voted *yes* and the parliament approved legislation to establish the GLA. The Green Paper had already stated that the government committed to work within the planned budget. The GLA property procurement process lay within the £20m allocation and was put on a specific procurement path that did not allow the GLA to own their headquarters due to a limited budget.[21] The GLA headquarters needed to be rented or leased in cooperation with a private developer. Raynsford's ambition to have the new headquarters to showcase the GLA's "environmentally progressive objectives, the principles of sustainability" (Interview Raynsford, 2010) became more difficult to reach, since this interest had to be aligned in a partnership with the interests of a private building developer through a set of compromises and conflict of aims.

Third, the White Paper's section "A home for the GLA" began to address how to accommodate the GLA. It set out a tight timeframe to provide the new accommodation, temporarily if necessary, to have the GLA operational as soon as possible after the first elections:

> The other major task in preparing for the GLA will be identifying and acquiring a suitable building. […] We believe the Mayor, Assembly and the GLA's core staff will need to be located together in a single building (p. 84).

The paper determined that a single building was required (in principle the GLA could have been accommodated within different existing government offices.) Fourth, the space allocation plan was further developed: "The building will need to house the Mayor's office, an Assembly chamber and committee rooms, to which the public must have access, and briefing rooms and space for key staff." The number of GLA members to house would be approximately 275 (pp. 26, 84).Fifth, the paper hinted at finding a suitable building by narrowing down options: "The government will be considering a range of buildings in central and inner London to see which provides suitable accommodation at reasonable cost" (p. 84). And sixth, a tight timeframe became established in which the "final decision

[21] The construction costs of City Hall alone were about £35m (Detail, 2002, p. 1203).

on the GLA's building will need to be taken well before the first elections to the GLA and will therefore be taken by Ministers" (p. 84).

The White Paper did not specify any further criteria for City Hall's design process, so responsibilities for the property procurement and the design briefing were delegated to Raynsford and his team.

4.2.3.4 GLA referendum (May 1998)

In February 1998 the Houses of Parliament passed the Greater London Authority (Referendum) Act 1998 to make provisions for the referendum on the new authority, entitlements to vote and referendum expenditure, and to set out the ballot paper. On 7th May 1998, together with the London Borough Council, eligible Londoners were asked:

> Are you in favour of the Government's proposals for a Greater London Authority, made up of an elected mayor and a separately elected assembly? (Houses of Parliament, 1998, p. 7).

The referendum gave overwhelming support to setting up the GLA with majorities in every single London borough voting in favour of the proposal based on a low referendum turnout of just 34.6%. With an almost 3 to 1 approval rating (72% yes, 28% no votes), Raynsford and his colleagues were now able to continue with their task of establishing the GLA and had to introduce legislation to bring the new authority into being (London Research Centre, 1998).

In summary, the Green and the White Papers were central tools in outlining and defining the functions and responsibilities of the GLA, but they were not simply the instantiation of these plans since. They provided the basis on which Londoners voted in favour of the new institution.

The 'environmental crisis' cannot be understood in its full entirety; its understanding can only be appropriated through particular concepts. These tend to emphasise some challenges, and suppress others. Sustainable development was set as the overarching principle for the GLA. As such, the DETR constructed the environmental crises that needed to be addressed: climate change, air pollution, noise pollution, waste generation and loss of biodiversity. Raynsford wanted these environmental responsibilities to be exemplified in the building that was going to become the domicile of the GLA. This desire left many questions open - since it did not provide unambiguous design instructions, it needed interpretation.

The major challenge for Raynsford and his team was then to translate their intentions into a design briefing that would provide particular goals and targets that could be taken up by developers, architects, engineers and others.

4.3 Finding a 'home for the GLA'

4.3.1 Setting up the property procurement process

Following the positive referendum result, Raynsford and his team entered a new phase. After Londoners had voted for the GLA to be set up, they had to put this into effect: the new mayor and the assembly needed to be housed. The decision to build a new city hall presented an opportunity that capital cities rarely obtain.

There was a tight schedule to establish and bring the GLA into operation and after May 1998 things moved quickly. Raynsford, his collaborators and parliament now needed to introduce the necessary legislation in the form of a bill; this became the Greater London Authority Act 1999 (UK Government, 1999). The bill needed to go through its second reading in the House of Commons until the government was constitutionally permitted to commit any greater expenditure to setting up the GLA.

Nick Raynsford expanded his team to set up a procurement process for the new authority's home. Heterogeneous elements co-shaped City Hall's design briefing. Raynsford headed the Government Office for London (GOL) as Minister for London, and several civil servants joined his team. He also included representatives from the DETR. The GOL became the body that procured the building (the quasi client) for the GLA headquarters. Gradually Knight Frank Estate Agents (KFEA), new members at the GOL, and a team of Turner & Townsend Project Management (TTPM) joined Raynsford. In a collaborative process their task was to develop a design briefing for the GLA accommodation search, which was continuously developed and refined until the GLA building materialised.

KFEA won the instruction to find a suitable building for the GLA. On behalf of the GOL, KFEA started to consider development proposals, new buildings or refurbishments in central London, with room for a debating chamber for around 25 members and offices for 250 staff. KFEA was commissioned to organise the procurement process and to issue the documents to potential teams interested in housing the GLA.

4.3.2 The lease deal

KFEA started to search for teams composed of developers and architects, which had a piece of land or an existing building that would suit the projected needs of the GLA. According to Raynsford, the government wanted a deal with developers to lease accommodation. The New Labour government needed to spend a lot of money on the creation of the GLA and was obliged to work within previous governments' overall spending commitments (Interview Raynsford, 2010). It thus pledged to work within the Conservatives' spending commitments for two years. Consequently, in 1998 and 1999, the new government was working on tight budgets and Raynsford explained that it attempted to make sure the money available went into the delivery of things it categorised as absolutely vital. Yet it seems that owning the home of the GLA was not part of New Labour's vital projects. Nick Raynsford recalls:

> It was a time much tighter financially than it became the case later on in the life of the government. I think, if we would have been doing this five years later it would have been a different scenario. However having said that, we did not want to see the kind of process occurred over the Scottish parliament, which was an escalation of cost absolutely on [a] horrific scale. So, there was method there, we were working on tight budgets but we wanted to deliver something of quality, we didn't want to take too many risks, we wanted to try to set high standards, but we didn't want this thing to be a glorious failure (Interview Raynsford, 2010).

The decision to look for a lease with a private developer was informed by two factors, the first of which was the limited budget to establish the GLA. Secondly, the leasing scheme was a route of procurement in which the risks of construction cost overruns would be outsourced to the developer.[22] Raynsford summarised: "[W]hat we were trying to do is to make sure City Hall was built and built within budget and on time" (Interview Raynsford, 2010). The option for the government to commission and own a building was accordingly ruled out.

4.3.3 A unique type of competition

In the summer of 1998, shortly after the referendum, Raynsford and his officials discussed potential forms the property search could take. Officials at the GOL initially suggested a developer competition in which they would simply set out the brief, leave the developer to come forward with schemes, and the schemes would be judged essentially on their fitness for purpose and on cost. Raynsford insisted that this was changed to ensure that the GOL team had an architectural quality component in the assessment and that there would be clear emphasis on "meeting the objectives, the sustainability objectives which underpinned the whole legislation. The principle of sustainable development is stated very clearly here in the overall functions of the GLA" (Interview Raynsford, 2010). The result of discussions between Raynsford and his officials was a rather unique type of architectural competition: the judges would assess the cost and the fitness for purpose of the proposals, and their architectural quality. Raynsford had clashed with architects at the Royal Institute of British Architects (RIBA) who wanted him to launch a more conventional architectural design competition. But Raynsford argued that he "wanted an integrated approach with the developer and the architect as part of the team, rather than going through the different stages of the architectural competition, then the procurement". Both potential forms of developer competition and architectural design competition (open to architects to design schemes) for the GOL property search were ruled out and Raynsford initiated a unique type of competition that could be described as a developer-funded property search in which developers were required to team up with architects. The difference from most architectural competitions was that developers were an integral part of the selection process and the design teams.

[22] There was massive criticism of the procurement and construction process for the new Scottish parliament. A 1997 White Paper set the construction cost of a new building at £40 million. The new Scottish Parliament, designed by the Catalan architect Enric Miralles, opened three years late in September 2004 with an estimated final cost of £431 million.

Most architectural design competitions are conceived in one or two stages, in which a comprehensive brief is first issued, normally followed by a question and answer session, concluding with a final submission of schemes. The GOL property search was unique in its setup, which was conceived as an initial call for outline proposals covering financial aspects and questions of feasibility but not architectural design, and then two stages of ministerial presentations. The process encouraged intense and ongoing communication between government officials, government consultants and the developer teams. It was a competitive procurement process based on enacting a property deal with a developer.

Raynsford declared the property search open to bids from developers (accompanied by architects) who could deliver. He stated that the competition was to be judged on three criteria: architectural quality and functionality, cost, and building performance to meet the brief (Interview Raynsford, 2010). To discuss questions of architectural quality within the competition, Raynsford insisted on bringing in an experienced architectural advisory group of five that was led by Sir Michael Hopkins (principal at Hopkins Architects) and included Paul Finch (later deputy chair of the Design Council), Lucy Musgrave (former director of the Architecture Foundation), Pankaj Patel (principal at Patel Taylor Architects) and Jane Priestman (former Chairman of RIBA awards).

Following the successful GLA referendum, the GOL and KFEA held a number of meetings to clarify the requirements and attributes of the new authority's home. KFEA then sent out a circular on its 'normal' agents' circular system in London to seek details of any properties or sites that met the GLA's requirement. This circular apparently went to over 600 agents and information was requested back by 29 May 1998 (TTPM, 1998h, p. 29). However the procedure was not as open as Raynsford claimed, since it was limited to a pre-selection of 600 agents through KFEA. It was not an open call published in one of the typical journals (*Estates Gazette*, *Property Week*) to attract interested parties, and the rationale of Knight Frank for selecting the 600 developers remains unclear.

Despite intensive attempts through different avenues, I was unable to get hold of the original document that formed the initial call for outline proposals that led to the "long longlist" of 55 proposals. The initial call was drafted between KFEA and the GOL before TTPM became deeply involved.

Gordon Rautenbach (TTPM), who joined the GLA property search later, recalls that KFEA approached the property developer market "with a very vague requirement where a size was indicated […] and very little else – they probably mentioned that it was to be for a government or local authority occupier – to generate interest". The spatial programme became more refined later in the process, though at this stage it could only be a rough estimation (Interview Rautenbach, 2010). Anne Griffiths, who also just joined after the 55 proposals were received, described the initial invitation for projects: "[I]t was very high level and fairly short" (Interview Griffiths, 2010). And Raynsford recalls: "We asked initially for expressions of interest and outline proposals, but not asking for any great detail" (Interview Raynsford, 2010). The initial call for outline proposals most likely was released right after the successful GLA referendum under huge time constraints. Retrospectively it appears that the beginning of the property search was initiated through a vague call that didn't have the character of a comprehensive design brief. It was an ongoing process to define the character and requirements of the future GLA. At that time nobody had a clear idea how the GLA would operate, or what its precise demands would be, since this process happened before the new authority had come into existence as an organisation. The future occupiers could not be consulted.

4.4 Assembling design challenges for developers and architects

4.4.1 Shortlisting 55 responses to a list of seven

From the 600 contacted developers KFEA received 55 entries by 29 May 1998. It was at that moment that the developers, CIT (More London), and Foster+Partners architects submitted their initial outline proposal that began to align their interests with the GOL to construct a new headquarters. They had just recently teamed up; CIT appointed Foster+Partners architects as master planners for its £1bn London Bridge project in the middle of May 1998.[23]

[23] See *Estates Gazette*, 23 May 1998, Issue 9821, p. 35.

KFEA was commissioned to identify a "longlist" of seven properties from the 55 against broad criteria set by the GOL by July 1998.[24]

4.4.2 Expanding Raynsford's team

Just before KFEA had selected the longlist, Raynsford took three important actors into his property procurement team. Anne Griffiths joined the GOL in the role of "project sponsor", which is a government term for a named individual in government departments with responsibility for bringing major building projects into being and delivering them on time, at the right quality and on budget (Interview Griffiths, 2010). Raynsford also commissioned TTPM, with which the government had collaborated on several building assessments, feasibility studies and cost estimations. TTPM's architect Gordon Rautenbach and building services engineer Jon Spring started working for the GOL. They had support from cost and logistics consultants at TTPM.

These three individuals were central as they assembled the design brief on behalf of Raynsford. Anne Griffith's (GOL) role was to give direction on policy, especially to ensure that the proposals set out in the Green and White Papers were transformed into the design briefs. She monitored costs, quality and time, and provided information on projected GLA staff numbers and the required facilities. Gordon Rautenbach and Jon Spring (both TTPM) were the "technical team" (Interview Spring, 2010). Gordon Rautenbach focused on architectural issues such as programme schedules, materials and architectural specifications. Jon Spring was responsible for mechanical and electrical questions and "took the lead on environmental issues" (Interview Rautenbach, 2010). One difficulty that all three faced was that nobody knew how the GLA would operate so, based on assumptions, the GOL and TTPM began to inscribe their visions into the emerging design briefing (Akrich, 1992).

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[24] The "long list" included the following developer-architect teams - First: London Bridge City, SE1, CIT International Limited and Foster & Partners; second: Town Square, Victoria, SW1, Point Ventures Limited, Munkenbeck + Marshall and Atelier 10; third: Victoria House, Bloomsbury Square, WC1, Blackfriars Investments Ltd, William Pears Group and Alsop & Stormer; fourth: Regents Place, Euston, NW1, the British Land Company plc and Sheppard Robson; fifth: Vauxhall Cross (the Effra site), SW8, St Georges plc and Broadway Malyan; sixth: Camelford House, Albert Embankment, SE1, Chelsfield plc and Watts & Partners; and seventh: 15 Westferry Circus, Canary Wharf, E14, Canary Wharf Limited and Terry Farrell (based on TTPM, 1998d; 1998h).

4.4.3 Drafting the initial statement of requirements

As one of the first actions at the beginning of July 1998, TTPM started preparing the initial GLA statement of requirements (SOR) in conjunction with representatives from the GOL. At that time representatives from TTPM were discussing spatial requirements for the GLA. It was a new body, and nobody knew how it would operate. This happened at the same time as KFEA members were selecting the seven proposals for further consideration (the longlist). Immediately before announcing the long list, and after the TTPM began to work on the GLA's likely space requirement, it emerged that more space - 11,000 to 13,000 m^2 - would be needed. Knight Frank contacted all those who were expected be on the shortlist to enquire whether they could meet this additional space requirement.[25]

Following the successful referendum the development of the design briefing for the GLA property search was a fragile and contingent process of going back and forth that took a further three months. Collaboratively, the GOL and TTPM team aimed to inscribe more and more heterogeneous elements (functions, square metres, number of people to accommodate, time constraints, etc.) into the brief in order to refine it. The consecutive versions accumulated more information, but also presented *choices* in which the vast potentialities were narrowed down. The goal was to put together a detailed design brief, to be issued at the beginning of August 1998, intended to align the design activities of the seven selected developer-architect teams with the GOL's intents for the design of the GLA headquarters.

Spring explained that he and Rautenbach had carried out many building searches for other projects prior to joining Raynsford's task so they had a base structure and template at hand for setting out the design brief for the GLA property search. After a couple of working sessions with the GOL, in which they went through the templates, Spring and Rautenbach "started adding to it quickly" (Interview Spring, 2010). Jon Spring recalled:

> So there was a kind of process of putting forward our ideas, from what we'd done with government, we'd done a lot of work with government, and looking at option

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[25] According to the GLA, today's City Hall is 18,734m^2 (Interview Kraus, 2012).

> building studies and negotiating with developers. So we had a good idea for what was right (Interview Spring, 2010).

Spring and Rautenbach drew on their previous knowledge and experiences as they drafted the GLA property search brief as a two-stage specification: a general specification, which referred to government and public building design standards, and then a particular specification. Both concentrated more on the particular specification that would associate diverse issues, questions "around space, things we wanted from the building, in terms of visual, feel of the building, but also performance" (Interview Spring, 2010).

It was Raynsford's responsibility to check and sign off on the brief before its release. From his perspective, there were two things that influenced the environmental agenda setting of the design brief:

> I was construction minister; I was responsible for the Building Regulations. One of the things we were doing was upgrading *Part L* of the Building Regulations, which was the energy efficiency. And that was going on simultaneously. So, I was particularly keen that this new building should be seen […] to deliver high quality building that performed well in energy terms and therefore was seen as an exemplar, which others should follow. So that was part of the brief. But the main reason was that there was a commitment to sustainable development as one of the overarching objectives of the Greater London Authority and it was important therefore that the building that the authority occupied should be compatible with that (Interview Raynsford, 2010).

Environmental politics and architectural design practices crucially "depend on the specific social construction of environmental problems" (Hajer, 1995, p. 2). Raynsford explained in interview the environmental challenge for the design brief as both "commitment to sustainable development" and a question of "energy efficiency". This version largely coincided with the definition of the GLA's environmental responsibilities outlined in the Green and White Papers. The challenge for the GOL and TTPM team became essentially to understand, interpret and give meaning to these two concepts or, in other words, how to link policymaking and materialising architectural design through a series of translations. It was the role of Griffiths, Rautenbach and Spring to align their different vocational perspectives, gain knowledge in this exchange, and to compose a joint strategy. The design briefs thereby became crucial devices to align the GOL and competitors.

4.4.4 The first three design briefs

Following the initial call for outline proposals, KFEA then issued three design briefs prepared by TTPM to the selected seven competing developers (long list) at the beginning of August 1998. The *Greater London Authority: Preliminary Summary of Authority's Requirements* (TTPM, 1998a) was one key document that Spring called it the "particular specification". It was followed approximately a week later by the *Property Search Option Appraisal* – Draft 4 (TTPM, 1998c), setting out a detailed space allocation plan (functions, square meters) alongside the *Occupier Brief* (TTPM, 1998b) that defined mechanical, electrical, material and other specifications for distinct spaces.

The three design briefs became important "devices" to enlist and align diverse actors and elements into the "initial plan [… of] transaction" (Callon, 1986). They assembled many decisions - such as the environmental agenda setting of the GLA - and can therefore be seen as particular results of power. But the briefs also possessed the power to instigate particular actions as they aimed to guide and align the diverse vocational actors (politicians, civil servants, developers, architects, engineers) into the joint action plan to find a "suitable accommodation" for the new authority.

Figure 4.3 The cover pages of the *Greater London Authority: Preliminary Summary of Authority's Requirements*, *Property Search Option Appraisal (Statement of Requirements Draft 4)* and *Occupier Brief* (Turner & Townsend Project Management, 1998a, 1998b; 1998c)

With the design briefs the GOL and TTPM team brought together heterogeneous and partially contradictory elements. Although my interviewees underlined that the three design briefs were informed by the Green and White Papers, they did not directly refer to them. The challenge thus remained for the goals of policymaking (e.g. Green and White Papers) to be translated in order to devise problems that could be handled and for which design solutions could be found by developers, architects, engineers and others (cf. Hajer, 1995, p. 15). While Raynsford set out his thinking in overarching concepts, the GOL and TTPM team had to translate and transform these concepts into a set of problems that they could address through architectural design.

Raynsford wanted the design of the new GLA building to be “a statement” about and “exemplar” of “its commitment to the environmentally progressive objectives, the principles of sustainability” (Interview Raynsford, 2010).

If the concept of sustainable development is understood as a “specific kind of problem framing” (Voβ et al., 2006, p. 4) ,then the focus is precisely on the way sustainable development is understood and translated into the design briefs through setting out characteristics, indicators and targets. The Green and White Papers hinted at the difficulty of giving meaning to sustainability and this became one of the central challenges of the design briefing.

The design briefs were produced through processes of translations that shifted particular understandings of the initial concept and suggested particular approaches to problem accommodation. Decisively, none of the three design briefs mentioned the concepts of “sustainable development” or “sustainability”. They became abandoned and transformed as elements from the vocational field of the built environment were introduced: “square metres”, “temperature ranges” and “lux levels”, and qualitative characteristics such as “green”, “prominent” and “distinctive” were common framings.

Raynsford, Griffiths, Rautenbach and Spring explained that the briefing was deliberately kept vague to allow the widest range of opportunities to be investigated:

> We deliberately did not start with definitive employer/client requirements in relation to construction form, fabric and finishes or green/environmental criteria

> […] The only exception was a very specific requirement for space where we required the specific amount, no less and not a lot more. […] For the remainder of the client requirements, we provided as open a brief as possible and delivered a challenge to the bidders – to exceed the efforts of their competitors, and to promote excellence in all respects, including location, architecture and environmental performance. […] The intention was for the brief to be as loose as possible to allow it to achieve the maximum we could within an environment of competition. To have set specific requirements would have been seen by the developers as being the least that they needed to provide and we sought, through competition to achieve the most that they would offer (Interview Rautenbach, 2010).

Anne Griffiths commented: "We wanted to bring in architects who would bring in the innovation, the new ideas. You don't produce a prescriptive brief if you want to encourage innovation" (Interview Griffiths, 2010).

The team around Raynsford intended to use the competition to increase thinking about the architectural task of creating a new domicile for the GLA. The avoidance of any prescriptive architectural or technical pathways seems sensible in order to allow for flexible, imaginative solutions, and not fixed products. The lack of prescription did not seem to be problematic, but what was problematic was that the translation of the concept of sustainability lacked significant environmental ambition and force.

4.4.4.1 The GLA Preliminary Summary of Authority's Requirements

The *Greater London Authority: Preliminary Summary of Authority's Requirements* was the first of the three design briefs to be issued. It is a short document that summarised the then "current thinking" about the GLA headquarters' requirements (TTPM, 1998a, p. 1). Within the GLA property procurement process, this document presents the most comprehensive overview of the design criteria that the new home of the GLA needed to meet (see Figure 4.4) and is a key document, central to the design development to come. It illustrates how architectural design is a process of *drawing together* diverse sets of issues and spheres. The parameters that inform design strategies and related material transformations are manifold and interrelated.

SUMMARY OF REQUIREMENTS

An Occupier Brief and detailed Statement of Requirements are being developed, and the current thinking has been summarised below.

- Nett Lettable Floor Area

  12,000m^2 to 13,000m^2 total (130,000ft^2 to 140,000ft^2)

  ⇨ To include approximately 1,900m^2 (20,000ft^2) for public areas, including the double height Assembly Chamber (approx. 16m x 22m), public and press viewing galleries for about 250 people, the committee rooms, etc.

  ⇨ To include approximately 1,900m^2 (20,000ft^2) high quality offices for the Mayor, his appointed Deputies and Advisors, the Assembly Secretariat and Members, much of which will be in cellular configuration.

  ⇨ The remaining area will be good quality, modern, adaptable, office space for administrative, research, and support staff (much of which will be open plan) and ancillary accommodation.

- Design Parameters

  The design of the building shall be appropriate for the intended use. There are three distinct areas of use within the building, being -

  ⇨ The areas accessible to the public – portraying the vitality of London being as it is an important centre for local, national, European and international affairs – reflecting a blend of the progressive, even futuristic, with London's rich heritage and cultural diversity.

  ⇨ The interface between the public and the Authority – the Chamber and committee rooms – demonstrating openness and accessibility – reflecting the status and importance of the Authority.

  ⇨ The offices, incorporating a common theme, but varying in quality and style from the impressive Mayor's office, emphasising the status of the elected position, to the efficient, modern, functional open plan offices for the administrative and support staff.

  Externally, the building should be prominent and distinctive and be a design for the future, avoiding transience and ensuring longevity of design.

  Generally, the end product should be of high quality (but not opulent), and for every element value for money must be demonstrable. Innovation will be encouraged providing it is clearly beneficial and works. Simple, elegant, adaptable solutions will be preferred.

Figure 4.4 The GLA's *Preliminary Summary of Authority's Requirements* (Turner & Townsend Project Management, 1998a)

- Programme

  It is recognised that the programme for the selection of a site / property and for the implementation of the project are very tight. The following key dates are anticipated.

  ⇨ Submit Business Case to HM Treasury – end of November 1998.

  ⇨ Full commencement of the GLA operations – first quarter 2000.

  The costs of temporary accommodation will play a part in the Business Case. Overall solutions that minimise these costs and minimise the disruption of relocation would be preferred.

- Services Installations

  Services solutions should be simple and based upon current best practice. The design standards should be based on typical institutional grade office accommodation, tailored to suit the particular requirements. The assembly chamber will require special environmental services solutions, acoustic control, and specialist electronic systems to allow the live filming and transmission of proceedings.

  All parts of the design process should be properly coordinated to ensure that integrated solutions are achieved to provide flexibility and appropriate access for maintenance and repairs.

  Services solutions must be value engineered to ensure that the appropriate balance is achieved between initial capital costs and future running costs.

  Information Technology is to be given special consideration, the systems and infrastructure must be highly adaptable in order that the GLA can keep their IT systems up to date in line with the rapid advancements in the IT industry.

  ‘Green’ issues should be given proper consideration. A full environmental assessment should be undertaken and an overall "BREEAM" rating of at least "very good" should be achieved.

This brief consists of four main sections. The first sets out the floor area of about 13,000m^2 containing the three key areas of the GLA: those accessible to public; the assembly chamber with a viewing gallery for 250 people and committee rooms; and enclosed and open plan offices for the GLA members. The second part assigns a vast set of characteristics to the design of the interior and exterior: appropriate, progressive, futuristic, open, accessible, efficient, modern, functional, prominent and distinctive. Generally the building should be of "high quality" and provide "value for money"; "innovation will be encouraged. […] Simple, elegant, adaptable solutions will be preferred" (TTPM, 1998a). These heterogeneous characteristics require interpretation and translation. The third section set out the tight schedule to project completion. The fourth part describes the service installations. Solutions should be "simple", "based on best practice" and "value engineered" (TTPM, 1998a). The last paragraph of this document is decisive for the purpose of this chapter: "'Green' issues should be given proper consideration. A full environmental assessment should be undertaken and an overall 'BREEAM' rating of at least 'very good' should be achieved" (TTPM, 1998a).

The call for "green issues" gave some vague direction to the architectural designers but provided no clear directions. The adjective "green" may be interpreted as a colour; as a symbol, "green" may connote some idea of nature or environmental protection or social justice. Most importantly, the brief contained one unambiguous criterion: The Building Research Establishment Environmental Assessment Method (BREEAM) required at least a "very good" assessment rating for the new headquarters.[26]

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[26] The Building Research Establishment (BRE) was founded in 1921 (then named Building Research Board) as a branch of the British Civil Service. BRE was privatised under the Conservative Government in March 1997 and today is a non-profit charitable organization. BRE was first to introduce a certification system in 1990. When BREEAM was launched it sought "to provide authoritative guidance on ways of minimising the adverse effects of buildings on the global and local environments while promoting a healthy and comfortable indoor environment. […] The basis of the scheme is a certificate awarded to individual buildings on the basis of 'credits' for a set of performance criteria. […] The main objectives of the scheme are to distinguish buildings of reduced environmental impact in the market place, […] to encourage best environmental practice in building design, operation, management and maintenance, […] to set criteria and standards going beyond those required by law and regulations, […] to raise the awareness of owners, occupants, designers and operators of the benefits of buildings with a reduced impact on the environment" (BRE, 1998, p. 1).

By law, buildings have to comply with regulations that apply at the moment the architects submit their application for planning permission. The BREEAM certification is a voluntary step that was made mandatory through this brief for the GLA property search.

BREEAM 98 for Offices was about to be released in September 1998 and the BRE described the update as a “major overhaul” that introduced the current layout and weighting system. The BRE markets its assessment method as a tool “to ensure a broader coverage of sustainability and environmental issues” (BRE, 1998, p. 5).[27] BREEAM 98 established a system of 87 possible credits - following particular accreditation logics - that are grouped within nine assessment sections with different percentile weightings (Figure 4.5). The future GLA headquarters was set to achieve a minimum BREEAM rating of “Very Good”, which required at least 55% of the score available (“Excellent” requires 70%).

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[27] In relation to the concept of sustainable development BRE claims that “BREEAM addresses the following which are relevant to these aims: […] environmental impacts, leading to protection and perhaps enhancement of the environment by reducing pollution of air, land and water. […] Prudent use of natural resources by: providing durable buildings able to survive changes off fashion and use; selection of materials and products with better environmental performance; encouraging appropriate recycling; encouraging the re-use of buildings; encouraging the re-use of land, water economy, etc. […] Quality of life with competitive business providing high-quality built environments, buildings and indoor environments to satisfy human and business needs” (BRE, 1998, p. 4).

<table>
<tr><th>assessment section</th><th>87 credits max. available</th><th>weigting</th><th>total score</th></tr>
<tr><td>Management
Overall policy & procedural issues</td><td>5</td><td>15%</td><td rowspan="9">overall score translates into BREEAM rating</td></tr>
<tr><td>Health & Comfort
Indoor & external issues</td><td>16</td><td>15%</td></tr>
<tr><td>Energy
Operational energy & CO2 issues</td><td>17</td><td rowspan="2">25%</td></tr>
<tr><td>Transport
Transport related CO2 & locational issues</td><td>13</td></tr>
<tr><td>Water
Consumption and leakage related issues</td><td>6</td><td>5%</td></tr>
<tr><td>Materials
Env. implications of materials selection</td><td>11</td><td>10%</td></tr>
<tr><td>Pollution
Air & water pollution issues (excl.CO2)</td><td>10</td><td>15%</td></tr>
<tr><td>Land Use Greenfield & Brownfield site issues</td><td>2</td><td rowspan="2">15%</td></tr>
<tr><td>Site Ecology
Ecological valve of the site issues</td><td>7</td></tr>
</table>

Figure 4.5 The *BREEAM 98 for Offices* weighting scheme (Diagram: Author, 2014, based on BRE 1998)

It is important to recognise that the BRE is responsible for specifying the criteria and methods of assessment . Therefore BREEAM must be understood as a very specific way of framing and evaluating the relationship between architectural design and environmental challenges. BREEAM was constructed by different actors with different viewpoints and ways of addressing problems and understanding the world (Jamison, 2001, pp. 27-32). Through its specific "issue", "credit" and "weighting" system, it translates a complex and messy world into a set of quantifiable parameters. It creates a worldview. As a general tool, BREEAM suggests particular pathways over others. For instance "materials" are weighted twice as high as "water". Then these categories and processes of awarding credit have to be defined. BREEAM is a tool that can be used, but how it is assembled and why particular categories become weighted in specific ways and so on, remain hidden to those who apply it. BREEAM is an essential tool that was drawn into the GLA property search. Jon Spring recalled when he and colleagues drafted the design briefs: "BREEAM were just beginning to kick off then […] as a performance tool" (Interview Spring, 2010). In 1998 it was unusual and innovative to require a BREEAM assessment.

Raynsford's claim that the new headquarters was to exemplify the "commitment to the environmentally progressive objectives, the principles of sustainability" (Interview Raynsford, 2010) was through the briefing transformed (in association with other elements) into a BREEAM "very good" building assessment. BREEAM thus became the crucial "device" within the design briefing to align the heterogeneous actors and entities in the overall transaction (Callon, 1986).

The concept of sustainability is clearly not equivalent to this BREEAM assessment score of 55%; its transformation, displacement and translation are therefore of crucial importance. It is argued that the BRE has become a dominant force in the struggle to attribute meaning to environmental sustainability in architectural design practices in the UK (Hagan, 2001, p. 100). Leach, Scoones and Stirling (2010) argue to avoid treating "sustainability in a general, colloquial sense". Rather, they emphasise the importance of transforming the concept into definitions of the "explicit qualities of human well-being, social equity and environmental integrity" (p. 5). BREEAM, on the other hand, is criticised for its tendency to "compress the meaning of sustainability into a relatively narrow band of particular issues" (Farmer & Guy, 2005, p. 22).

My STS-inspired approach is useful to analyse how the design briefing was constructed and composed, but it also highlights that these constructions could have been produced in different ways, based on other preferences and ambitions. Leach, Scoones and Stirling (2010) argue that the "goals of sustainability are context-specific and inevitably contested". Therefore they point out that it is "essential to recognise the roles of public deliberation and negotiation - both of the definition of *what is to be sustained* and of *how to get there* (p. 5, emphasis added).

But the question of how to translate the concept into the design brief for the GLA headquarters to come was neither made part of an in-depth debate nor declared a controversial issue within the GOL team.[28] Raynsford had the power to foster this debate through his role and responsibility to sign off on the competition brief(s). In order to exemplify "the principles of sustainability", Raynsford and his team could have explicitly passed on the challenge of interpretation to the bidders to come. They could have obliged the developers, architects and engineers to develop a tailored strategy, indicators and vision of what sustainability could mean for the new GLA headquarters.

BREEAM was deployed as the dominant pathway (Leach et al., 2010) to frame sustainability in the GLA's headquarter development. With this transformation especially the social and ethical components of the concept become neglected within the translation process of the design briefing. The design brief could have made mandatory "to specify clearly, for particular issues and settings, what is to be sustained for whom, and who will gain or lose in the process" (p. 171).

The idea of "innovation" became one design parameter. Innovation is one of the popular buzzwords surrounding approaches to sustainable development. It may be understood as the "action of innovating; the introduction of novelties; the alteration of what is

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[28] This question was acknowledged in 1994 when the then Prime Minister John Major stated in the foreword of the *Sustainable development: the UK strategy*, "Sustainable development is hard to define. […] Making the choices necessary to deliver sustainable development requires a national and international debate. This strategy is the starting point for that debate" (DOE, 1994).

established by the introduction of new elements or forms", a "[r]evolution" and a "change made in the nature or fashion of anything; something newly introduced; a novel practice, method" (Oxford English Dictionary, 2011). The brief stated, "innovation will be encouraged providing it is clearly beneficial and works" (TTPM, 1998a). The idea of innovation was brought together with a "risk adverse" approach. These two ideas conflict: how can a technology be innovative and at the same time "tried and tested"? (Interview Griffiths, 2010)

In summary, the *Greater London Authority: Preliminary Summary of Authority's Requirements* set out and assembled diverse heterogeneous elements for the GLA building search. It identified the three key programme areas, assigned a vast set of design characteristics, and established a potential conflict between "best practice" and "innovation". Essentially, the document defined the environmental challenge for the future GLA building as achieving a BREEAM 1998 assessment rating of at least 55%. But, importantly, this goal became associated with other elements such as providing 12,000m^2 or the goal that the building should be perceived as externally "prominent and distinctive and be a design for the future" (TTPM, 1998a). In order to fulfil the majority of design goals, not only a BREEAM "very good" assessment was required, but other detours had to be accepted and problems solved that were associated with BREEAM.

4.4.4.2 The GLA Statement of Requirements (SOR4)

Approximately a week after the first brief, KFEA issued the detailed *Greater London Authority: Property Search Option Appraisal* that set out a "Statement of Requirements", draft 4 (SOR4), prepared collectively by TTPM and the GOL. This brief provided a detailed schedule of the net floor space required to let for 400 staff of the GLA. The generic SOR identified overall needs which were not specific to any particular building. It formed the benchmark against which the developers' proposals were to be compared and set out a schedule of "GLA Space Standards" that included information on the required measurements and enclosure (enclosed cellular, part glazed cellular, screened and open) for respective staff grades. This catalogue of space standards was followed by a "schedule of accommodation" of more than eight pages of detailed information on proposed GLA departments (the mayor's office, the assembly secretariat and so on) by function, department, grade, area per unit in square metres, staff number and total floor area, and whether they should be open plan. Each planned room was listed and the document concluded by giving the total spatial requirement for the 400 staff to be 11,609m^2 (TTPM, 1998c). Gordon Rautenbach explained the very specific briefing for the spatial requirements as an approach to "avoid excessive energy usage for unwanted space" (Interview Rautenbach, 2010).

4.4.4.3 The GLA Occupier Brief

The GLA *Occupier Brief* was issued alongside the GLA *Property Search Option Appraisal*. The brief identified 16 distinct areas within the anticipated GLA headquarters (mayor's office, assembly chamber, press suite and others) and explained their related "function", "element" and "description" in a three-column schedule. Gordon Rautenbach called it the "M&E [mechanical and electrical] brief". Under "function", the chart specified projected ways of inhabiting the areas, and quality standards of finishes, fixtures and fittings (sometimes even furniture). The richness of detail varies for different areas.[29] Under "element", the schedule described particular mechanical and electrical building services – "Heating, Ventilation and Air Conditioning" (HVAC), "HVAC & Control" options, "Noise Criteria", "Lighting", "Small Power", "Fire Protection" and "Specialist Systems". The third column, "Description", brings in a broad range of different technical units and technical equipment such as temperature (^{o}C), noise criteria, lighting lux levels, ampere (amp), watt/m^2, power sockets, automatic fire detectors, TV/FM aerial systems, telephones, data systems and much more (TTPM, 1998b). These specifications for typical office spaces are set out in accordance with recommendations of the British Council for Office's *Guide to Specification.*

The GLA headquarters was to be located in London, implying specific projections of temperature, daylight and weather conditions, and site-specific boundary conditions. The *GLA Occupier Brief* specified the environmental challenge for the building's interior

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[29] The function of the mayor's office is described as such: "The Mayor's office shall accommodate a working area, a formal meeting area with seating for up to twelve in boardroom style and an informal seating area with armchairs and sofas for six. The quality of the fixtures, furniture, fittings and finishes should reflect the status of the Mayor's role. The layout of the office should be adaptable to suit the particular needs of the incumbent Mayor" (TTPM, 1998b).

through a set of “user-specific boundary conditions” (Lenz, Schreiber, & Stark, 2011). These reflected particular understandings of the occupier’s comfort and safety conditions and defined them through quantitative measures. For instance, the mayor’s office was required to be kept constantly within a temperature range of 22°C ± 3°C. The brief specifies targets in physical dimensions for relative air humidity (50% ± 10%), airflows (10 air exchanges per hour) and lighting levels (400lux dimmable). This definition of the user-specific boundary conditions provided the basis for designers and building service engineers to design, measure and create the building service devices (for instance size and number of air handling units). Crucially, it is a particular definition of user-specific boundary conditions that influences the energy demand of buildings (Lenz et al., 2011, pp. 12-13). They define which interior environmental conditions are acceptable. Through energy consumption and by mechanical and electrical devices these conditions need to be maintained at any time of the year, whether hot or cold. The environmental challenge of the exterior is inseparably tied to the environmental challenge of the interior.

Following the release of the GLA *Preliminary Summary of Authority’s Requirements*, the GLA *Property Search Option Appraisal* (SOR4) and the *GLA Occupier Brief* to the seven selected developer-architect teams, the GLA property search entered a new phase. These teams started interpreting the three design briefs with the goal to further translate them into design strategies, forms, materialities and more. In the following chapter I explore how the CIT (More London), Foster+Partners and Arup design team (among others) responded to this set of criteria during the design development, and how the design brief continued to evolve parallel to the development of the architectural design schemes.

4.5 Conclusions

In this chapter I retraced the practices that brought City Hall into being prior to the architects and engineers of the More London team taking up their work. The central aim of this chapter was to explore how in these ‘early’ design practices (envisioning the GLA and its accommodation) the environmental challenge was constructed as an issue at the outset of the project, and how particular targets and goals were formulated to instruct the architects, engineers and developers in making their design proposals.

In his role as Minister for London, Nick Raynsford had to start thinking about how to establish the GLA. As part of this process, before Raynsford and his team were able to draft the design briefing for the headquarters to come, he had to outline, consult and pass (stabilise) the functions, responsibilities and housing of the new authority and set up legislation to bring the it into being. Not much was known at that time about the anticipated new building, “a little-known, abstract and fuzzy entity” that began to accumulate more and more well-known characteristics (Yaneva, 2009, p. 21).

The GLA’s overarching function was defined in two government consultation papers (DETR, 1997, 1998b) as being to promote sustainable development. Under the umbrella of “sustainable development”, Raynsford and his DETR team constructed the GLA’s environmental responsibility predominantly through five environmental crises that need strategic action: climate change, air pollution, noise pollution, waste generation and the loss of biodiversity.

As the functions of the GLA became gradually defined, heterogeneous elements began to inform the design development of City Hall. For instance, the headquarters had to become an exemplar of the authorities overarching environmental responsibilities, and as “symbol of what […] the labour government […] tried to achieve” in their early years (Interview Raynsford, 2010), further only a tight budget, and a tight timeframe were allowed, and a vague space allocation plan emerged. Through the accumulation of these design knowledges, the design briefing also increasingly took shape.

Raynsford defined the environmental challenge for the design of the GLA headquarters through the concept of sustainability. In his hands, as well as in the government papers, the concept of sustainability seemed to be a useful frame with which to guide policymaking. But in order for the design briefing to to guide and align the developers, architects, engineers and others in developing their design proposals, the concept needed to be translated into challenges to which solutions could be found. Yet the question of how to translate the concept into the design brief was neither made part of an in-depth debate nor declared a controversial issue to be tackled within the GOL team. Raynsford and his team had the power to foster this debate through his role and responsibility to draft and sign off on the brief(s) for the GLA headquarters to come. They could have explicitly delivered the challenge of interpretation and given meaning to the concept through architectural design to the bidders. They did not ask the developers, architects and engineers to develop a tailored strategy, indicators and vision of what sustainability could mean for the new GLA headquarters.

Instead, the concept of sustainability was translated into a certain amount of BREEAM credits and score. The meaning of sustainability was thereby reduced to a narrow definition of selected issues. Furthermore, only a score of 55% (i.e. “very good”) of this questionable delegation to BREEAM was made mandatory. The opportunity to come up with a more innovative (beyond typical pathways) interpretation of sustainability for the GLA’s headquarters was not taken. Heterogeneous elements, scales and actors became assembled in the design briefing. The environmental challenge to achieve 55% BREEAM assessment credits must be seen in relation to other “design parameters” that were set out for the GLA design. It seemed that the government’s choice to stay with the spending commitments of the previous government, as well as the decision to enter a lease deal with a commercial developer, were factors in a more radical translation of sustainability not being enacted.

To innovate in building practices, and to escape the typical pathways of responding to environmental problems, those involved have to eschew usual formulations of the environmental problem and redesign the specific social construction of the environmental problems themselves. Given London’s role as a powerhouse of global economic activity and interrelated global environmental degrading, the brief for City Hall should have been more radical.[30]

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[30] London hosts a vast concentration of headquarters of leading transnational cooperations (TNCs) within the administrative boundaries of the GLA. Within this territory, these cooperations draw together and bundle their command hierarchies that span across the globe. London therefore forms an important site in global environmental accountability (Sassen, 2004).

Chapter 5

Finding forms, choosing strategies

5.1 Introduction

Chapters 5 and 6 retrace the design practices that led to City Hall's materialisation. In this chapter I describe how many new actors and entities became associated in this unpredictable and conflictual design development process. By the end of August 1998, CIT, Foster+Partners architects and Arup engineers began to work as key members of the developer team, shaping their proposals in order to win the competitive property search for the Greater London Authority (GLA) headquarters.

The involved actors comprehended the design development as a process of continuous transformation in which four transient key design schemes could be identified that built on each other (Interview Hyams, 2011) (Figure 5.1). Two schemes were presented to Nick Raynsford in September and November 1998, along which I develop this chapter. The other two schemes presented crucial stages within the planning process: the Planning Application Scheme (July 1999) and the Schematic Design Scheme (November 1999), which I explore in Chapter 6.

These four schemes marked the progressive accumulation of heterogeneous elements and design knowledge. Involved actors were required to feed in to and coordinate their contributions in a supposedly single transient scheme. This chapter draws on presentation material, design documents, guidelines and interviews to retell the history of the GLA headquarters design proposal of the CIT, Foster+Partners and Arup team until they succeeded in winning the GLA property search in February 1999.

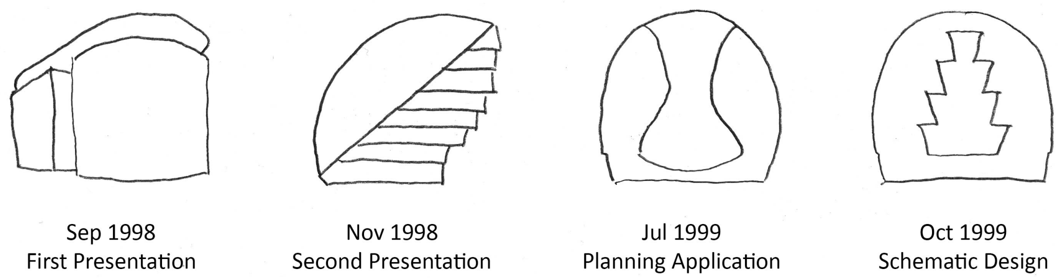

Figure 5.1 Four transient key schemes within City Hall's continuously transforming design development; from left to right, the first Ministerial Presentation Scheme, the second Ministerial Presentation Scheme, the Planning Application Scheme and the Schematic Design Scheme (Drawing: author, 2012).

Chapter 5 and 6 aim to explain how the design team translated the environmental challenges and targets defined in the Government Office for London's (GOL) design briefings into design strategies, building technologies and the materialising building. The next Chapter explains how selected strategies were further tested, transformed and stabilised. I focus on the development of City Hall's unique building form, orientation and envelope. The design of these building elements was given a pivotal role within the design team's environmental design strategy, and their design associated and brought together diverse issues and heterogeneous entities: questions of environmental control (e.g. heat losses, solar gains, fresh air, daylight), materiality (e.g. glass, solidity), operability (e.g. openable windows, cleaning), constructability (e.g. geometrical definition, assembling), perception processes (e.g. transparency, symbolism), cost, security, durability and more.

In order to proceed from the initial design briefing towards materialisation of the GLA headquarters, the GOL, Turner and Townsend Project Management (TTPM), CIT, Foster+Partners and Arup necessarily depended on the simultaneous production of new design knowledge and the additional association of heterogeneous entities. The initial design briefing, the role of actors and their interests, the properties of entities and their relationships were reciprocally shaped and modified during the design process. This process was performed through two mechanisms: the various sorts of transformations and choices and the diverse negotiations and adjustments that accompanied them (Callon, 1986, p. 224).

5.2 Setting the scene

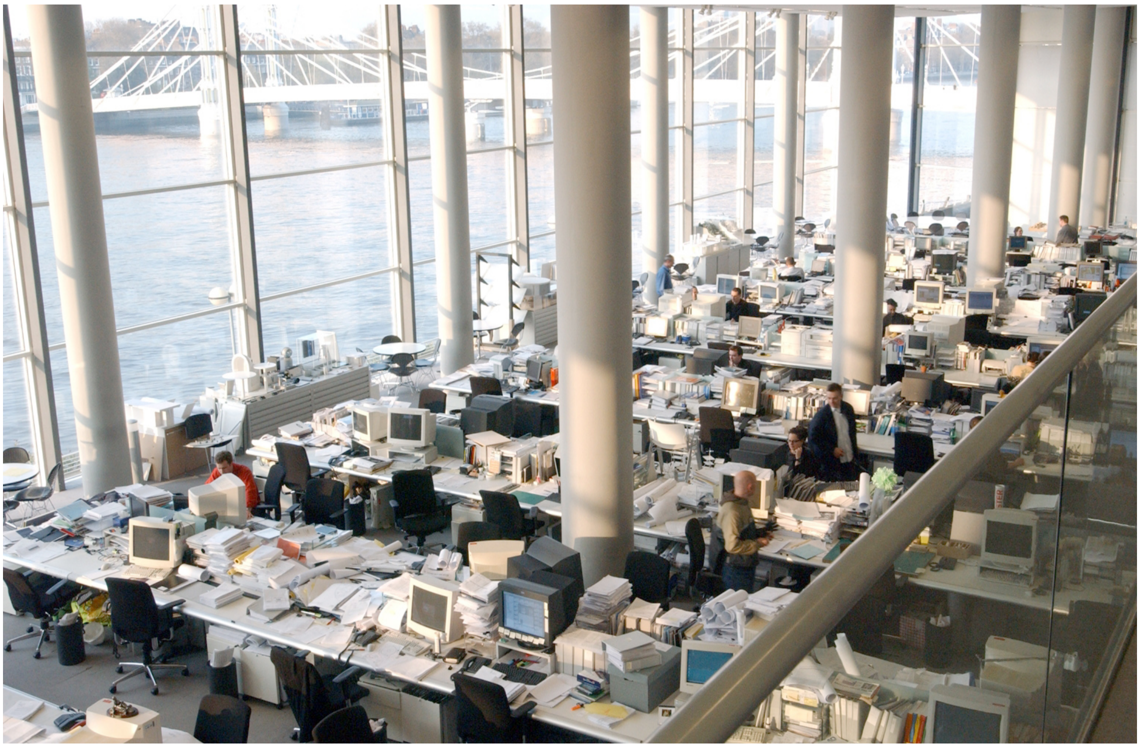

Figure 5.2 Foster+Partners' Riverside Studio in 2002 as one centre of transformations and choices (Photograph: Nigel Young and Foster+Partners, 2002)

Two disconnected but concurrent processes that started in different offices by different actors, and were driven by different interests and responsibilities, began to merge and co-shape each other in May 1998. The first process was Labour's commitment to bring back a London-wide government and, following the successful election, the new government's preparations to install the GLA overseen by Nick Raynsford (Chapter 4). The second process was the development of the 139,350m^2 site on the River Thames, facing the Tower of London and next to Tower Bridge, called *London Bridge City*. This second phase had involved several architects, masterplans and setbacks since 1987. These two processes became interrelated in May 1998 when CIT submitted their London Bridge City proposal in response to the initial call for outline proposals by Knight Frank Estate Agents (KFEA). CIT entered the competitive property search with the aim of building the GLA headquarters as part of its masterplan.

On behalf of the GOL, TTPM issued the first three design briefs (Chapter 4) to the seven selected developer teams in August 1998, requesting design and financial proposals for the GLA headquarters to come. Then the London Bridge City team began an unpredictable design process which prepared for the first ministerial presentation and submission of proposals only six weeks later in mid-September.

5.2.1 The London Bridge City design team

The London Bridge City team that entered the GOL's competitive property search was comprised three distinct key parties, each having different roles, ways of working, skills, and interests in relation to the GLA headquarter design.[31] The developer CIT was itself part of a consortium of three different groups of companies (an investor, an asset management company and a development company).[32] CIT, as the client, employed Foster+Partners and Arup. The CIT team was responsible for marketing, leasing, financing, accounting, development delivery and space management. It consisted of up to 24 people. The team that worked on development delivery never exceeded ten people. Liam Bond was the development director at CIT, responsible for the entire London Bridge City project, which was later reorganised and rebranded as *More London* development. In this role he focused on the appointment and briefing of the design teams, taking the schemes through planning, establishing the phasing strategy (More London consists of eleven other projects besides City Hall), setting up the construction procurement, and managing a team of project managers internally to deliver the projects (Interview Bond, 2011).

Foster+Partners architectural practice was founded in 1967 by Norman Foster and Wendy Cheesman.[33] Today, Foster+Partners is one of the largest architectural practices in the world and has designed architecture and infrastructure projects in 150 different cities and

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[31] The wider team included Davis Langdon & Everest and Mott Green & Wall (cost consultants), Montagu Evans (planning consultants) and MACE (construction managers).

[32] First the investors DEPFA Bank and CIT Group Plc, which formed and held shares in the holding company, London Bridge Holdings, located offshore in the Bahamas for tax reasons. Second and third, CIT founded two onshore (UK-based) companies in order to set up, deliver and manage the development. One was an asset management company and the other was CIT Markborough Ltd as the development company.

[33] Initially the practice was called Foster Associates; the practice was renamed Foster+Partners in 1990.

50 countries.[34] Three key people at Foster+Partners led the GLA project. Ken Shuttleworth was in charge of the GLA project and project architect, Sean Afflek, "ran" the day-to-day job. Richard Hyams later joined him. About 20 Foster+Partners architects worked on the project over its course.

The third key party to join City Hall's design team was Arup, a global services firm that provides engineering, design, planning, project management and consulting services to many areas of the built environment.[35] During peak times the GLA team at Arup comprised up to 30 members. James Thonger was the engineering project manager and the lead building services engineer. In this role he was directly involved in City Hall's design. Thonger had a counterpart in David Glover, who was the structural lead designer, and the two were the main actors responsible for developing the building design. Thonger had a lead mechanical engineer, a lead electrical and a public health engineer below him. The team working with building services comprised up to ten people in total. The structural engineering team was much bigger with approximately 20 structural engineers (Interview Thonger, 2011).

In August 1998 the team of CIT, Foster+Partners and Arup began to put the first three design briefs into action. Raynsford had been responsible for the design briefing. The briefing had translated the environmental challenge from the concept of sustainability (as the overarching function of the GLA) into a narrowly compressed understanding of nine assessment areas in architectural practices defined under BREEAM as "very good", and into an undefined vague request that "'Green' issues should be given proper consideration" (TTPM, 1998a). This design challenge was clearly not posed in isolation, but associated with diverse heterogeneous requirements including *inter alia* the demand for a "prominent and distinctive" building, "high quality", "innovation", "simple and based upon

[34] The practice's works include projects like the Willis Faber & Dumas Headquarters, Ipswich, 1971–1975; the Sainsbury Centre for the Visual Arts, Norwich, 1974–1978; the Hongkong and Shanghai Bank headquarters, Hong Kong, 1979–1986; the Commerzbank Headquarters in Frankfurt, 1991–1997, and in 1998 Foster+Partners was close to completing the Reichstag, the new German Parliament in Berlin, 1992–1999 (based on http://www.fosterandpartners.com, accessed 08 August 2014).

[35] In 1946 Ove Arup founded the firm with an initial focus on structural engineering. In 1963, together with the architect Philip Dowson, the firm became Arup Associates, and in 1970 it was transformed into Ove Arup & Partners. Today Arup has about 10,000 employees, offices in 37 countries and operates in more than 160 countries (http://www.arup.com/About_us.aspx, accessed 04 April 2014).

current on best practice […] service solutions”, a chamber “demonstrating openness and accessibility” (TTPM, 1998a), 11,609m^2 floor area, accommodation for 400 GLA staff, more than 200 different room types (TTPM, 1998c), interior temperature differences of 22^{o}C ± 3^{o}C, relative air humidity (50% ± 10%), 400 lux lighting levels (TTPM, 1998b). These diverse design issues were required to be addressed as a package.. As I will show in this and the following chapter, the design briefing requirements were not fixed, but developed in relation to the unpredictable proceeding design practices.

The three design briefs were produced and deployed on behalf of the GOL as powerful devices to align the London Bridge City team members with the GOL team in the joint mission to develop a successful proposal that could spatially manifest and materialise the new GLA headquarters. As devices the briefs aimed to instigate particular design developments that would fulfil the supposedly shared interests of the actors involved (cf. Callon, 1986). GOL’s key interest was to find a suitable accommodation for the GLA, that of CIT was to start kickstart the development of their London Bridge City site, and of key interest to Foster+ Partners and Arup was a new and prominent design commission.

Upon issuing the first three briefs, the GOL gave CIT, Foster+Partners and Arup only six weeks to assemble their proposal for the initial presentation to Raynsford and his advisors. They first had to translate three design briefs into design strategies, proposed spatial arrangements, building forms, building technologies and presentation materials (diagrams, design drawings, renderings, 3D models) in order to create a proposal that could succeed. They entered into a contingent design process that required interpreting the design briefing and, in order to progress, the team was dependent on the accumulation of additional design information, prioritising and transforming it. In this process additional heterogeneous entities became associated that forged a conflictual and unpredictable alliance.

City Hall’s design development emerged through the rather messy day-to-day interaction of practitioners, papers, computers and physical models. Design sketches, drawings and 3D models were a crucial means to investigate, communicate and work together. They were the material elements that the design team sought to assemble, since the two ministerial presentations, the planning application and the scheme design drawing package (the four key schemes) were decisively built and constituted through them. They were central and necessary intermediary products that bound participants together (Henderson, 1999) and that had to be produced to enable the journey towards materialisation.

The day-to-day collaboration between CIT, Foster+Partners and Arup relied on frequent telephone and fax exchanges in which lots of data were transferred over and back. In 1998 emails were only beginning to become important and were then not capable of transferring large files. Further, the collaboration was built on three types of meetings in Foster+Partners' Riverside Studio - an important centre of negotiation and decision-making in City Hall's design practices (Figure 5.2). Weekly "design team meetings" in which project managers and team leaders met for most of the day were central. In addition there were "project coordination meetings", which in peak times also took place weekly, that dealt with financial or organisational matters. And a "meeting of principals" was held monthly to inform each other about key issues and project progress (Interview Thonger, 2011).

In order to develop my account of the heterogeneous design practices that took place I composed an additional timeline (Figure 5.3) that draws together key elements from July 1997 (the beginning of the design briefing development) to July 2002 (the opening of City Hall). In comparison with the timeline in Figure 4.2, I concentrate here on a particular facet of the design process over a shorter period that relates important events, key design phases (e.g. the design briefing, the competitive property search, construction on site, etc.), the arrival or departure of important different vocational actors (e.g. GOL, Foster+Partners, Arup, Raynsford's architectural advisors), the release of design documents (e.g. design briefs, design documents, BREEAM updates), the emergence, stabilisation and elimination of environmental design strategies, and the release of key visual representations (e.g. design sketches, diagrams, drawings, renderings). The four consecutive key design schemes along which I develop my account are marked through the numbered red circles on the bottom of the timeline.

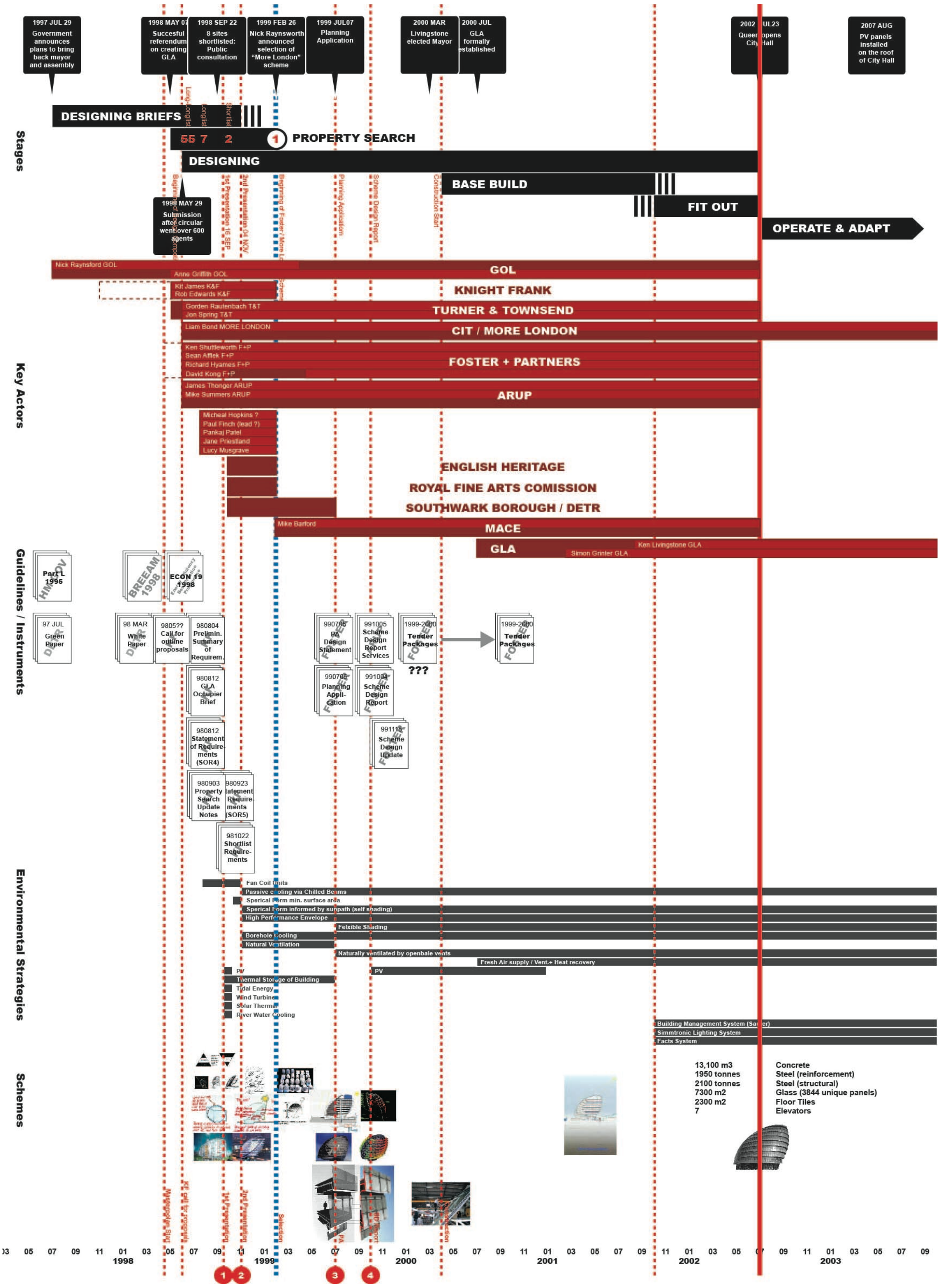

Figure 5.3 Timeline 1997 - 2003 with the four key schemes (numbered 1 to 4 in circles on red background at bottom), mapping reciprocal presence and shaping of actors, key documents, design strategies and evolving schemes (Timeline: Author, 2014)

In the following I begin to analyse the multifarious translation processes that transformed the design briefing requirements into environmental design strategies and building technologies.

5.2.2 Constructing the context and commencing massing studies

In exploring the development of City Hall's building form and orientation as the chosen pivotal environmental design strategy in response to the design briefing, it is necessary to go back and start with the architectural massing studies of the masterplan design. Prior to KFEA's call for outline proposals on 29 May 1998 CIT Markborough Ltd announced that it had appointed Sir Norman Foster and his practice as masterplanner for the 139,350m^2 site called London Bridge City. The *Estates Gazette* commented that "CIT boosted its chance by appointing Foster+Partners as masterplanners for the £1bn Thameside site" in their vital search to secure a major tenant for their development (Estates Gazette, 1998, pp. 35, 40). CIT's development director Liam Bond argued that CIT needed a masterplan with the aim of creating a "development with its own identity, its own sense of place and its own critical mass" (Interview Bond, 2011). He explained the rationale for choosing Foster+Partners as follows:

> [T]hey had the capability, […] they weren't overexposed to the London market at that particular point in time. […] There weren't a huge cannon of Foster's buildings within the City of London […] yet they had an international renown. So, it was a big draw to use their name as well (Interview Bond, 2011).

Foster+Partners' reputation was seen as a strategic asset in CIT's interest to attract and secure potential tenants, which was a necessary precondition for CIT to start the development process. Bond argued that CIT chose Foster+Partners because of the practice's international reputation and its ability to handle a large development. Bond did not list questions of 'environmental design' as a possible rationale for the choice. CIT started negotiations with potential tenants but initially couldn't secure any major property deal. Rather than developing the site for a big specific occupier, Foster+Partners was

Figure 5.4 The cleared London Bridge City site in the 1990s in front, Tower Bridge in the back (Photograph: *Estates Gazette*, 14 March 1998, Issue 9811, p.59)

briefed to develop a masterplan for the whole site that would potentially suit different generic users.

The masterplan site had a troubled history. Before the Second World War Bermondsey Riverside was part of a thriving industrial community within the London Docklands. Bombing between 1940 and 1945 heavily damaged the site that would become London Bridge City. Shifts towards railway network cargo distribution in the 1960s, larger ships, the liberalisation of port legislation and expanding container ports downstream were some of the factors that set in motion the general decline of Bermondsey Riverside site and the Docklands in general. During the 1970s the site that More London occupied later was to a large extent cleared of its existing buildings. There had been a number of design proposals for the site before CIT became involved.[36] Overall the site had lain fallow for

[36] The owner preceding CIT, the Kuwaiti Investment Office, represented by St Martins Property Cooperation, had a huge tract of land, which spread from London Bridge eastwards to Tower Bridge. After completing their first phase of London Bridge City, St Martins' failed to develop the two subsequent phases of London Bridge City. In the 1980s St Martins attempted to develop the site through the *Venice on Thames scheme* by John Simpson & Partners, and a proposal by the famous architect Philip Johnson. None of these schemes was realised over the course of many years. In November 1997 the London Bridge City site II and III were sold by St Martins to the DEPFA Bank for about £60 million. Later DEPFA sold a major equity share to the CIT group.

over 25 years until Foster+Partners started constructing City Hall and the More London infrastructure. In May 1998 work started on the masterplan in a design collective led and coordinated by Foster+Partners. The team included Arup in the role of consultants for transportation, services engineering and infrastructure engineering and a growing number of other building specialists.[37]

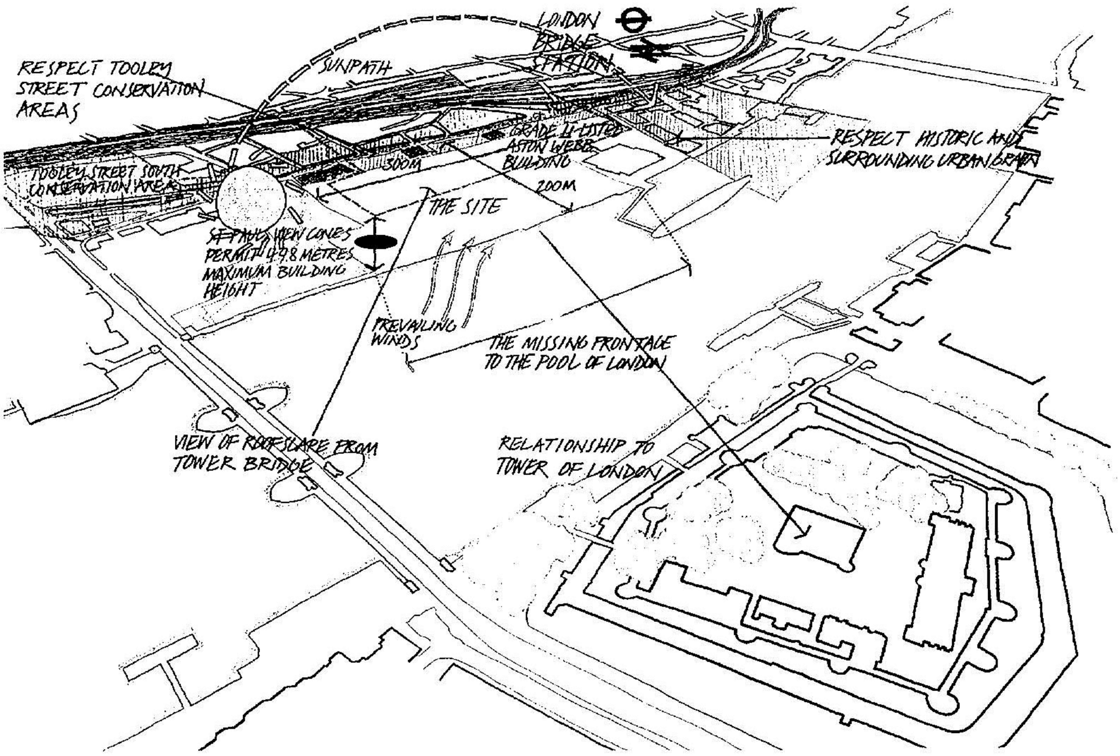

Figure 5.5 Assembling the heterogeneous masterplan context in City Hall's later Design Statement (Drawing: Foster+Partners, 1999a, p. 11)

The context for the masterplan was neither fixed nor given (Yaneva, 2009, p. 16). Rather, Foster+Partners needed to develop an understanding of it, abstract it and assemble it through specific design elements (Figure 5.5). New design information was collected and produced: the required compliance with relevant planning guidance and building codes, the location on this historic stretch of the Thames, the proximity to the Tower of London (a World Heritage site), the proximity to Tower Bridge (a Grade I listed building), and the

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[37] For a full list of the design collective see http://www.fosterandpartners.com/projects/more-london-masterplan

location within the London view management framework from Greenwich to St Paul's Cathedral imposed a height limit for buildings of 50 metres on site. The site also became understood through particular composed environmental design criteria such as predicted temperatures, sunshine angles and intensity, wind and precipitation. The constructed context became one important driver of City Hall's later design trajectory.

Foster+Partners were instructed by CIT to develop a "very flexible masterplan" (Interview Hyams, 2011). This plan was made up of a series of "fingers", which pointed towards the river (Figure 5.6).

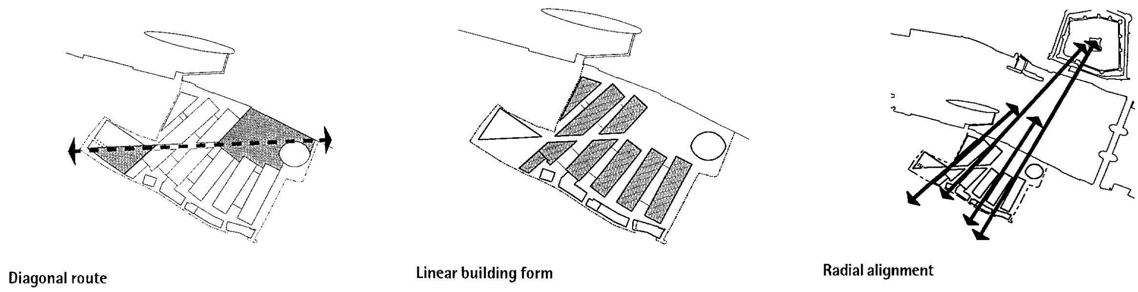

Figure 5.6 Initial concepts of the masterplan design in City Hall's later Design Statement (Drawing: Foster+Partners, 1999a, p. 17)

City Hall's later Design Statement explains: "The layout of the masterplan is principally derived from the creation of a series of views and routes responding to the River, Tower of London and Tower Bridge" (F+P, 1999a, p. 17). According to interviewees the layout of the fingers was intended to provide flexibility. Particular tenants could take one, two or more different fingers, depending on their spatial requirements. The initial spatial configuration of the fingers had significant consequences for the later architectural design of the entire development since the possibilities of daylighting and natural ventilation became partially shaped by building depths, distances and orientations that the masterplan in its schematic layout stabilised.

5.3 Assembling the First Ministerial Presentation Scheme

5.3.1 Translating and putting the design briefing into action

In mid-August 1998 the London Bridge City team began to develop initial translations of the challenges, targets and aspirations that Raynsford and his team had set out in written form through the three initial design briefs (see Chapter 4). The three briefs were the devices chosen to inform the seven developer/architect teams that were selected to compete for closing a deal with the GOL to house the future GLA.

Ken Shuttleworth of Foster+Partners was in charge of the London Bridge City masterplan design. Wen CIT submitted the masterplan project for the GLA headquarters competition he also became responsible for this building project and the two projects then began to shape each other. Arup were involved in the masterplan design and Thonger recalls that the "masterplan design was pushed forward" by CIT when they submitted the project for the GLA headquarters competition (Interview Thonger, 2009). The GOL searched for a building and CIT entered the competition with a masterplan development. The *GLA Preliminary Summary of Authority's Requirements* made mandatory the GOL's request for a BREEAM building assessment of at least "very good" and that "'Green' issues should be given proper consideration" (TTPM, 1998a). Decisively, the design briefing did not demand a BREEAM-assessed masterplan, but concentrated on an individual building.

Shuttleworth explained that during the masterplan phase the concept of sustainable development was not chosen or made "a major driver at all" (Interview Shuttleworth, 2010). He felt a bit helpless in explaining its relation to the masterplan design. He argued that the challenge of the concept of sustainability had been transformed by CIT and Foster+Partners into the masterplan design through the design strategy of creating "a public space and [...] a public route . So from the sustainability point of view we were looking at trying to link the pedestrian link from London Bridge station right through to Tower Bridge and beyond"(Interview Shuttleworth, 2010).[38] CIT's development director,

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[38] He added that the masterplan design conceived 50 per cent of the site to be built on, and the other 50 per cent to become a "public space" with paving, landscaping and plantings. It is important to highlight that Shuttleworth's claim is problematic since the concept of "public space" is a contested one (to enter into in-depth discussion on this is beyond the scope of this thesis). Crucially, the More London development is privately owned and this has far reaching consequences. It allowed More London to later deploy its own security service in order to exercise their

Liam Bond, argued that there was a shift in recognising sustainability as a driver during the entire masterplan design and materialisation between 1998 and 2011:

> Well, certainly it's got issues to do with sustainability etc., but peoples' understanding of those and the pertinence of those and the importance of those questions did develop during the course of the development. Peoples' understandings and how relevant the question, how important an issue it was back in here [*1998 - Bond pointing at one of my timelines*] is very different from peoples' understanding here [*2011*]. Not only peoples' awareness of it, its position within the market and how people wanted to respond to it and also the technology and design tools that were available to address it have changed (Interview Bond, 2011).

While Bond develops his argument from the perceived perspective of general "people" and the "market", he conceals his own involvement. CIT was the client that employed Foster+Partners and Arup. Crucially, they had the power and responsibility to set the agenda for the masterplan that they commissioned. It was CIT's choice not to make sustainability an issue in the design agenda. Rather, it was the GOL in its role to provide a domicile for the GLA who chose to make this question a design issue to be addressed.

The development of the masterplan is a crucial phase that potentially opens up strategic design opportunities that cannot be addressed on the scale of a single building. Instead of the (later) efforts to make the GLA headquarters "a statement about […] the principles of sustainability" (Interview Raynsford, 2010), CIT largely neglected to tap the opportunities that could have been seized through the scale of the masterplan design.[39] Consequently CIT did not choose to give the masterplan design a crucial role in enacting the GOL's demand that "'Green' issues should be given proper consideration" (TTPM, 1998a).

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property rights. In this way, More London can allow or suppress particular activities and access for various groups and individuals.

[39] City Hall's project architect Sean Afflek criticised that the issue of energy efficiency - as one prominent but limited interpretation of sustainability – could have been improved through taking advantage of the masterplan's diverse building programme. It intended to include offices, a hotel, a theatre and a gym. Afflek stated that "mixed use" could have been introduced to "share loads around buildings" (Interview Afflek, 2011). Benefits could have resulted from the different building service demand patterns in a service network (e.g. excess heat in offices could have been used in the gym, which would have a huge heat demand).

But responsibility was not only in the hands of CIT. In principle, Foster+Partners and Arup could themselves have redefined their roles to critically comment, intervene, refine and expand the GOL's briefing. The GOL was driving this agenda setting, but in principle also the architects, engineers or developers could have insisted on making the sustainability question a crucial issue for design practice that needs further investigation within design processes. But it wasn't until after the first ministerial presentation that the CIT, Foster+Partners and Arup team achieved a consensus on the adoption of the GOL's 'environmental' design agenda in ways that surpassed the then majority of mainstream commercial office developments.

5.3.2 First building systems

Alternative design strategies were put forward, negotiated and eliminated in the attempt to find a consensus between the different vocational team members at this early stage of the GLA headquarters design process. Thonger explained that right from the beginning they interpreted and translated the design challenge for the GLA headquarters into designing "a very low energy building, […] energy consumption was our main goal on it" (Interview Thonger, 2011).

While BREEAM 98 for offices - introduced by the design briefing - was built on nine different assessment areas, Arup chose to translate the design briefing into a constricted endeavour of "low energy" design as their initial framing of the competition phase.[40] While the question of "Energy" is one of the nine BREEAM assessment areas, Arup did not use or deploy BREEAM as a tool to guide their design development. Further, the way Arup framed "Energy" was different to that of BREEAM's framing. Arup attempted to generate new design knowledge through an "option process" (Yaneva, 2009, p. 162) of guessing, assuming and eliminating that included diverse forms of renewable energy generation:

> During the competition phase we just threw everything down regardless of whether it was going to work or not, […] wind turbines or something like that, […] it was ranked as to whether or not it was suitable for […] this particular location. We even had […] tidal barriers and stuff like that to generate [electricity], so nothing

[40] The BREEAM 98 for Offices assessment areas are: Management, Health & Comfort, Energy, Transport, Water, Materials, Pollution, Land Use, Site Ecology (see Chapters 4 and 6).

> was held back […]. Throw it all out there, and then start to rank it and so from that we came to a kind of series of proposals if you like for how this building could respond in terms of energy, but that was really only right at the beginning (Interview Thonger, 2011).

Thonger's team entered a different way of exploring design options when TTPM issued the *Property Search Option Appraisal* – Draft 4 (TTPM, 1998c) that set out a detailed space allocation plan (functions, square meters) alongside the *Occupier Brief* (TTPM, 1998b) that defined mechanical, electrical, material and other specifications for distinct spaces. Thonger explained that the "whole process was restarted when Turner and Townsend […] started to talk about real, real requirements and particularly about the density of occupation" (Interview Thonger, 2011).

What Thonger called "real requirements" were the particular building blocks through which Arup constructed the "projected" (Akrich, 1992, p. 209) operations of City Hall in an attempt to anticipate the actual operations to come (see Chapter 7). This data Arup were able to feed into their calculations and computer models. Their design knowledge consisted of and was generated through projected numbers of occupants, a set of specific construction of "external design conditions", which became the basis for particular simulations, modelling exercises and building services calculations (Arup, 1999, p. 3). TTPM's *GLA Occupier Brief* provided essential information about the GOL's desired "internal design conditions"; the mayor's office and most other areas were set to be maintained between of 22°C ± 3°C, with a relative humidity of 50% ± 10% (TTPM, 1998b). This information formed the basis to frame, estimate and calculate particular features of the building form, orientation, envelope and technical services (heating, cooling and ventilation). The engineers were required to provide a building service design that guaranteed conditions within the above limits at any time throughout the entire year. The projected interior environment became defined, constructed and reduced through a set of quantitative measurement units (e.g. temperatures in ^{o}C or light levels in lux). Arup began to translate the design briefing into a chosen set of associated elements and strategies. One crucial question was whether Arup's chosen building blocks would be sufficient to anticipate the heterogeneous forces that would co-constitute the later operations and whether these would fulfil the targets set by the GOL's briefing. The actual operations were later co-constituted by a wide range of unpredictable elements, for instance the actual performance of specified mechanical devices, occupancy numbers, and behavioural preferences of users. Arup's approach in designing City Hall derived from their specific expertise, experience and responsibility for mechanical engineering of the project (cf. Yaneva, 2009, p. 154). Arup's building blocks, tools, and issues of concern were fundamentally different from those of CIT and Foster+Partners.

5.3.3 First building forms

The spatial requirements for the GLA headquarters were defined in the design briefing as 11,609m^2 (TTPM, 1998c). Compared with the total floor area of the London Bridge City masterplan the GLA requirements were a tiny part – about 5%. In mere floor area quantity the GLA project was not an important project for CIT, which was more interested in the other 95% of development. Shuttleworth explained:

> [The site] was 'out there', it was like in the doldrums. Nobody wanted to go there. It […] had been empty since the war. It wasn't a site that people saw as being in a way developable for London. […] To encourage people to go there […] was very, very difficult. So they [CIT] used it [the GLA headquarters] to kick-start, to sort of put it on the map […] it was the [GLA] building that […] signalled the start of More London to get other people to come and want to be there. And I think it was a sort of catalyst for the rest of More London (Interview Shuttleworth, 2010).

After issuing the first three design briefs in August 1998 the seven selected developer/architect teams began to develop their proposals with the aim of winning the competition. CIT had the strategic advantage that they wanted to kick-start a much bigger development. Therefore, offering a good deal to the GOL still presented a profitable strategy, since the GOL headquarters were able to become the anchor tenant that would enhance CIT's chances of finding tenants for the remaining 95% of London Bridge City. CIT recognised that housing the mayor would be a valuable asset.

Since the building for the future GLA required a rather small area, CIT and Foster+Partners needed to translate the 11,609m^2 into a form within the overall masterplan (More London later got planning consent for 280,000 m^2 of mixed-use space). The masterplan was developed as a series of fingers and the projected GLA headquarters initially was placed within the east finger, in the most prominent part facing Tower Bridge and the waterfront. Shuttleworth explained at the outset: “Because it was such a small building we were playing it very, very safe to start with. And it was just a sort of box” (Interview Shuttleworth, 2010).

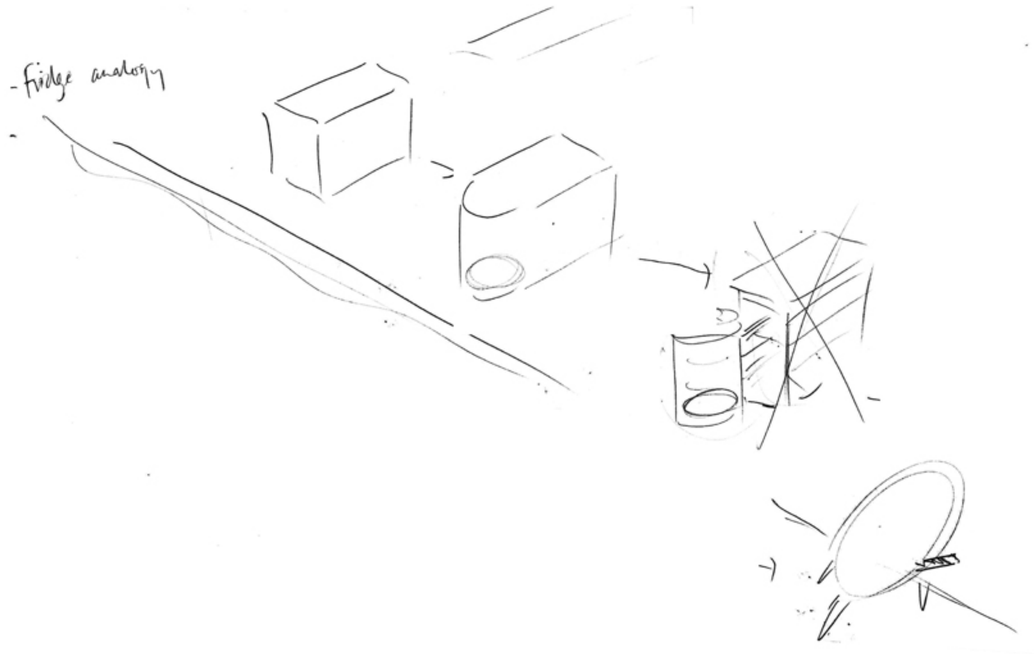

Figure 5.7 The masterplan “finger analogy” (Drawing: Richard Hyams, 2011)

Richard Hyams explained the development of the initial building form through a sketch he called “finger analogy” (Interview Hyams, 2011) (Figure 5.7). Team members nicknamed the emerging scheme that was first presented to Raynsford and his advisors the “box” scheme (Figure 5.8). The architects developed and tested their understanding of the anticipated GLA headquarters through basic square meter calculations, sketches, basic drawings, perspectives, cardboard and foam working models.

Hyams’ sketch envisions the development of the building form in four successive steps, from the initial massing studies through increasing independence from the fingers of the masterplan. First (left) the GLA building was in a rectangular form, part of the east finger; second, the front facade became rounded; then the third scheme became detached from the finger but stayed interconnected with the finger through a series of bridges. This temporary scheme was initially presented to Raynsford. The fourth scheme on the bottom right was a consequence of the first presentation. Hyams' sketch illustrates how the design process is built on a series of unpredictable transformations and displacements in which heterogeneous design elements become accumulated, stabilised or abandoned.

While CIT did recognise that housing the GLA headquarters would be a valuable asset for their development, they were initially hesitant to make huge concessions regarding the GOL's design briefing requirements. CIT's development director Bond stated:

> There was a masterplan for a series of buildings on the site and that happened to be the site we chose to submit for it [the GLA headquarters competition] because what was asked for was a site with effectively a pretty standard office building. So, we used one of the offices that [was] planned from the masterplan (Interview Bond, 2011).

Ken Shuttleworth commented on CIT's approach during designing the first presentation scheme:

> CIT weren't taking it 100% seriously, because it wasn't such a big area for them. They just took it as being a catalyst, so they then didn't really want us to give them a Rolls-Royce scheme. They really wanted us to just give them a box, which they [the GOL] could fit out (Interview Shuttleworth, 2010).

Shuttleworth argued that CIT, through their power as client, initially defined the "margins of manoeuvre" (Callon, 1986, p. 203) for the design team. Foster+Partners and Arup did not challenge these margins and consequently were prompted to assemble a "standard office building" (Interview Bond, 2011). Shuttleworth emphasised that environmental design strategies did not play an important role in the initial "box" scheme:

> It was probably just a typical office building. […] BCO [British Council for Offices] standard specs because it's an offices building. And the chamber just had to be a sort of add on […] put on the end (Interview Shuttleworth, 2010).

For Bond the project seemed to be a welcome vehicle to kick-start CIT's entire London Bridge City development, which was one of his key interests and responsibilities. He interpreted the briefing as a challenge to design "effectively a pretty standard office building" (Interview Bond, 2011). At this stage Bond's and Raynsford's interests were in conflict, since Raynsford and his team claimed that they intended to assemble an ambitious design briefing to compel developers to design a building that would be perceived as a "symbol of a new London" and as a "statement about the new authority, including its commitment to environmentally progressive objectives, the principles of sustainability" (Interview Raynsford, 2010).

Rautenbach (TTPM) emphasised the struggle over the interpretation and translation of the design briefing between the involved parties and their conflicting interests. He reinforced Raynsford's claim that the GOL's design briefing intended to deliver the challenge "to promote excellence in all respects, including location, architecture, and environmental performance" to the bidders, but at that stage "many of the developer teams did not get it" (Interview Rautenbach, 2010). Consequently the GOL's design briefing as a device to align the different stakeholders lacked the power to bring the London Bridge City team to develop an ambitious design proposal. It became increasingly evident that the initial design briefing's already weak translation of Raynsford's "environmentally progressive objectives, the principles of sustainability" (Interview Raynsford, 2010) into a "an overall 'BREEAM' rating of at least 'very good'" (TTPM, 1998a) proved rather to be ineffective.

Hence, during the designing of the "box" scheme, the different actors and their interests (especially between the GOL and the developer team) that derived from specific responsibilities were not well aligned and stood in conflict. To succeed in the translation of the initial design briefing the actors had to negotiate to find a consensus on particular design objectives and strategies. This called for a realigning of the actor's roles, interpretations, interests and practices in order to translate the briefing into form and materialisation. At that time there was still potential for the project to fall apart, or not to progress at all.

5.3.4 Reshaping the design briefing

The design briefing was not limited to or fixed through the first three design briefs. It fluctuated and co-developed with the design progress. The GOL encouraged consultation with the developer teams. I assume that after first negotiations the GOL felt the necessity to reshape the design briefing by adding additional elements, thus increasing its definitional power. The environmental design goals were reshaped through six relevant elements (below) that included both quantitative reference values and suggested design pathways.

On 3 September 1998, two weeks before the first presentation to Raynsford, TTPM issued the *GLA Information Update Notes* (TTPM, 1998e) to the selected seven design teams to add more refined design criteria to the GLA property search. It included two "architectural issues" (TTPM, 1998e): first, a recommendation on floorplate widths of 12m to 14m and no more than 19m; second, it stated that if "floor to ceiling perimeter glazing is proposed then convincing reasons should be provided to overcome concerns relating to heat gain [and] running cost issues". Further four elements defined as "environment & green issues" (TTPM, 1998e) were added: first, BREEAM became reconfirmed as an "important cornerstone for setting environmental standards", but was expanded through the additional request for the headquarters to "achieve a challenging CO_2 emissions target, set at 70kg/m^2/annum". Second, specific renewable energy and energy efficiency pathways were encouraged: "renewable energy sources, CHP [combined heat and power], district-heating schemes, [and] solar/electric systems". Third, it addressed the issue of water consumption by recommending "grey water use" and undefined "other efficiency measures". Fourth, "sustainable building materials" were "given high priority", without any indication of what that might imply for the material selection.

Even when the design teams were close to presenting their schemes to the minister, additional design information was fed into the briefing process. With these changes the GOL in part reinforced its translation of its environmental agenda into the design briefing.

5.3.5 Meeting Raynsford and his advisors

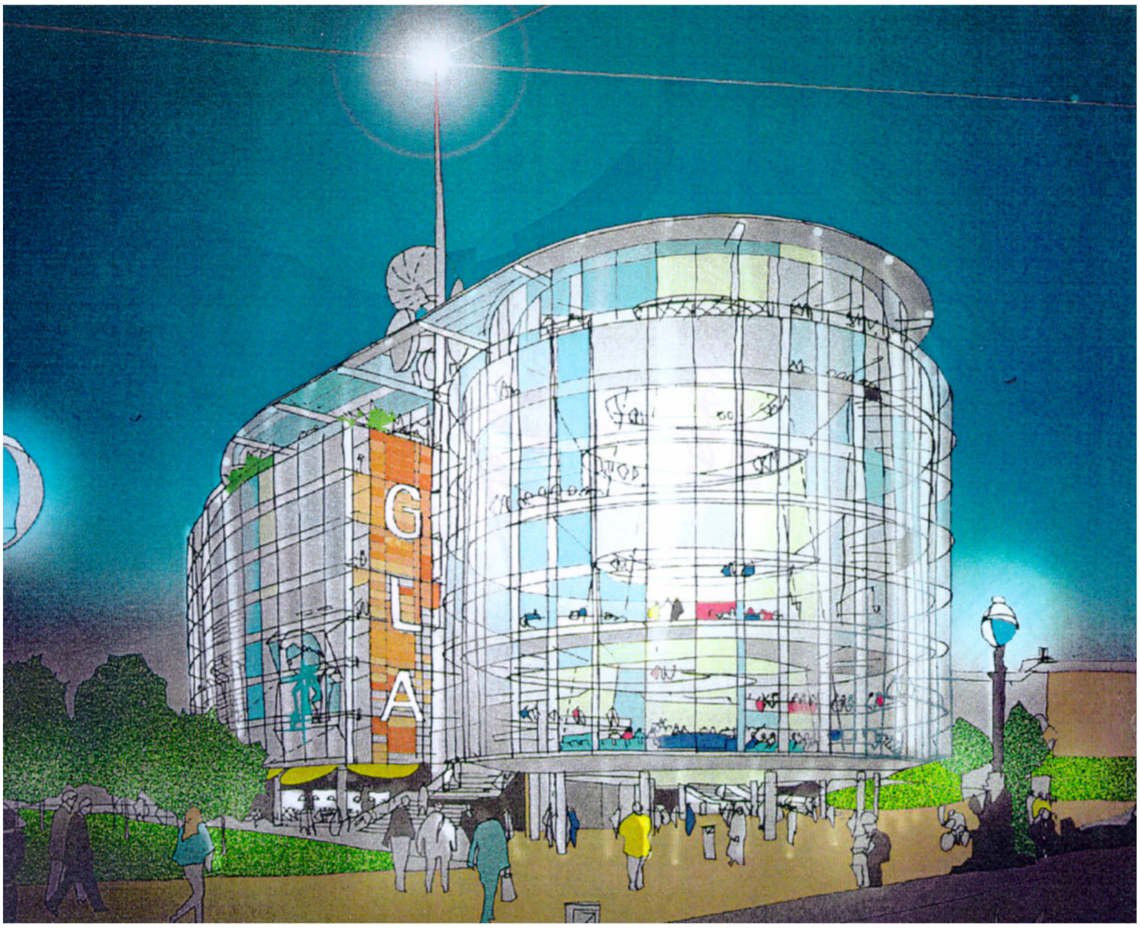

Figure 5.8 The CIT team's proposal for the GLA headquarters at the first ministerial presentation, nicknamed the "box" scheme (Drawing: Foster+Partners, 2004)

In September 1998 CIT, Foster+Partners and Arup presented their initial design proposal to Raynsford and his architectural advisors. With this first ministerial presentation the search for GLA headquarters moved into the next important phase. Following site visits by Raynsford and his advisors, the seven selected developer teams made short presentations to this group followed by a question and answer session. The GOL had called for design and financial proposals that would form the basis of the envisaged lease deal between the GOL and one chosen developer. Under time constraints of only six weeks, the CIT team assembled a schematical visual presentation package that, as the key deliverable, had been the target point of their previous activities. The package contained basic drawings, perspectives and 3D physical models. These visual tools were deployed to communicate the CIT team's initial proposal and translations in response to the GOL's design briefing. With these visualisations the team tried to envision, promote and convince Raynsford and his team of their proposal assembled in the design studio and offices of CIT, Foster+Partners and Arup. A submission of technical and financial reports was required two weeks later.

The GOL's objectives with this first presentation were complex and mixed many diverse elements: to shortlist two out of the seven proposals for continued design development, "to encourage distinctive exciting proposals providing appropriate accommodation tailored to the needs of the GLA", "to encourage environmentally sensitive solutions", and "to make initial assessments of financial issues" (TTPM, 1998h, p. 1).

Raynsford and his advisors then looked at the glass "box" that was placed in front of them by the CIT, Foster+Partners and Arup design team. Anne Griffiths (GOL) described the situation thus:

> The designs were then looked at by the design advisory group, and I know – with this building – when Fosters first came forward, they had presented a (sort of) glass box. And Nick sent them away and said: "It's looking good, but go away and play" (Interview Griffiths, 2010).

Similarly, Bond recalled:

> I can't remember exactly the words that Nick Raynsford said, but it was something that went along the lines of, "Fantastic site, brilliant location, very interesting location within it, it's very interesting facing the river on the other side of the South and regeneration of blah, blah, blah, blah, blah," but the building isn't what we want. Can you have your architects to have some fun please and actually put some imagination into it (Interview Bond, 2011).

Many of my interviewees referred to the initial design proposal as the "box". This banal labelling became the preferred way to characterise the scheme from the first presentation. The scheme was not fundamentally different to many others of Foster+Partners' office schemes at the time. The initial scheme was located in the east finger of the masterplan (Figure 5.6). The GLA HQs was conceived to be placed within two distinct fully glazed volumes, a ten-floored glass drum, which was connected by bridges to a glass "box" of the same height. The glass "box" merges with the rest of the finger and contains generic office areas. The assembly chamber and committee rooms are located within the drum facing the Thames. The ground floor is kept empty; above hovers the double height assembly chamber and on top there are committee rooms. The round floor plates above the assembly chamber contain a void in the centre so as to allow views and daylight into the assembly from above.

Richard Hyams recalled Raynsford and his advisors saying: "well actually that's not particularly inspiring" (Interview Hyams, 2011). Raynsford and his advisors sent the team design team away and encouraged them to redesign their initial proposal. The "box" scheme could potentially have fulfilled the majority of requirements set out in the first design briefs, but after the presentation it became clear that Raynsford and his advisors were looking for a "landmark" and "symbol". The need for the building to have a "distinctive" character was made a dominant requirement that presented a necessary detour in the translation process for the environmental design agenda. Crucially, in this presentation, Raynsford foregrounded a perception of building form that pushed environmental performance into the background.

5.3.6 Initial reactions of the GOL team

On 1 October 1998, following the first presentation, TTPM produced a set of *Questions/Queries for Developers* (TTPM, 1998f) to check to what extent the presentation schemes complied with and translated the GOL's briefing. As confirmed by Shuttleworth and Bond, the initial "box" *s*cheme did not include any in-depth design strategies in response to the suggested BREEAM "very good" assessment (TTPM, 1998a) or the briefing update's CO_2 emissions target of 70kg/m^2/a (TTPM, 1998e). The London Bridge City team initially largely neglected to provide information required by the first three design briefs developed in August 1998. It was probably in the verbal part of the presentation and the subsequent question-and-answer session that the "green issues" (TTPM, 1998a) began to gain more recognition.

The above TTPM document asked specifically for the London Bridge City team to confirm their "intention in providing a passive environmental solution to the offices, rather than 4-pipe fancoils" and to explain their "thoughts regarding the application of the 'bigger' energy environmental systems you speak of" (TTPM, 1998f, p. 2). In addition, it emphasised the desire of Raynsford and his advisory group to associate two different design elements within the emerging scheme: that the design team should relocate the building from the rear of the site closer to the waterfront, and that it should improve "the shortfall of distinctive identity" (TTPM, 1998h, p. 5).

Developer Team & Site		**LONDON BRIDGE CITY**	
FACTOR	ISSUE	COMMENTS	MARKS
Design Criteria	▪ Compliance ▪ Innovation & improvements	▪ Generally comply with brief ▪ Good response	9
Environment	▪ Heating properties ▪ Passive A/C ▪ Acoustics ▪ Controlability	▪ Cat 'A' basis 4-pipe fancoils, but, chilled ceiling with displacement is preferred ▪ No great detail.	10
Electrical Services	▪ Flexibility of power ▪ Lighting solution ▪ Specialist systems concepts	▪ 350 lux lighting Cat2 LG3 ▪ Intelligent lighting control mentioned	10
IT Matters	▪ Future thinking and imagination ▪ Resilience / flexible ▪ ATM type methodology	▪ No detail ▪ Provision of infrastructure for systems	10
Green Issues	▪ Green identity ▪ BREEAM ▪ CO_2 targets ▪ Low energy ▪ Simple ▪ Reversible energy ▪ Sustainable materials	▪ Mechanical ventilation proposed to chamber ▪ Cool air reservoir : energy recycling – Excellent ▪ Really good concepts	20
Other points		▪ Last minute rush ▪ This team has the capability to delivery??	8
		TOTAL SCORE	**67**

Figure 5.9 Evaluation matrix following the first ministerial presentation (Chart: Turner & Townsend Project Management, 1998f, p. 3)

On behalf of the GOL, TTPM produced an evaluation matrix to assess the seven schemes through six distinct "factor[s]" (Figure 5.9). Under Raynsford's responsibility TTPM framed and displaced Raynsford's declared "environmentally progressive objectives" (Interview Raynsford, 2010) through two perspectives: one "Environment", and the other "Green Issues" (TTPM, 1998e, p. 3). This was relevant for the translation process as the GOL's and TTPM's evaluation approach led the CIT team to adjust and reorder their design strategies in order to win the competition process. The divergent interests of the GOL and CIT teams thereby became more aligned through particular accepted "movements and detours" (Callon, 1986, p. 206). CIT began to recognise the necessity of following TTPM's transforming design briefing that began to suggest specific preferred design pathways: to design for "reversible energy" systems (TTPM, 1998e, p. 3), "passive A/C [Air-

Conditioning]", "chilled ceiling" and "displacement" ventilation systems. The latter three are approaches associated with projected lower energy consumption.

The document sated that TTPM's assessment would evaluate "green issues" through three questions:

> Does the scheme have the 'Green Identity'? […] Have the team adopted the 'Green' concept fully? […] Will this appreciation be fully developed? (TTPM, 1998f, p. 8)

These questions lack definitional clarity, but they indicate that a "green issues" agenda became more forceful in selection and thereby design criteria. Jon Spring's and Gordon Rautenbach's roles were to produce the TTPM documents on behalf of the GOL. I asked them to define "green identity", one aspect of "green issues". Rautenbach replied:

> The term was meant to imply an "image" in terms of perception rather than physical appearance […] - green credentials that can be benchmarked against other sustainable buildings. […] For some it means cladding in timber to be instantly recognisable. […] Portcullis House [MP's offices in Westminster] also comes to mind as a building that also has the credentials and to some extent the appearance of a "green identity" with its large natural ventilation flues being obviously visible. […] For the layman, I suspect it has to look like a log cabin to truly meet the definition of "green identity" but to designers, it is the performance capability that is most important – the dream is for the users to also buy into the concept (Interview Rautenbach, 2010).

Spring added:

> I think that the other aspect of green identity that we were looking for on behalf of the GLA was setting an example. […] We certainly had an eye upon total operational impact, energy and environmental impact (electrical, heating and cooling) being one key aspect (Email Spring, 2011).

Their attempt to explain the issue of "green identity" remained sketchy. The concept of identity has been widely debated in psychology and sociology. Yaneva rejects the claim that a building can possess "essence" or "stable form", since that would exclude the possibility that a building can be interpreted in alternative ways (Yaneva, 2012, p. 20).

Since the then-emerging GLA headquarters could not itself decide its own identity, the question of its identity is ephemeral, changing with time, and rather difficult to define. It may be ambiguously coproduced in the ways individuals perceive the building and how actors (e.g. architects, journalists) ascribe particular characteristics to the building through media channels. Rautenbach made clear that the issue itself depends on heterogeneous actors and elements. For him, it oscillated between questions of perception of building form and materiality, and particular framings of performance criteria. He also emphasised that different individuals would attribute different meanings to a building, which hinted that buildings would rather have multiple identities at once. Spring's explanation of making the building "an example" evokes many questions: An example for whom? An example of what?

Crucially, the introduction of the issue of "green identity" in a vague way signalled that the emerging headquarters was not only to be perceived as a "landmark", but also as "green". These two desires became intrinsically linked and the challenge to enact this request was delivered to the developer teams.

The seven contenders in the first ministerial presentation in mid-September 1998 were considered by Raynsford's team in order to compose a shortlist of proposals. All teams faced potential elimination from the contest. All five members of the architectural advisory group met Raynsford on 9th October to draw up a shortlist of schemes, on the basis of some additionally submitted material, before moving on to the next competition stage. They appraised the schemes through a specific set of key criteria: "location, prominence, accessibility [,…] external design [...], building design, surrounding civic space, and the potential to regenerate the surrounding area" (TTPM, 1998h, p. 7). These criteria can be seen as further modification and expansion of the initial design briefing since new elements were added. Despite serious criticism of the "box" scheme, Raynsford and his advisors decided on the basis of the first presentation, as well as additional technical and financial submissions, that "London Bridge City and Victoria House should be shortlisted" (TTPM, 1998h, p. 7). The group's comments on the CIT, Foster+Partners and Arup proposal are summarised as:

> An excellent site and proposal, but the identity of the GLA building should not be allowed to suffer from the very dense office buildings planned for the overall development. Further work would be necessary to ensure this (TTPM, 1998h, p. 7).

CIT's competitor was the Victoria House proposal at Bloomsbury Square, a refurbishment of an existing building initially completed in 1926, put forward by Blackfriars Investment Ltd and the architects Alsop & Stormer. After shortlisting the two projects, the two remaining developer teams had only four weeks to transform their proposals into a scheme that could win in the final presentation on 4th November 1998.

5.4 Adapting to comments and re-strategising for the Second Presentation Scheme

5.4.1 Accumulating and producing design knowledge, adding associations

Following the first ministerial presentation the design development intensified and TTPM's "green issues" became increasingly assimilated, interpreted and translated into design strategies. Liam Bond explained that the environmental challenge

> emerged and developed significantly as their [GOL] procurement process went on. […] It wasn't as high on their agenda when we first were involved in it and […] the development of some of the environmental themes came subsequently (Interview Bond, 2011).

There were conflicting interpretations within the CIT team regarding the point at which the GOL's environmental agenda gained significance. The first design brief already translated the challenge into a BREEAM assessment rating of "very good" and into the vague request that "'Green' issues should be given proper consideration" (TTPM, 1998a). The agenda had thus been introduced at the outset of the competition, in at least a narrow translation of sustainability (see Chapter 4). While Bond argued that this agenda gained significance only within the competition, Shuttleworth declared in contrast that CIT was initially not willing to take the GOL's agenda seriously:

> It wasn't til they [CIT] realised in fact that […] there's a potential here to kick-start the whole development, they became all interested then […]. And when it became

into a competition and we were in the last two [the shortlist] it became even more evident (Interview Shuttleworth, 2010).

Raynsford and his team had reworked the initial design briefing through the introduction of, for instance, additional benchmark criteria and a recommendation to integrate a "passive" air-conditioning system (TTPM, 1998e). The briefing gained more definitional strength. At the same time CIT gained interest in winning the competition. They adjusted their position, recognised that the "alliance" (Callon, 1986, p. 206) with the GOL could be beneficial, and agreed to make more concessions as necessary detours to achieve a consensus with the GOL and keep the alliance together. In consequence CIT agreed and encouraged Foster+Partners and Arup to assimilate the GOL's design requirements more seriously. With the support of CIT a fundamental rethinking took place at Foster+Partners and Arup, which made the "box" scheme obsolete. The scheme was substantially redesigned and the architects at Foster+Partners started to "play". One significant design move suggested by Raynsford and his advisors was to give the GLA scheme a more distinct appearance compared to the masterplan fingers by creating a detached building and moving it towards the Thames.

In order to proceed in the design process and to translate and materialise the GOL's design briefing, the CIT team depended on the simultaneous production of new design knowledge and the additional association of heterogeneous entities (Callon, 1986, p. 203). In order to overcome the "box" scheme, new design ideas and knowledge was needed. The twinned agendas of creating a landmark building and achieving environmental goals gained increasing significance and began to shape each other. The GOL had defined "green issues" predominantly through the BREEAM "very good" assessment (TTPM, 1998a) and the briefing update's CO_2 emissions target of 70kg/m^2/a (TTPM, 1998e). In response, Arup's project manager with responsibility for engineering explained that they, together with Foster+Partners, interpreted and transformed the design briefing into the challenge of designing "a very low energy building […]. Energy consumption was our main goal on it" (Interview Thonger, 2011). As such, Arup and Foster+Partners translated the target CO_2 emissions into the design strategy to establish "a sound basis for low energy design" (Shuttleworth, Hyams, & Hall, 2003, p. 303). Two specific key "devices" (Callon, 1986, p.

206ff) were chosen to align the activities of individual teams and to transform the issue of low energy design into particular design strategies.

5.4.1.1 Device one: Energy Consumption Guide 19

In order to address and develop an understanding of which elements affect building-related energy use, Foster+Partners and Arup chose to import additional design knowledge via the Energy Consumption Guide 19: *Energy Use in Offices*. Abbreviated *ECON 19* by my interviewees, it was produced by the government's Energy Efficiency Best Practice Programme (DETR, 1998a) as design guidance for building-related energy efficiency. ECON 19 was chosen by Foster+Partners and Arup as a crucial reference that later underpinned many arguments, although the anticipated GLA headquarters did not comfortably fit into ECON 19's generalised building typologies of the office building.

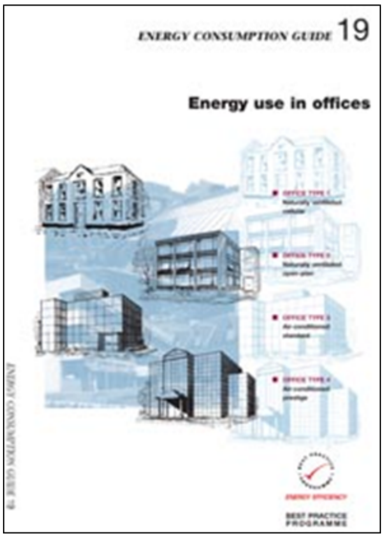

Figure 5.10 Cover of the Energy Consumption Guide 19 (ECON 19): *Energy Use in Offices* (Department of the Environment Transport and the Regions, 1998a)

The guidelines devise and proposes benchmark values for "typical" and "good practice" energy use patterns and related carbon emissions for four differently framed types of office buildings. Against these values, Foster+Partners and Arup later began to compare the projected consumption patterns of the future City Hall. Thonger explained:

> What we were actually looking at was a thing called ECON 19. […] It was a recommendation […] it was part historic, so you kind of see [how] buildings were

typically operated. […] That was our benchmark, if you like, for what we should be aiming for […] It's a reasonably good sort of starting point (Interview Thonger, 2011)

In the further design practices of the GLA headquarters, ECON 19 was deployed by Foster+Partners and Arup as the tool against which to benchmark City Hall's predicted energy performance. ECON 19 suggests breakdowns of distinct energy end uses. One of the key claims is that an "Office Type 4 air-conditioned prestige"- the benchmark reference chosen for the development of City Hall - would consume most energy for heating, followed by cooling, ventilation, lighting and others (DETR, 1998a). ECON 19 constructed a specific hierarchy of the major building services associated with energy consumption and CO_2 emissions (Figure 5.11).[41] This hierarchy informed and supported the choice of design strategies. ECON 19 provided a particular representation of how energy consumption might be constituted, highlighting specific heterogeneous elements and assumptions, while excluding others.

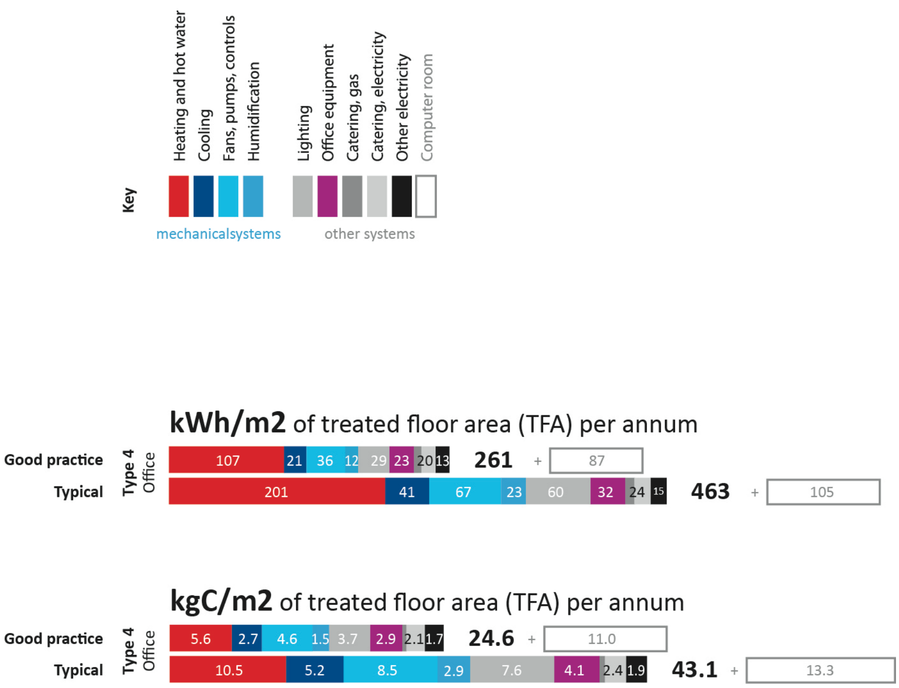

Figure 5.11 ECON 19 diagram comparing "Good practice" and "Typical" Type 4 Offices projected energy use and carbon emissions (Diagram: Author 2012, based on DETR, 1998a, p. 10)

[41] The GLA headquarters design brief (and later building) did not contain a large computer room. Related energy consumption and carbon emissions are therefore separated from the total benchmark values.

The GOL had defined the emissions target of $70kgCO_2/m^2/a$. CO_2 converted into C (Carbon), the unit used in ECON 19, the emissions target corresponded to approximately $19.1kgC/m^2/a$.[42] While the GOL claimed that the target was "challenging" (TTPM, 1998e), it was at least significantly lower in comparison to ECON 19's "good practice" reference of $24.6kgC/m^2/a$.[43] This GOL target thus posed a design challenge that required serious effort by the CIT, Foster+Partners and Arup team to comply with it.

ECON 19 was studied in the architectural 'laboratories' as new design information. David Kong, architect at Foster+Partners, recalled:

> I don't remember it [ECON 19] as a big, thick document […] we actually read cover to cover. […] It was really taking the salient points about what constitutes the definition of a best practice, and minimum energy consuming offices, […] then we took that (Interview Kong, 2010).

ECON 19 emphasises the role of "design which maximises the use of form and fabric to control the internal environment" in designing a low energy building (DETR, 1998a, p. 6). As Kong suggested above, Foster+Partners "took" that advice and translated it into their key design strategy for the GLA scheme. ECON 19 was conjointly chosen and deployed as a key device by Foster+Partners and Arup to guide, align and coordinate their versatile translation activities of design-briefing-to-design-materialisation. It became a reoccurring reference in the later design (and operation) processes.

5.4.1.2 Device two: the diagram of the 'Triangular Approach'

The second device to inform and align the CIT team in developing design strategies in response to the GOL briefing was a diagram entitled "What makes a building green" (Figure 5.12), jointly produced by Foster+Partners and Arup. It was also referred to as the "Triangular Approach" (Interview Thonger, 2011). In the development of the environmental strategy for City Hall, Foster+Partners and Arup shared the belief in a hierarchical approach in which it is most important to address "building form and orientation" first, then "passive elements", and last "active systems" in relation to building

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[42] Based on: "To convert from kg CO_2 to kg C, multiply by 12/44" (Carbon Trust, 2008, p. 2).

[43] The GOL does not specify which area (m^2) to refer to, while ECON 19 refers to treated floor area (m^2).

costs. Passive elements are here defined through “deep space natural ventilation” and “responsive shading”. Active elements include “photovoltaics” and “heat recovery systems” (F+P,1999a, p. 24). The diagram in part presents a visualised extension of ECON 19’s recommendation to maximise “use of form” into a hierarchy of different design pathways.

In Figure 5.12 environmental strategies and building costs are represented in the juxtaposition of two triangles facing different directions, one pointing to the top, the other to the bottom. This approach marks the renunciation of approaches that rely heavily on active mechanical building service systems (e.g. air conditioning systems with air cooled chillers) in order to control the interior climate. At the outset of the design process, building form and construction are given a pivotal strategic role.

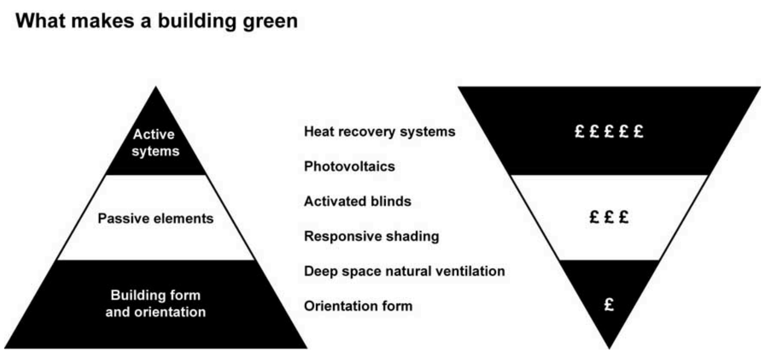

Figure 5.12 The “Triangular Approach” entitled “What makes a building green”, relating strategies of active systems (top left), passive elements (middle left) and building form (bottom left) to potential costs (Diagram: Author 2011, redrawn from Foster+Partners, 1999a, p. 24)

This diagram was produced interactively between Foster+Partners and Arup and was an important device to communicate, work together, and to organise the design development (cf. Henderson, 1999, p. 6). This approach formed a sort of compass for the design team to navigate through the vast possibilities of how to design a low energy building. Consequently, explorations of building form and orientation were central from the beginning of the design development and from the outset of developing the environmental strategy. The goal was to establish “a sound basis for low energy design” (Shuttleworth et al., 2003, p. 303)

My interviewees without exception confirmed this approach, though there was some confusion over where and how it had emerged. Since the building form played a crucial role within the GLA's building design, this strategy also became a crucial tool to justify the design team's chosen design moves.

Thonger (Arup) stated that the "Triangular Approach" as a form of design knowledge is widely accepted:[44]

> Who owns it originally, I have no idea […]. It's a very crude way of just saying that […] you get your massive benefits by just making sure your building is properly situated […]. If you don't get the basics right then […] all of these passive elements are never going to really work particularly well (Interview Thonger, 2011).

He confirmed it as a "key diagram" in the design practices of City Hall. Thonger stated that the "Triangular Approach" was "pretty directly translated into City Hall" (Interview Thonger, 2009).

The CIT team transformed the GOL's design briefing of "green concerns" (predominantly defined through BREEAM and the CO_2 target) into a "low energy" design approach. Foster+Partners and Arup each had distinct expertise, and CIT had assigned distinct responsibilities to them. Both thus began to transform the "low energy" approach into design strategies. In their design studio and offices these transformations were built on specific working operations and assumptions, and the invoking of selected heterogeneous elements.

5.4.2 Extending assumptions into building form

Although interviewees mentioned that Norman Foster was not deeply involved in the design development, he did comment on the form and orientation of the design development:

> The jury, however, wanted a stand-alone building with a more symbolic form. Given this clear direction, the design team, led by partner Ken Shuttleworth, progressed to the first version of a unified scheme. Initially, this took the form of a spherical building raised above the ground. As the design and environmental

[44] The architect and teacher Inaki Abalos also assigns credit for a later version of this diagram jointly to Foster+Partners and Arup and highlights its relevance for design practices (in *Harvard Design Magazine*, 2009, p. 15).

> studies progressed, however, this assumed a more fluid, dynamic shape (Foster in Detail, 2002, p. 1090).

And Shuttleworth, as the partner endowed with the responsibility of designing City Hall, later commented:

> The City Hall project was a unique opportunity. It had to express the values of the newly formed Greater London Assembly and be a symbol for change for London. The real architect behind the scheme was Nick Raynsford, the minister responsible for the project. It was his briefing and his desire to create a landmark building that inspired us to produce a structure unlike any other (Shuttleworth in Detail, 2002, p. 1091).

Both attribute much significance to Raynsford's powerful role in co-shaping the design direction and to his interest in building "form". Although Raynsford had a powerful role as key translator, he could only execute this by working with a complex and contested assemblage of heterogeneous elements. In response to Raynsford, Foster+Partners and Arup then aligned and merged their different interests on building form, thus informing the design trajectory that overcame the "box" scheme. One interest concerned the perception of form and attempted to evoke a symbolic interpretation of it; the other was about maximising the use of building form in order to aim for a low energy design. The first interest seemed partially suppressed in the accounts of my interviewees; the story to emerge later formed the backbone of the key narrative of the design strategy, and was used to explain and justify the unique (as then unseen) building form that was materialising.

Raynsford and his team introduced a broad set of terms that addressed questions of building form and its experience. Initially, the first design brief required that externally "the building should be prominent and distinctive and be a design for the future" (TTPM, 1998a, p. 1). After the first ministerial presentation, TTPM resumed work on the "box" scheme, having a "shortfall of distinctive identity" (TTPM, 1998h, p. 5). Later, during the meetings of the initial briefing process, the TTPM team fed more information into the process and advised the design teams that they wanted a "landmark building" (TTPM, 1998h, p. 5). Raynsford wanted the GLA building to be a "symbol of a new London"

(Interview Raynsford, 2010). Gordon Rautenbach recalled they wanted "something iconic and instantly recognisable" (Interview Rautenbach, 2010).

Significantly, Raysnford's team did not criticise the CIT team's "box" scheme for a shortfall in "green identity" based on the vague assessment category that TTPM had introduced into the selection process (TTPM, 1998f, p. 3). Their concern was focused more around the issue to generate a landmark project. Raynsford and his advisors pushed Foster+Partners to accept "movements and detours" (Callon, 1986, p. 206) in their development of "building form and orientation" in order to keep the alliance together and make it succeed in their quest to bring City Hall into being.

The Foster+Partners team, in consultation with Arup, took the lead in developing three key strategies to develop building form and orientation as the foundation of their "low energy" design approach. These individual perspectives attempted to approximate the actual complex entanglements of building form in the design studio through specific projected relationships and thereby mobilised specific entities.

5.4.2.1 The strategy to create a compact form

Ken Shuttleworth's idea to create a compact building form appeared to be strikingly simple: "A sphere has 25% less surface area then a cube of the same volume" (Figure 5.13). In the continuing translation process this simple idea later posed a huge challenge in geometrical definition and architectural materialisation:

> When it became more of a competition we then went through a whole process saying well, why don't we just make it fantastic; […] we might as well win it! […] Starting off with the box, […] the box actually doesn't really give you the optimum amount of wall to floor area; if you've got a sphere you've got less wall for the same amount of floor area so you actually get a spherical building, which gives you the tightest possible wall-to-floor ratio. So we were saying at this point, […] you got less wall to handle heating and cooling (Interview Shuttleworth, 2010).

Surprisingly, Shuttleworth speaks of floor area while Foster+Partners' design documents refer to surface area to volume - they are not the same, but related arguments. ECON 19 identified heating and cooling as the two largest sources of office-related energy consumption. In consequence, the surface-to-volume argument suggested that a reduced amount of building envelope surface would lose less heat in winter (and less cold in summer) and thus have lower energy consumption. This ontological view generated in the design studio associated selected heterogeneous elements: building form, envelope surface, losses of heat and cold. Other constitutive elements of *actual* energy consumption and operation were at this point disregarded (e.g. the build-up of the facade envelope and its heat conductivity).

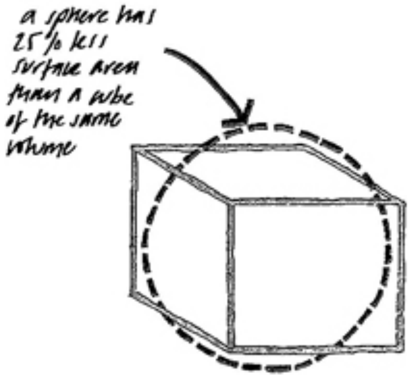

Figure 5.13 Diagram in the *Planning Application Design Statement* (Diagram: Foster+Partners, 1999a, p. 23)

The surface area-to-volume ratio assumption and knowledge claim seems simple and robust. Brought forward by Foster+Partners, it extended the ECON 19 claim about the important role of building form. Many arguments during the design process are highly dependent on their specific understanding, framing and interpretation. Decontextualised and drawn from geometry, the surface area-to-volume ratio argument seemed simple and convincing. I challenged the claim and calculated the ratio between these two elementary solid figures myself to find that the sphere had not 25% less surface than a cube of the same volume Instead my calculations inferred that it has approximately only 19.4% less surface area (see calculation in Appendices). Perhaps Shuttleworth and his team confused some assumptions. More importantly, there are two ways of understanding clashing here: the ideal conception of a Euclidian geometry and the messy architectural design practice. To translate or to move from the ideal conception to the heterogeneous practice is a troubled path, and the argumentation during the translation process loses its momentum. Decisively, Foster+Partners attributed a critical role to the compacting approach that they developed and predominantly justified by arguing for the reduction losses of heat and cold through the perimeter surface.

The spherical building strategy was not new in the Foster's design studio, but was informed by previous design experience and knowledge. Richard Hyams mentioned that at Foster+Partners "there was a big debate about Buckminster Fuller's domes and geometric forms".[45] Norman Foster had used Fuller "quite a lot to follow as a reference through the scheme" (Interview Hyams, 2011). Shuttleworth also referred to "Bucky" who had done a lot of work on buildings' surface-to-volume ratio (Interview Shuttleworth, 2010). Between 1971 and 1983 Norman Foster and his practice collaborated with Buckminster Fuller on a number of projects: For instance in the *Climatroffice* in 1971 (Figure 5.14).

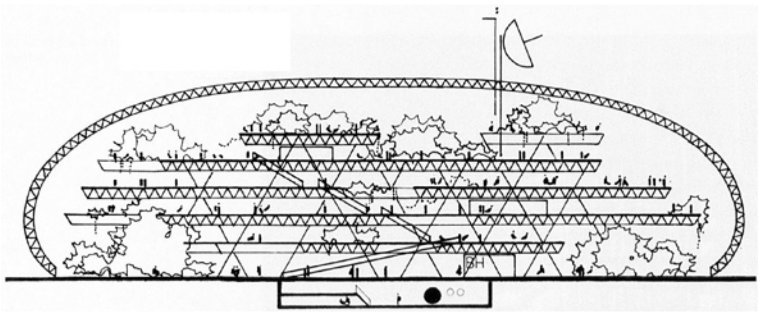

Figure 5.14 The *Climatroffice* project (1971) by Foster Associates and Buckminster Fuller (Drawing: Foster & Jenkins, 2001, p. 29)

With reference to Buckminster Fuller, Shuttleworth and his team redesigned the "box" scheme and introduced the strategy of compacting. While the "box" scheme represented an ordinary way of doing things, the approaches towards building form that followed were innovative. Foster+Partners tested new CAD tools at the design studio that informed and crucially enabled the construction of complex architectural forms that were largely unprecedented in 1998. While Fuller's explorations to minimise the building's enclosure surface kept informing the design for the GLA building, Foster+Partners attempted to

[45] For a standard account of Richard Buckminster Fuller see Krausse and Lichtenstein (1999): Fuller lived from 1895 to 1983. Trained as an engineer, his worked addressed architecture, design, engineering and research, and he could be described as one of the early pioneers attempting to innovate architectural practices in relation to effective use of materials. One of Fuller's key statements is: "Doing the most with the least" (Fuller in Krausse & Lichtenstein, 1999, pp. 92-93).

introduce two seminal changes. Fuller's domes were based on basic regular geometries in order to allow for easy calculability, fabrication and assembly by minimising the number of different structural elements. Fuller's domes adapted to environmental influences, for instance sunshine through moveable surface elements (overlay or rotation of sun protection), but not through a modulation of form itself in interdependence to orientation.

In comparison to the first presentation scheme, the Foster+Partners team seemed to have redefined their roles and ambitions. Hyams recalled a fundamentally changing interest in which Buckminster Fuller's ideas were influential:

> A building like this has got to demonstrate, it's got to be a demonstration project […]. It had to deliver on a level that a building of this type had not delivered on before. That was the challenge. How you then define that into contractual terms was then a debate over the next few months. […] The starting point was it's got to be the best building of its type. […] But the environmental agenda was really key and that's why the whole dome […] studies that Norman had done with Bucky were quite key to his agenda on energy (Interview Hyams, 2011).

5.4.2.2 The strategy to create a tilting form

The GOL's design briefing allowed for the interior temperature range of the future GLA building to vary between 22°C ± 3°C (TTPM, 1998b). The second distinct environmental issue that Foster+Partners recognised and addressed through the use of building form was the attempt to reduce direct solar gains. Limiting direct solar radiation into the building through the glass facade was in turn expected to reduce the required cooling loads and related energy consumption.

In consultation with Arup the Foster+Partners team decided to modify the spherical building form by stretching and tilting it along the north–south axis. This move indicated an innovative redesign of Fuller's regular dome structures. The geometrical perfect sphere was discarded. The strikingly simple claim that "a sphere has 25% [in fact 19.4%] less surface area than a cube of the same volume" thereby increasingly lost its explanatory power, since the emerging building form became less compact.

Ken Shuttleworth attempted to explain the building form and orientation experiments retrospectively:

> I think that the sphere […], because we're [51] degrees north, basically you […] should make use of a sort of sausage shape; an oval shape, to get the minimum […] amount of surface area angled towards the sun. So that was why we angled it back at the angle of the sun to actually basically reduce the amount of solar gain. And also to get more daylight onto the river, […] so onto the riverside walk. And also to allow the building to be self-shaded on the south side. So environmentally, […] when it was built it was one of the most environmentally friendly buildings – probably still is actually – in London (Interview Shuttleworth, 2010).

The design team was required to collect and adapt particular knowledge about solar irradiance. City Hall's geographical position is at a latitude of 51°30′N, and longitude of 0°08′W. The solar radiation associated with this strategy was *direct radiation* (unobstructed), while *diffuse radiation* (reflected) became ignored. The projected angles in which direct solar radiation hits a horizontal plane vary depending on the time of year and time of day – between as high as 61.9°C (noon, summer solstice in June) and as low as 15.1°C (noon, winter solstice in December).

The design team's first objective of creating a compact building form seemed to be at least partially in conflict with the second, which was to create a tilted building form. These two objectives addressed two distinct environmental issues: reducing heat (cold) losses and reducing solar gains. Although creating a compact spherical building form seems to be a promising strategy to address the first issue of reducing heat losses, it is partially problematic for the second issue of reducing solar gains as spherical building surface zones that are hit by sun beams almost in perpendicular angles gain disproportionately high solar irradiance. These two hypothetical strategies did not fully contradict each other, but were at least partially in conflict with each other, a conflict not thematised by Foster+Partners.

5.4.2.3 The strategy to create a stepping form

A third strategy that Foster+Partners introduced to "get the basics right" was to introduce steps in the building form in areas of high solar irradiance. Like the second strategy to create a tilting form, the aim was to reduce direct solar gains. Steeping form also further weakened the argument to produce a compact building form. Foster+Partners proposed to cantilever individual floors, so that overlapping floor plates would cast partial shadow on the facades of the floor beneath it (Figure 5.16). The architects' stepping strategy was based on the assumption and desire to equip floors with a floor to ceiling perimeter glass facade (see Chapter 6). This seemed to be their preferred default option, evident in early renderings and physical models. Later, when the building form was largely stabilised, the CIT team dropped full height glazing and introduced opaque facade elements on the bottom and very top of the facade. As a result, the stepping strategy later became partly redundant in the contingent design practices, since shadows were mostly cast on opaque facade zones. Shuttleworth and his team started to extend the above hypotheses and strategies into a cohort of building forms.

Shuttleworth and his team continued experimenting and sketching alternatives. Figure 5.15 displays some of Shuttleworth's ideas for intermediary schemes. In response to the evolutionary design briefing process, these sketches demonstrate the drive to experiment with building form as a vehicle to evoke interpretations of a more "distinctive identity" (TTPM, 1998h, p. 5) and of Raysnford's "desire to create a landmark building" (Shuttleworth in Detail, 2002, p. 1091).

Sketches like this presented important "tools of investigation" for the architects (Yaneva, 2009, p. 120) in which particular spherical schemes became tested and discussed between them. These hypotheses constructed in the design studio needed to be strengthened through computer simulations and were later put on trial in actual operation. The strategies of the compact, tilted and stepped building form convinced the wider design team and thus became in principle stabilised within the continued translation processes.

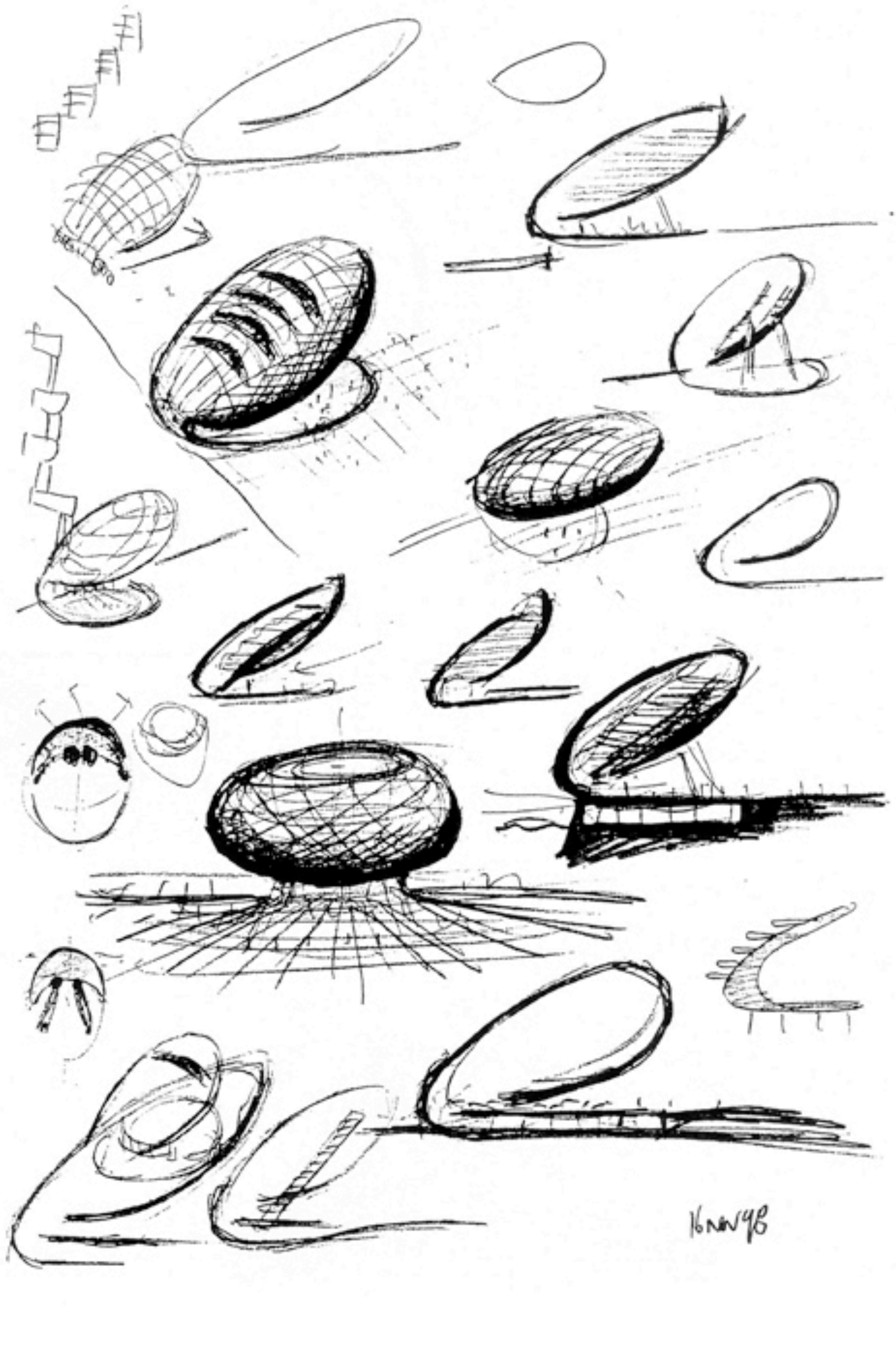

Figure 5.15 Sketches by Ken Shuttleworth in 1998 following the "box" scheme (Drawing: Foster+Partners, 2004)

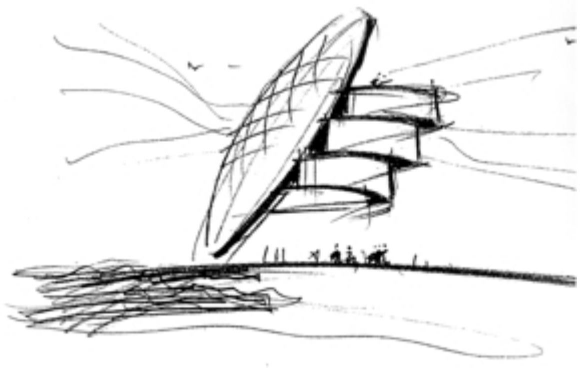

Figure 5.16 Development sketch in 1998 (Drawing: Foster+Partners, 2004)

My Foster+Partners interviewees and their design documents explained and defended the emerging building form largely through simple cause-effect arguments: particular hypotheses on how to limit heat losses and how to limit solar gains through the use of building form were developed. It seemed that many other associations, such as the question of perception, involved in the making and finding of form were largely muted or were inadequately communicated. The architect, David Kong, explained:

> Iconic for us isn't about doing an organic shape, we wanted the form of the building to reflect some kind of an environmental influence […]. It's that shape [...] for an environmental reason, it's not that shape because we wanted, we felt that it looked nice, so we kind of married the two together (Interview Kong, 2010).

Norman Foster assigned much influence to Raynsford who gave the "clear direction" to develop a "more symbolic form" (Foster in Detail, 2002, p. 1090). Yet, surprisingly, when I spoke to the team members of Foster+Partners they indicated that it was only next to the functional hypotheses (e.g. compacting to reduce heat loss) that the many design moves of form finding were also driven by aesthetic and perceptual questions.

Kong's metaphor of *marriage* is a rare acknowledgement from an architect recognising other influences in the form-finding process beyond the mere functional argument. The strategies to maximise the use building form were at once translations of the CIT team's approach to low energy design, as well as attempts to adapt to Raysnford's request for a landmark building. This became a necessary detour in the design process in order to enable continued participation within the competitive selection process.

5.4.3 Extending assumptions into cooling systems

In the following section I explain the development of strategies that mainly fell to Arup's responsibility and expertise. These strategies were not controversially discussed by my interviewees, hence I explain them only briefly here.

The building services engineers at Arup also worked with building forms, but approached and understood them in different ways to the architects at Foster+Partners. In mutual exchange, Arup incorporated emerging building forms into their testing, calculations and modelling, and thus commented, checked and gave feedback on individual building form proposals. Consensus on design issues was not always possible between the two parties. Thonger, Arup's engineering project manager with responsibility for the GLA headquarters project, commented on Foster+Partners' intensively propagated strategy of the surface-to-volume ratio: "Oh yes, I never subscribed to that" (Interview Thonger, 2011). He explained: "Building form and orientation are significant […], rather than critical, […] in the design process. It is the facade treatment that is arguably more significant" (Email Thonger, 2012).

The two teams had conflicting priorities when translating the low energy approach into strategies. Thonger assigned an important role to the use of "building form and orientation", though less important when compared with Foster+Partners' interpretation. He gave the most significant role to the design of the facade according to orientation. The facade design emerged as a topic early on but became intensively debated and developed only after the building form was largely stabilised (see Chapter 6). Arup's role and responsibility within the design team was to comment on and thus co-shape emerging building forms, while their main responsibility was to design and develop the building services design, to which CIT and Foster+Partners provided comments and feedback. This was a form of mutual exchange in which advice was sometimes ignored.

Thonger explained how Arup approached the design of the GLA headquarters and how they chose the design trajectories of building services to extend and materialise the initial design briefing. TTPM's design briefing provided crucial design information to develop particular building services system strategies, for instance the projected 11,609m^2 floor area, 400 GLA staff (TTPM, 1998c), occupancy hours, permitted interior temperature differences of 22^{o}C ± 3^{o}C, relative air humidity (50% ± 10%), and projected ventilation air exchange rates (TTPM, 1998b). Further consultation with TTPM and the continuously developing design briefing provided design directions. Arup's design knowledge was grounded in their practice, in their previous experiences, and in the technical and organisational possibilities constructed around the GLA headquarters project. Thonger explained how Arup evaluated and chose potential building services strategies for the GLA project:

> Some of […] these things are done, […] probably with a gut feel, to say you know, what are the advantages, disadvantages, what you can see (Interview Thonger, 2011).

He explained that at an early stage, when the building form and other parameters were still fluctuating, choices were based on "a few kind of fairly crude calculations". Only later, when design elements would be more stabilised, Arup would go

> through annual energy analysis, so we would have worked out what the solar gains were. We then put the whole thing through […] a process. […] So we have a fully automated system to go through. But […] we only run those when you've got a fairly good idea about what the performance is or what the building is going [to] end up being, so up to this point […] it's kind of guesswork and knowledge and […] just previous experience to get to a point where you can say, this is good enough for us to do the full analysis and as it happened on this building there was no need to do a re-analysis because […] it was meeting all the requirements […] it takes a long time to model these things we try and limit it. Reasonable experience to get to a certain point and then press the button to analyse it.

Thonger's team had translated the GOL's design briefing together with CIT and Foster+Partners into the challenge of designing "a very low energy building" (Interview Thonger, 2011). He pointed out that the GLA headquarters project was exceptional, since the GOL briefing, on behalf of the long-term occupier GLA, defined non-standard environmental design goals:

> In those times […] there was a lot of debate about low energy buildings. […] We very rarely get to design owner-occupier buildings, mostly they're for developers and then they're sold on, […] so the debate about low energy kind of doesn't get that far because you are designing to […] a very standard brief.

But in the development of the building services strategies (heating, cooling, ventilation) Thonger did not make much reference to the design briefing of the GOL and TTPM. He did not mention TTPM's design briefing update on the CO_2 emissions target of 70kg/m^2/a (TTPM, 1998e) as relevant to the translation process. Still, the CIT team's low energy approach was targeted to reduce CO_2 emissions.

Thonger also explained that BREEAM, which was chosen by the GOL as an "important cornerstone for setting environmental standards" (TTPM, 1998e), did not play a decisive role in informing the building services design strategies. He acknowledged that the BREEAM assessment was recognised: "Yes, it was […] but […] we don't tend to have to do a lot of extra stuff for BREEAM, even in those days, we were just following kind of what was required" (Interview Thonger, 2011). Hence the BREEAM device chosen by TTPM did not exert much influence over the CIT team's trajectory of design strategies.

5.4.3.1 The strategy to design a low energy cooling system

In contrast to Foster+Partners, Arup's initial priority to further translate the low energy design challenge into design strategies was not to maximise the use of building form. Arup concentrated on the development of building services and their design strategy was based on the following hypothesis:

> We know enough as engineers to know that if you wanted to go for a really, a proper, low energy design that you have to start off assuming that you've got a low energy cooling system. […] Otherwise if you have a high energy cooling system you'll never be low energy (Interview Thonger, 2011).

Arup's low energy cooling strategy was built on three elements: chilled beams, a borehole cooling system, and a "natural ventilation" system. Following the first presentation to Raynsford, TTPM asked the London Bridge City team to confirm their "intention in providing a passive environmental solution to the offices, rather than 4-pipe fancoils" and noted that a "chilled ceiling with displacement [ventilation] is preferred" (TTPM, 1998f, pp. 2-3). It is not clear whether Arup adapted to TTPM's demand or if they themselves chose that design direction. Thonger claimed that to design a low energy cooling system "you've got to start off with saying that the cooling systems have to be either chill beams […] or chilled ceilings.[46]

Thonger and his team proposed to use a borehole cooling system. This proposed system was (and is) quite rare - in central London there are only about 30 buildings equipped with this system (Interview Kraus, 2012). Although the system makes it unnecessary to use electricity intensive chillers, it still requires electricity for pumps and diverse control elements. Boreholes were projected to provide water from the aquifer in 120m depth at 12°C-13°C as cooling source. Thonger argued the choice of the borehole cooling strategy through its projected use of only “about one third of the power of a conventional chiller”. He framed the energy efficiency of cooling approaches through the coefficient of performance (COP) to suggest that the borehole cooling system would have a COP between 12 and 15, compared with an air-cooled chiller with a COP of 4.5.[47]

CIT’s construction cost consultant, Davis Langdon, estimated that the borehole system would be 20% more expensive than typical air conditioning systems, which were accepted by CIT. Thonger explained that they considered it “a risky strategy in a way” (Interview Thonger, 2011). They claimed that they knew enough about the expected depth of the water and its temperature, but what they didn’t know was “how much water you can actually expect to get out of the aquifer”. Financially they decided that they would drill a maximum of three boreholes. In actual operation the borehole approach could have failed. It was only months later, after the first borehole was drilled, that this strategy proved to follow predictions and could be stabilised since projected water flow rates were confirmed.

The third element associated with the low energy cooling and ventilation strategy was a “natural ventilation” system:

> When we were talking about the fresh air, natural ventilation supply, we started to do some calculations, which was about trying to work out what the buoyancy of the air was, and how much the wind blew and whether we had a problem in terms

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[46] In contrast to 4-pipe fan coil units, chilled beams do not depend on any motors. Space cooling (heating) is achieved through air convection and buoyancy. Chilled beams have a comparatively low volume flow-through rate of cooled (warmed) water and are projected to consume less energy than fan coils.

[47] COP is the ratio of cooling provided to electrical energy input.- the higher the ratio the more efficient it is.

> of venting the stuff out. So that was done, a few kind of fairly crude calculations (Interview Thonger, 2011).

The compact building forms then in development under the lead of Foster+Partners were not ideal for natural ventilation since the building depth was relatively big. TTPM emphasised in their design briefing *Questions / Queries for Developers* (1998f, pp. 2-3) that developers adopt a passive air-conditioning system. Arup adapted to this request and translated it into the three specific strategies of chilled beams, a borehole cooling system, and a "natural ventilation" system that were and still are rather exceptional in office developments.

5.4.4 Assembling the second Ministerial Presentation Scheme

The scheme envisioned in Figure 5.17 emerged in the mutual exchange of ideas and strategies between Foster+Partners and Arup. The team began to translate the design brief requirements for the chamber and offices (TTPM, 1998a) into spatial arrangements. The geometrically perfect sphere was transformed into a unique building form: a northern lens-shaped part, and a southern part consisting of circular floor plates positioned non-concentrically in relation to each other.

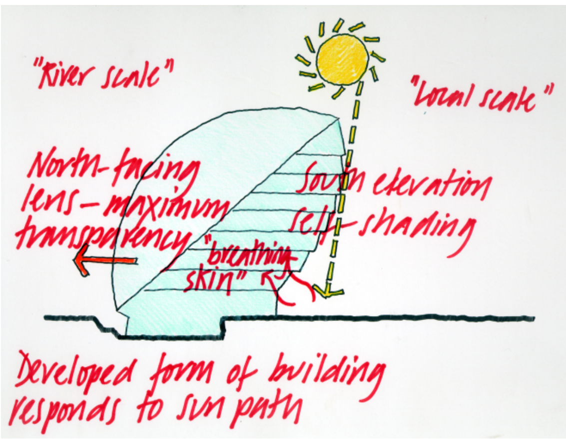

Figure 5.17 Environmental concept sketch in 1998 (Drawing: Foster+Partners, 2004)

The building plans suggested to follow the north-south axis. The assembly chamber was designed to be orientated towards the north, facing the Thames and the City of London. The tilting building form was projected to enable indirect daylight to enter the northern side of the building and allowed for wider views towards the City of London. The offices were oriented to the south and therefore more subjected to solar gains. Foster+Partners claimed that the developed "form of building responds to sun path […] south elevation self-shading" (Figure 5.17). In the next chapter I explain that Foster+Partners' claim was only partially valid. This became clear when Arup - in the translation process and building form stabilisation attempt - undertook a computer-based solar gain analysis of what at the time was unheard of complexity.

The GOL's design briefing had associated many heterogeneous elements. In developing a GLA headquarter design proposal, the CIT team had to invoke a set of additional diverse entities. Surprisingly, in the continuous transformation processes, BREEAM - that TTPM reconfirmed as an "important cornerstone for setting environmental standards" (TTPM, 1998e) - played a rather marginal role. Richard Hyams explained:

> BREEAM, yes, environmentally that was the only brief, the environmental goal. Because it's the only thing that you can measure at the time. We never really talked about BREEAM all the way through the job if I remember. Not like you do now: BREEAM is on every meeting agenda every week. It's just asked, whereas then it wasn't. What we were focusing on then was designing the best possible environmental building we could. And that's not necessarily BREEAM.

Thus Hyams considered BREEAM a useful measuring device, but not as a tool to guide "environmental" design. I asked Hyams if the Foster+Partners team addressed any other environmental issues beyond energy efficiency or CO_2 emissions as crucial drivers for the GLA design process:

> From a very pragmatic point of view, there weren't global issues that […] this building had to deliver. We knew the global issues needed to be addressed and we addressed them through low energy building. Then we looked at the building and said we need to make it [transmit as little] heat through the skin as possible, [and] as passive an air system internally as possible. Natural ventilation and all the things that were normally not seen in offices. So at Fosters we are building offices all over the place; you looked at them all and thought actually we can do better than that, we can do better than that, and do better than that. It was almost like an internal benchmark. […] So you say right, if I want to do better than that I've got to work

> really hard. It was almost that agenda that was driving the energy story behind this. So we were working and also struggling at the time because the tools didn't exist (Interview Hyams, 2011).

In preparation for the second ministerial presentation the two remaining developer teams were informed about the format, expected content and procedure of the second presentation to Raynsford scheduled for 4th November 1998. Besides the presentation, the selection process was also based on a "Design & Technical Submission", scheduled for the 20th November, that required defined proposals in written and drawn format (TTPM, 1998g, p. 3).

TTPM advised the design teams that the criteria for the final shortlist selection process were established through a mixed set of heterogeneous elements. These were framed through seven main categories with interrelated questions of "location and accessibility", "conceptual design" further defined through a focus on the "landmark building", the "assembly chamber", and "civic space (the context in which the building is sited)". Further related questions concerned "operational suitability", the "programme" addressing temporal questions of the project schedule, "finance" regarding the GOL-developer lease deal (i.e."the total cost of operation over 15-20 years"), and "public consultation". One of these main categories was "environmental issues", defined through the "construction & operation of the building" (TTPM, 1998h, p. 6).

The design briefing of "green issues" predominantly defined through the recommended BREEAM assessment, the CO_2 target, and preference for "passive" air-conditioning systems had to be evaluated in relation to these heterogeneous entities.

5.4.5 Meeting Raynsford and his advisors at the final presentation

Figure 5.18 Second ministerial presentation. Presenting the scheme that later won the competition (Collage / Rendering: Foster+Partners, 2004)

On 4th November 1998 the two remaining contenders in the competition presented their adapted schemes to about 30 people: Raynsford and other ministers, his design advisory group, representatives of the GOL and TTPM, property advisors to the civil estate and members of KFEA. Technical content was meant to be limited to the 30-minute presentations, which were followed by question-and-answer sessions of up to 15 minutes (TTPM, 1998g).

Ken Shuttleworth and his colleagues presented their “mask” scheme that, through many design transformations, modified and replaced the “box” scheme. I was unable to access any detailed documentation on this transient scheme, but my interviewees confirmed that at this stage the central elements of the environmental design strategy of the later City Hall building were introduced. These included the projected spherical compact, tilted and stepped building form, high performance facade, deep space natural ventilation, borehole cooling and chilled beams. Photovoltaics were considered at this point as well, but CIT decided that funding for it would have to be covered by the GOL and not by the developer. The CIT team’s design proposal included the promise to outmatch the GOL’s “cornerstone for setting environmental standards” (TTPM, 1998e) by claiming that their design scheme would reach a BREEAM “excellent” (min. 70% score) assessment instead of only “very good” (min. 55% score) (Interview Thonger, 2011). As I discuss in the next chapter, all these strategies were schematic and required further design development, testing and stabilisation. For instance, the project's suggested building form and orientation was later significantly redesigned and after the planning application the design of the facades became a crucial focus of the design practices.

On 26 February 1999 Nick Raynsford announced that the CIT, Foster+Partners and Arup scheme had won the contract. This decision was widely trailed in media and reactions were controversial. With the selection of the More London Bridge team, the design practice of the GLA headquarters went into the next and final phase of materialisation, which is explored in the next chapter.

5.5 Conclusions

In this chapter I have explained how mainly Foster+Partners and Arup translated environmental challenges and targets – defined through the GOL's design briefing – into specific design strategies and building service systems in the first two key design schemes for GLA headquarters. In order to put the design briefing into action and to proceed in the translation processes targeted towards materialisation of the GLA headquarters, a set of heterogeneous entities (e.g. guidelines, diagrams, strategies, heat losses) had to be invoked. I therefore focused on the use of "building form and orientation" that was given a pivotal role by Foster+Partners within the development of their design strategies.

In Chapter 4 I explained that the initial design briefing of the GOL had transformed the environmental design challenge predominantly into a request for a BREEAM building assessment of at least "very good" and the vague statement that "'green' issues should be given proper consideration" (TTPM, 1998a). Crucially, it was the GOL that was driving the environmental agenda. In principle, CIT, Foster+Partners and Arup could have conceived their roles as not only to enact the design briefing, but instead to critically comment, intervene, refine and expand the GOL's briefing. They could have insisted on making the question of what sustainability (as the overall objective of the GLA) might imply for design practice a crucial issue that needed further investigation within the design processes. They could have developed indicators, targets and visions tailored specifically to the diverse groups of people that were projected to be associated with the GLA headquarters. Instead, under the lead of CIT, it took the team until after the first ministerial presentation to adopt environmental design strategies that surpassed then mainstream commercial office developments. CIT, Foster+Partners and Arup consequently accepted that the concept of sustainability, with its fundamentally broader set of related issues, was largely abandoned in the translation processes.

Rautenbach stated that many developer teams initially failed to translate the GOL's environmental agenda defined through the first three design briefs (TTPM, 1998a, 1998b, 1998c) into their emerging design approaches (Interview Rautenbach, 2010). The initial briefing, as a guiding device, thus lacked the power to align the heterogeneous activities of design teams with the GOL's interests. In response, TTPM transformed and reinforced the environmental design briefing through a set of additional requirements. Amongst these were a required CO_2 emissions target of 70kg/m^2/a (TTPM, 1998e) that was more ambitious than ECON 19's suggested "good practice" CO_2 benchmark. Furthermore, the modified design briefing encouraged the use of particular technological pathways such as "renewable energy sources" (TTPM, 1998e) and "passive A/C [Air-Conditioning]", "chilled ceiling" and "displacement" ventilation systems (TTPM, 1998f, p. 3).

The main criticism of Raynsford's advisory team to the presented "box" scheme centred around the "shortfall of distinctive identity" in the proposal (TTPM, 1998h, p. 5). Although Raynsford had propagated an ambitious environmental agenda for the GLA headquarters, this seemed to be of secondary importance in his teams' comments. The CIT team changed strategies and intensified their interest in winning the competition after the first presentation. They realised that the GOL's desire to create a landmark building was one important and necessary "detour" (Callon, 1986) in the translation processes of environmental design briefing towards design materialisation that had to be adopted in order to stay in and win the competition. Thus CIT, Foster+Partners and Arup changed preferences that resulted in a more ambitious re-ordering of their design practices.

Foster+Partners and Arup interpreted the design briefing mainly as a singular issue of "low energy design" (Interview Thonger, 2011). This was a significant transformation, since it further limited the already narrowly compressed scope of issues that the BREEAM certification implied.

In order to translate the "low energy design" into specific design strategies and building service systems the design team was dependant on the accumulation and producing of additional design information and knowledge. ECON 19 and the "Triangular Approach" were chosen as two key devices with which to work together, communicate and align the teams in their continued design and transformation activities. The "Triangular Approach" presented an important visual and conceptual device to align the design team in its declared ambition to maximise the potential of passive design strategies. Shuttleworth interpreted the approach as "a sound basis for low energy design" (Shuttleworth et al., 2003, p. 303). Thonger described the approach as getting "the basics right" (Interview Thonger, 2011). All the interviewees with whom I discussed the approach confirmed it as a valuable device in aiming towards low energy design.

Foster+Partners and Arup transformed the low energy design approach into different strategies that were co-shaped by their respective roles, responsibilities and expertise. Out of a vast array of possible design trajectories, drawing on both ECON 19 and the "Triangular Approach", Foster+Partners chose to maximise the use of "building form and orientation" as their fundamental basis of low energy design. In their Riverside Studio they constructed the projected building operation mainly through the selected issues of heat losses and solar gains. They proposed a spherical compact building form to reduce the first issue. To reduce the second, they proposed to tilt and step the building form towards the south. I explained that these three strategies also partially conflicted and that the team did not address this potential conflict in any way. I return to the conflict between compact form and solar gain in the next chapter where I explore the development of the facade. These hypotheses (heat losses and solar gains) and building form strategies inscribed a particular "vision of (or prediction about) the world" into the emerging GLA proposal (Akrich, 1992, p. 208). They underpinned the construction of building form strategies and the design strategies can be seen as the materialising extensions of design hypotheses. The design team had foregrounded the issue of heat losses and solar gains in their activities and thus pushed other design issues associated with "building form and orientation" into the background that, in actual operation, could become significant elements in co-shaping energy consumption levels (e.g. daylight to reduce electrical lighting). In Figure 5.19 I attempt to envision a selection of the many heterogeneous elements that, during the multiple translations of design-briefing-to-design-materialisation, became associated with the design of building form and orientation.

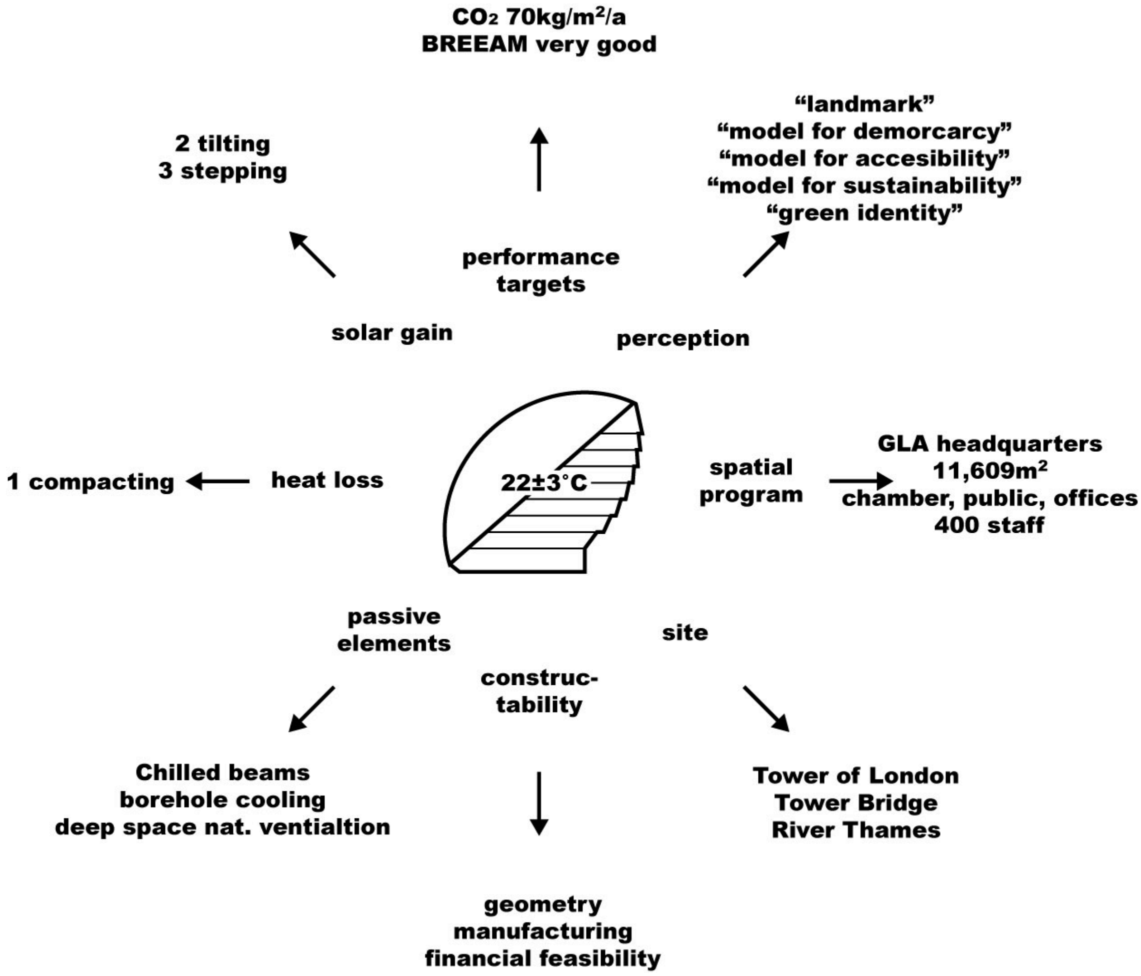

Figure 5.19 Assembly of heterogeneous elements associated with the building form and orientation design (Diagram: Author, 2012)

No consensus was achieved between Foster+Partners and Arup regarding the role of building form. Thonger questioned whether the emphasis on building form and orientation was critical, suggesting that it might instead be only significant. He attributed a more decisive role to the use of the facade design that became a focus of design development after the building form stabilised. In the next chapter I continue the investigation of the translation processes through a focus on the re-design of building form and orientation, the intensifying facade development and the stabilisation of these elements that were necessary to build the GLA headquarters.

Chapter 6

Adjusting building form, expanding the facade

6.1 Introduction

In February 1999 the initial plan of transaction, initiated by Nick Raynsford and the Government Office for London (GOL), to find, design and realise a suitable headquarters for the Greater London Authority (GLA) continued its unpredictable path through multifarious transformations and displacements. The plan was still contingent and could have failed. This chapter explores the continued design development through the third and fourth key design schemes, the *Planning Application* scheme (July 1999) and *Schematic Design* scheme (November 1999). The aim of this chapter is to explore how the design alliance continued to translate the environmental challenges and targets defined in the design briefings into design strategies, building technologies and the materialising building. I analyse the transformations, displacements, negotiations and adaptations centrally involved in this process (Callon, 1986).

While the previous chapter focused mainly on the initial development of building form and orientation through Foster+Partners' chosen strategies of compacting, tilting and stepping building form, this chapter focuses on how the these design strategies were transformed and how in reciprocity the facade design advanced. Building form, orientation and facade design were the key elements of Foster+Partners' and Arup's selected "low energy design" objective and are therefore at the centre of my investigation.

After More London (rebranded from CIT), Foster+Partners and Arup won the design competition for GLA headquarters with the "mask" scheme, roles and responsibilities were reordered. Knight Frank Estate Agents completed their task of organising the property search, Turner & Townsend Project Management (TTPM) stepped into the background with their advisory activity, and developer More London entered a new role by becoming the client to commission, build and own the future City Hall. More London and the GOL began to share responsibility for the GLA headquarters development, bound together through a 25-year contractual lease agreement. More London assumed responsibility for commissioning and financing the *shell and core* construction (e.g. building envelope, building structure, vertical transportation and main plants), while the GOL was responsible for the *fit out* of City Hall (e.g. partition walls, finishes, computer infrastructure and furniture).

The GOL's design briefing for the competition was largely adopted and expanded by the new alliance of More London and GOL, and later manifested through the "Employer's Brief" (F+P, 1999e, p. 8) and "Engineering Services Design Brief" (Arup, 1999, p. 7) to guide the continuing design development towards sign-off and materialisation.

With the GOL's selection of the "mask" scheme elementary design strategies had been chosen (e.g. the compact building form, the borehole cooling strategy) in mutual agreement between More London and the GOL. These design strategies needed further translation through the simultaneous production of additional design knowledge and the construction of new associations. They became transformed, redesigned, geometrically defined, adjusted through diverse tests, simulations, renegotiations and choices in the quest to make them perform as predicted, stable and material.

I explicate how the design team came to understand the complex associations and functions of building form, orientation and envelope design, which could not be understood in their actual heterogeneous complexity. In order to progress, the design team had to choose, foreground and define particular workable complexes of main design issues (e.g. building form, orientation and heat loss) that they considered most important at that time, while other related issues were either pushed into the background or not addressed at all. Thus the GLA headquarters design practices were built on an alternating play of thematisations, de-thematisations and omissions of design issues. These choices had decisive implications for the designers' ability to project, approximate and account for the complexity and consequences of the GLA headquarters' actual construction and operation.

This chapter ends by exploring how City Hall was assessed by BREEAM 98 for offices following completion in March 2002. This had been made a central requirement of its design briefing.

6.2 Reshaping building form and orientation

Figure 6.1 Ken Shuttelworth, Niall Monaghan and Max Neal (left to right) working on City Hall's design development at Foster+Partners' studio (Photograph: Nigel Young and Foster+Partners, 2002)

Following their successful selection in late February 1999, the design alliance around Foster+Partners went back to work as they had embarked on a project that had huge time constraints. The "mask" scheme outlined a key environmental strategy, founded on the spherical, tilted and stepped building form, and with low energy borehole cooling, chilled beams, a high performance envelope and deep space natural ventilation. The scheme had been selected and approved by Nick Raynsford and his architectural advisory team.

Nevertheless, Foster+Partners wanted to significantly transform the winning scheme. Ken Shuttleworth recalled the "problem" of the "mask" scheme:

> Having sold it [to Raynsford], we had […] second thoughts because the space inside the ring outside the chamber and the space behind the ring was exactly the same space and yet we had a different expression. And I remember saying I felt it was wrong. We need to change it and make it all the same and just pick out the bowl as a different shape. […] So diagrammatically it was a bit flawed really. […] When I changed this there was [an] absolute riot at [the GOL …]. I remember having a phone call from Nick Raynsford – and Nick Raynsford had already approved this; it was being signed off as far as the civil service was concerned; this was what we're

> going to build. And we went back and said we want to change it. They […] just couldn't understand why we'd want to do that. […] I know Nick Raynsford is terrific. He wasn't the architect and I was. […] I believed this was the right thing to do. And they were very, very, very stroppy about it. But they set up another session between me and Nick (Interview Shuttleworth, 2010).

Foster+Partners met with Raynsford to explain to him and his team why the architects had introduced changes to the "mask" scheme.

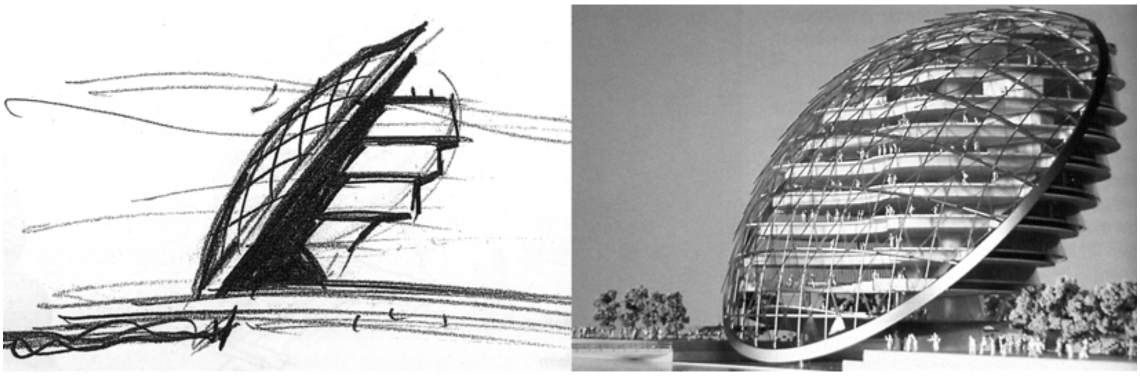

Figure 6.2 Architectural sketch and model of the winning City Hall competition scheme, nicknamed the "mask" scheme (Juxtaposition: Author 2012, based on Foster+Partners in Detail, 2002, pp. 1089-1090)

Richard Hyams, one of City Hall's project architects at Foster+Partners, described the "mask" scheme as "almost an extension of an architect's sketch" (Interview Hyams, 2011). Between the first design briefings in August 1998 and the second presentation to Raynsford they had only three months to develop the design. According to Hyams one of the key difficulties in the "mask" scheme was that

> the mask was there to sort of define the chamber and again the offices were behind the mask or not behind the mask, […] it's quite an odd form in that sense. The logic of the diagram and the principal way of doing it was lost a bit, it was weakened (Interview Hyams, 2011).

Hyams considered the problem to be that the 2D diagrammatic sketch (Figure 6.2 left) couldn't be translated into a 3D architectural design proposal; it required adjustment.

The diagram suggested a building that half consisted of the chamber, and half of offices. But the design briefing called for a spatial programme of a double height chamber of about 1,900m^2 and about 8,000m^2 of office space. Foster+Partners wanted the facade design to correspond to and reflect the programme behind the facade. Additionally the chamber could not be accommodated within the shallow shape of a lens. Foster+Partners therefore decided to redesign the “mask” scheme.

Another issue was that the architects at Foster+Partners also needed to tame the irregular spherical building form in order to make it more controllable in preparation of the then imminent application for planning permission and the further materialisation process. In a mixed-media process, drawings and models became influential tools of investigation, testing, assumption making and modification. 3D cardboard and blue foam models were assembled through Computer Aided Design (CAD) printed-paper templates, checked on 3D models and insights transferred back to CAD drawings.

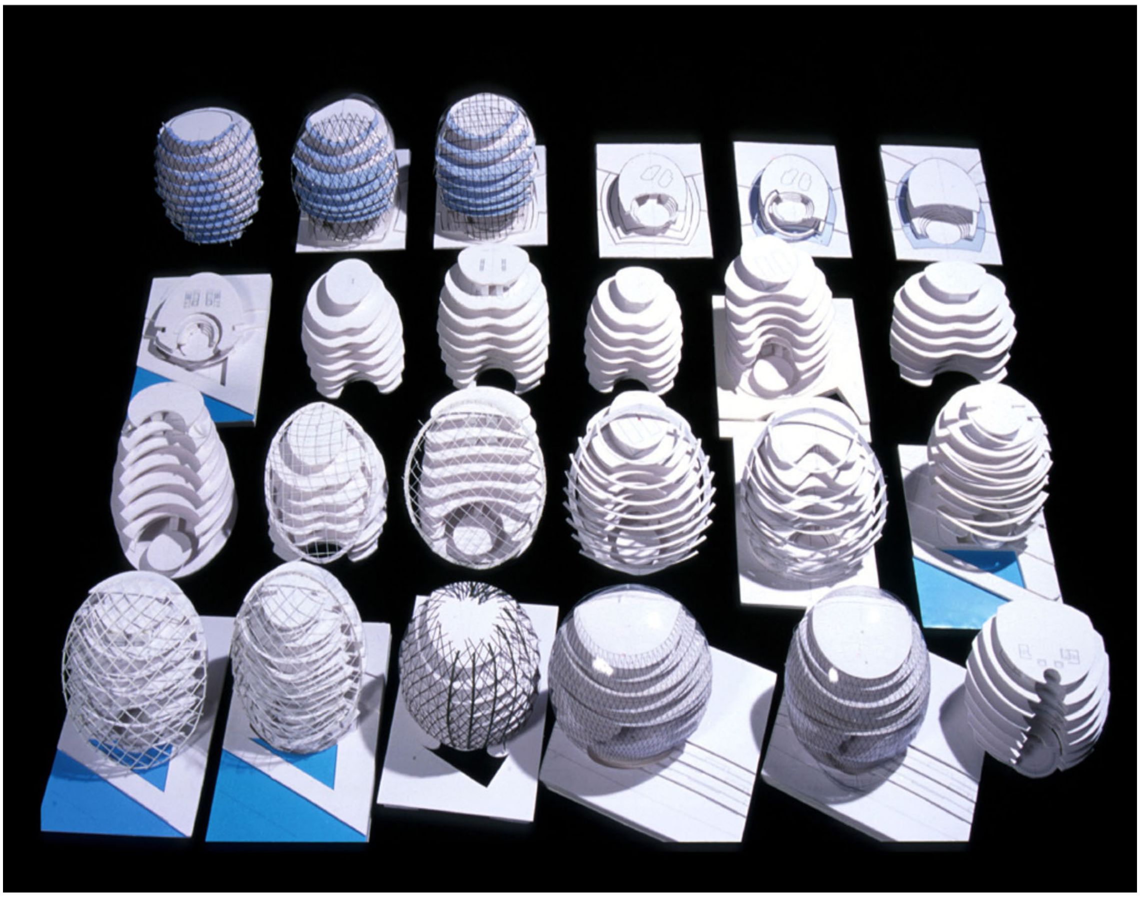

Figure 6.3 Testing of building forms, programme distributions, appearance and other elements (Photograph: Foster+Partners, 2004)

> It took us a long time to actually devise City Hall's form, which we did through testing. Loads and loads of testing of different models. […] That journey, […] it was like a really interesting one which shows 30 different shapes of how City Hall could evolve (Interview Hyams, 2011).

Shuttleworth, Hyams and colleagues gained knowledge through the interpretation, examination, and reassessment of models. Figure 6.3 displays this "option process" (Yaneva, 2009, p. 162) that foregrounded *inter alia* the interplay of diverse building forms, orientations, chambers, offices and facades. The headquarters' possible design trajectories were multiplied through conserving and innovating elements. Options were changed, redefined and compared to rethink and evaluate the emerging design proposal. As a result of the intensive modelling exercises in cardboard, foam and mesh, the design scheme was significantly transformed and reordered. The "mask" was eliminated and a more unified building form created. In disagreement with Arup, and after initial resistance by the GOL, Foster+Partners pushed this design move through.

6.2.1 The Planning Application drawing set

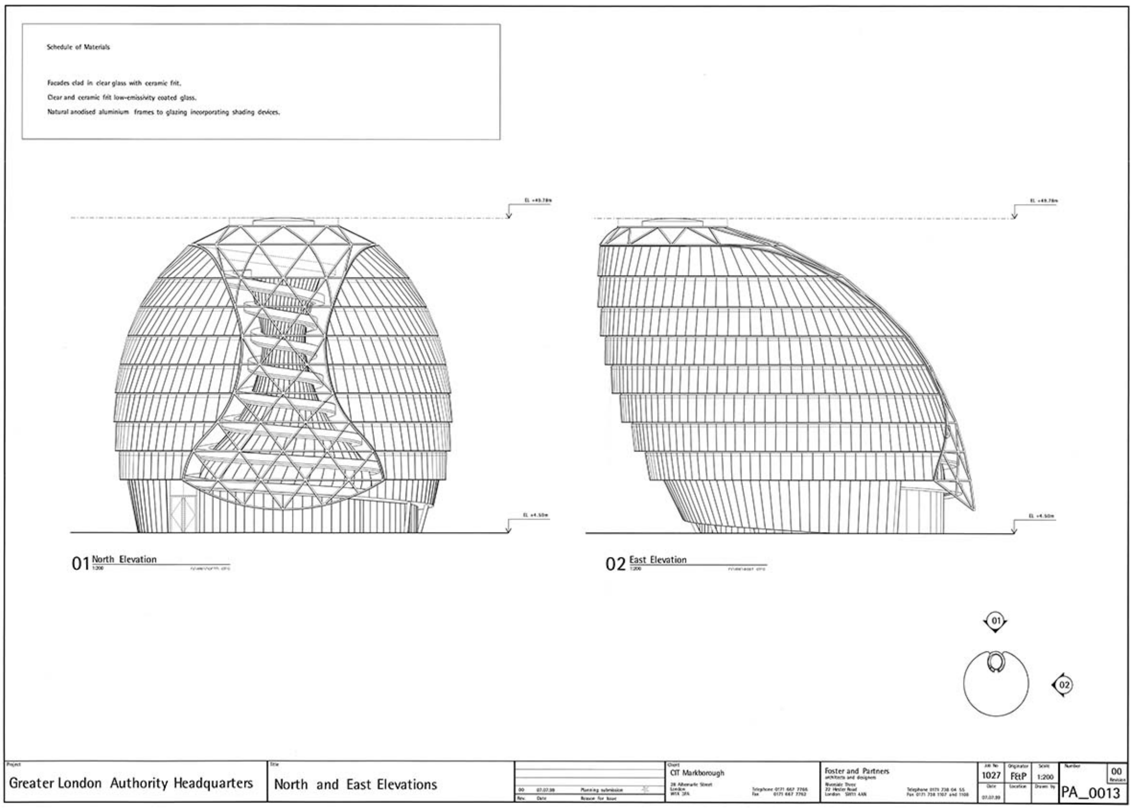

Figure 6.4 Drawings of the north and east elevation of the Planning Application scheme (Drawing: Foster+Partners, 1999b)

While the previous “mask” scheme could be described as a hybrid building form, the Planning Application scheme followed a more unified approach to form with two distinct facade designs. After elimination of the lens-shaped part of the building form, this third key scheme became adapted through a more spherical form; the south was less tilted and stepped, the north smooth with a similar tilt as before, and significantly the upper east and west were made more round. The chamber inside took the shape of a “flask” and became proportionally less exposed in the facade area.

In mid-July 1999 Foster+Partners submitted a comprehensive set of planning application documents to the Borough of Southwark for planning permission. This package was an important planning tool in the design-to-materialisation process, since it had to demonstrate compliance with the then valid Building Regulations. It assembled heterogeneous elements, choices and diverse struggles that were temporarily stabilised for the purposes of submission.

This set of planning application documents served to advance the design development through the further accumulation of design information; to transform previous hypotheses and strategies into more certain arrangements; and to expand performance predictions and design strategies.

Besides a full drawing set of, among other things, the site, individual floors, elevations, sections and perspectives (F+P, 1999b) ,the Planning Application package also comprised a *Design Statement* composed of mixed texts, diagrams, drawings and photographs (F+P, 1999a). In the statement Foster+Partners explained the design process for GLA headquarters from the outset as they attempted to render it plausible and agreeable. The Design Statement adopted most of the GOL's selection criteria from the second final design presentation (see Chapter 4) as themes: for instance, the site, the site context, the masterplan context, public space, accessibility and others. Foster+Partners explicitly dedicated pages in both the drawing set and the Design Statement to reinforcing the GLA headquarters scheme's "design logic" of "building form".

The drawing set invokes a vast set of heterogeneous arguments to justify the "building form", for example the relationship to the "pivotal site", the spatial programme, the importance of the assembly chamber as "the *heart* and focus of the building", etc. (Figure 6.5). Foster+Partners declared unequivocally, "Energy efficiency is of primary importance in the design of the GLA Building. The appropriate use of form and orientation are fundamental to energy efficiency" (F+P, 1999a, p. 23). The important co-constitutive forces in shaping the emerging building form – the low energy design strategies of compacting, tilting and stepping – could only be inscribed and stabilised within a complex set of other heterogeneous issues (the site, programme, etc.). These can be understood as necessary "movements and detours" (Callon, 1986, p. 206) to translate the team's "primary" low energy design objective into the developing building shape.

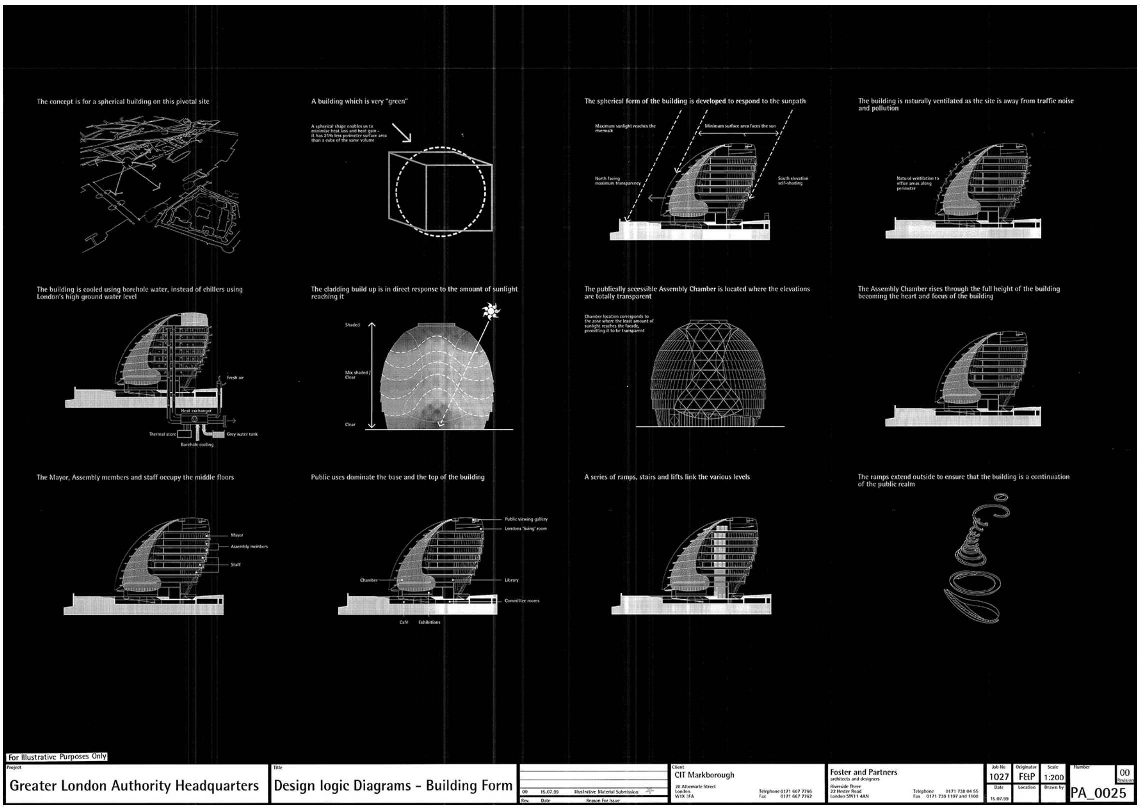

Figure 6.5 "Design Logic Diagrams - Building Form" (Drawing: Foster+Partners, 1999b)

The Design Statement contained an almost identical set of building form justification strategies but, in addition, contained two pages to substantiate the "Design Logic" of "Building Form and Environment" (Figure 6.6). Crucially, the environment constructed and defined in the Design Statement was, in its scale and environmental problematic, very limited. It included the site as one co-constitutive element, the building itself and the building interior. The design issues of this "environment" were framed as operational "energy efficiency" and "heating, cooling and ventilation" issues (F+P, 1999a, pp. 23-24). The architects' responsibility appeared to end at the boundary of the GLA headquarters' site and no reason was provided as to why their narrowly framed primary design objective of energy efficiency was important. In the translation process the multifarious and complex interactions between building construction and operation, and the global environment and human wellbeing, were here reduced to the single issue of energy efficiency.

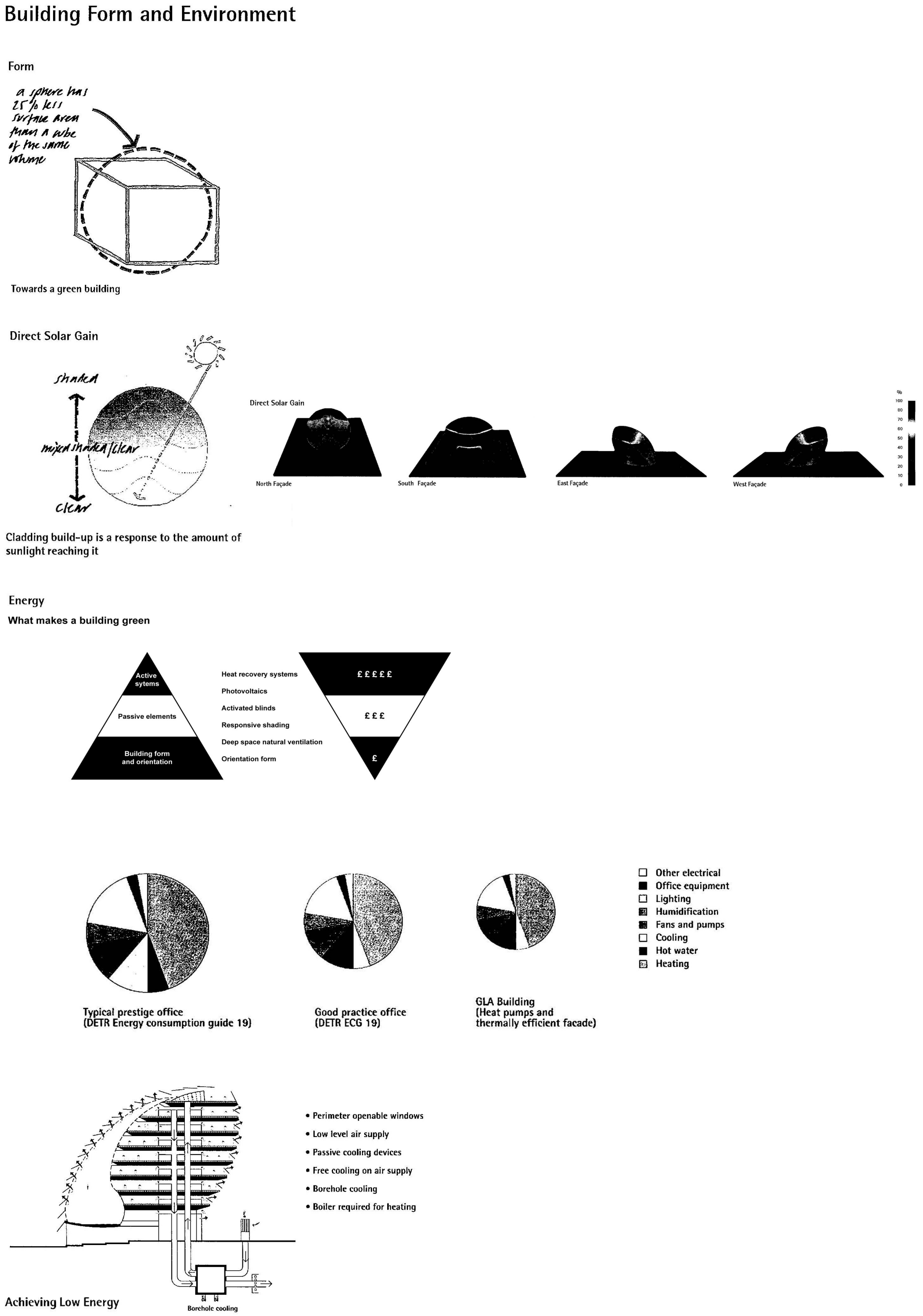

Figure 6.6 Selected diagrams of the “Design Logic […] Building Form and Environment” (Collage: Author 2014, based on Foster+Partners, 1999a, pp. 23-24)

Foster+Partners continued attempting to turn their design hypotheses and strategies into arrangements that would gain wider acceptance:

> The siting, orientation and response to surroundings and building brief, coupled with the extensive environmental considerations and responses support the proposed building form with the aim to provide a truly green building (F+P, 1999a, p. 23).

The minimisation of the building envelope surface to volume ratio formed the backbone or "sound basis" of the design team's argument. They declared the building would be in temperature balance with its environment for only 20% of the year; for the remainder of the year it would need heating or cooling. All the design knowledge claims of the form-finding exercises since the first ministerial presentation seemed to be legitimised.

All design struggles, potential conflicts (e.g. between spherical form and solar gains) and unresolved issues were in this representation of the design process removed and rendered non-existent. Foster+Partners made huge effort to legitimate their strategies of form finding, which raised questions over their actual legitimacy. Arup's Engineering Project Manager, Thonger, later declared that Foster+Partners had "post-rationalised" building form (Interview Thonger, 2009).

But Foster+Partners' efforts to explain their proposed building form seemed to spread as robust claims. As a non-architect, Raynsford retold Foster+Partners' argumentative claim regarding building form:

> And issues like that, […] at that stage, that was quite new thinking, in the late 90s, about how you created a building which by its very shape was likely to perform better environmentally and to avoid overheating in summer (Interview Raynsford, 2010).

The Planning Application set of documents built on and conserved three previous design devices that were co-constitutive of the "mask" scheme (see Chapter 4). First, the argument of the sphere to cube surface area comparison; second, the ECON 19 energy benchmarking tool; third, the "Triangular Approach" to prioritise building form and orientation and then passive design elements (see Figure 6.6: top, third from top, and fourth from top).

> Having established a sound basis for low energy design, the design team has applied passive energy saving techniques to further reduce the building energy usage (F+P, 1999a, p. 23).

Besides conserving entities, the Planning Application also introduced innovations by associating elements with the design development for the first time. With the "appropriate use of form and orientation" Foster+Partners shifted the design challenge to further expand "passive" and "active elements" (F+P, 1999a, p. 23). Three elements were important in the continued translation process.

The first was the development of the high performance building envelope (as an idea already introduced in the "mask" scheme) and the "responsive cladding" strategy (F+P, 1999b, p. 26). In principle, the GLA facade was conceived to consist of three distinct areas: the offices, the chamber and the ground floor (F+P, 1999a, p. 25). I focus on the design of the office facade that stood at the centre of design controversies. Following the responsive building form strategy (compacting, tilting, stepping), Foster+Partners introduced the responsive cladding strategy: "Cladding build-up is in response to the amount of sunlight reaching it" (see Figure 6.6, second from top). Arup produced some preliminary facade design studies of projected solar irradiance on the differently angled parts of the envelope. These were still rough since the building form had then not been geometrically defined and stabilised. On this basis the *Design Statement* conceived the facade build-up to integrate

> opaque, translucent and clear panels with integral shading devices responding to sun paths creating a varied and interesting appearance. […] The cladding […] responds naturally to the sun path; self-shading where required; more solid to prevent heat gain; more transparent where sun angles prevent direct solar gain (F+P, 1999a, p. 23).

Figure 6.7 Planning Application scheme (Photograph: Richard Davies, 2004)

Figure 6.8 Collage with rendering of the Planning Application scheme (Collage/ Rendering: Foster+Partners, 2004)

In contrast to the statement above, related drawings, models and renderings (Figure 6.4, Figure 6.7 and Figure 6.8) suggest that the architects seemed to have a strong preference to deploy a predominantly transparent glass facade from floor to ceiling around the entire building, combined only with flexible shading provisions and printed dot patterns on the glass. I explain later in this chapter why the responsive cladding strategy was abandoned as the facade design accumulated more design information and underwent further negotiations.

The second important expansion of design strategies was termed "Energy story" (Figure 6.10) by Foster+Partners. This combined "building form and orientation", "passive" and "active" design strategies, highlighting their interplay. As diagram form, the "Energy story" served as a pictorial communication tool (see also below) that introduced additional design strategies. In collaboration with Arup, the "heating, cooling and ventilation system design" was further advanced and tested (F+P, 1999a, p. 24). The compact, tilted and stepped building form, the "passive cooling with chilled beams", the borehole cooling and openable perimeter office windows had already been introduced in the "mask" scheme and became stabilised. New elements introduced included the responsive cladding strategy (see above), a displacement ventilation system, and a heat (cold) recovery system from the mechanical ventilation exhaust air through a heat exchanger (F+P, 1999b, p. 26). Some other elements had been introduced but were eliminated shortly thereafter (e.g. photovoltaic panels). Not related to the energy efficiency approach, the design team also established a grey water strategy that collected the return borehole water in tanks to reduce the use of water from the main. Crucially, the diverse anticipated design strategies were developed in relation to one another. I demonstrate this interdependence later through the example of the continuing facade design that, among other things, had to respond to the limited cooling capacities of the chilled beam system. The architects deployed the "Energy Story" diagram as a key tool to communicate the design teams chosen and partially stabilised design strategies of their primary objective of energy efficiency.

The third important element introduced was the first approximate energy performance prediction. Based on the chosen ECON 19 benchmarking device (Chapter 4), Foster+Partners predicted that the GLA headquarters would use only "approximately a quarter of a typical office building" (F+P, 1999a, p. 23).[48] This venturous claim was made in comparison to the chosen ECON 19 reference of an "Office Type 4 air-conditioned prestige" (DETR, 1998a, p. 5).

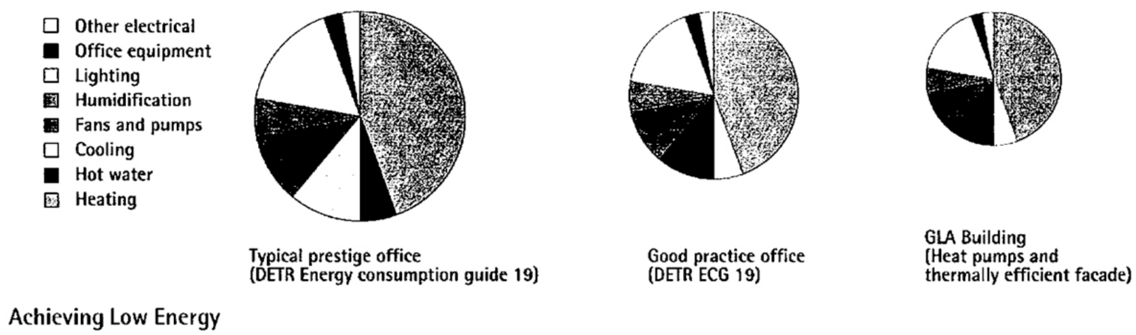

Figure 6.9 Diagrammatic comparison of projected energy consumption between a typical prestige office, a good practice office and the future GLA building based on the ECON 19 device (Diagram: Foster+Partners, 1999a, p. 24)

Foster+Partners' predicted energy performance benchmark for the future City Hall was later often referred to in the design and operation process. Replacing the GOL design briefing, this prediction was adopted in More London's "employer brief" as a mandatory design target (F+P, 1999e, p. 5), hence becoming an important design target in the translation processes.

Crucially, Foster+Partners launched this performance predication without achieving consensus with Arup. On account of their particular expertise and reasons of liability, Arup refused to take responsibility for total energy consumptions, instead limiting predictions to the heating, cooling and ventilation services only. Arup predicted the building services would consume 25% of a typical prestigious office – the ECON 19 reference scenario (Arup, 2002, p. 7).

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[48] In Chapter 7 I compare these predictions with City Hall's actual recorded energy consumption for the year 2010-11.

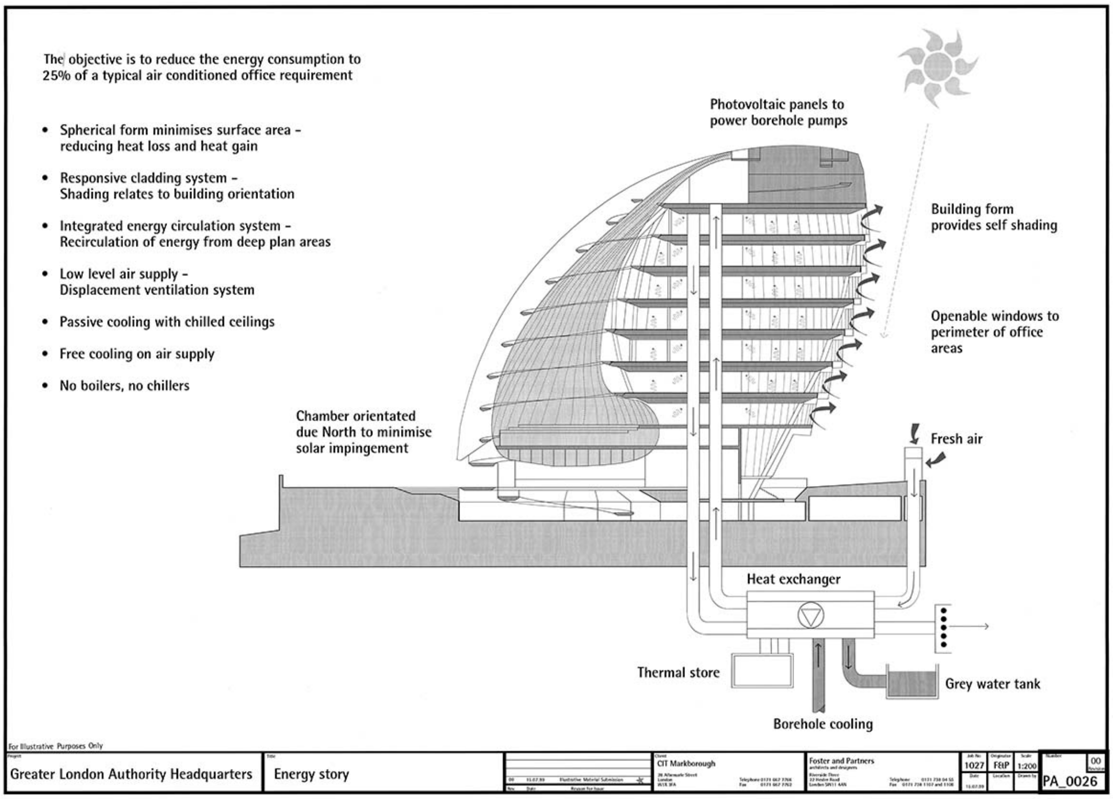

Figure 6.10 Diagram of the "Energy Story": "The objective is to reduce the energy consumption to 25% of a typical air conditioned office requirement" (Foster+Partners, 1999b)

Within the complex translation processes of design-briefing-to-design-materialisation, Foster+Partners' diagram of the "Energy Story" (Figure 6.10) was a crucial tool in attempting to align the diverse design parties and in rendering the "displacement" from previous design hypothesis-making into accepting design strategies easier (Callon, 1986, p. 218). It envisioned an expanded version of the team's primary design objective of energy efficiency. The diagram summarised the design team's proposal of design strategies and elements to be associated in the actual operations of the GLA headquarters. It sought to establish equivalences between the projected design and the actual building operation, as if the two worlds would be identical. City Hall's building services design exists in "two presentational states": in the studio as a "well-known, concrete, and precise object" in diagrams and models, and as a little-known "fuzzy entity" of the actual technical equipment that was to be constructed (Yaneva, 2009, p. 21).

The diagram draws together and orders diverse heterogeneous entities. It combines an architectural section with numerous arrows that point in different directions. It projects the spatial position and dimension of structural components like floor slabs and facade. It proposes the headquarters stretch over ten floors and a basement, and approximately 120 metres below earth surface (not depicted here). The section depicts and embraces the sun in the sky. The building form tilts towards the sun and its facade is roughly at a tangent to a sunbeam arrow, which is an awkward angle for a north–south cross-section. On the left Thames side, the building section is smoothly curved; opposite, the floor plates are stepped and cantilevered with floor level to provide shade to level below. The left part of the building section indicates the vertical atrium with the spiral stair that reaches from the ground to the top floor. On the right there are nine floors, which are disconnected from the rest of the building. Some words explain the arrows. C-shaped arrows seek to communicate air ventilation movements through “openable windows”. Other arrows indicate groundwater pumped up via boreholes from the water table 120 metres below as a “free cooling” source. A box labelled “heat exchanger” suggests the thermal transfer of cold to a building water circuit that supplies the chilled beams integrated in the office ceilings.

The diagram attempts to envision what will be invisible in the actual perception: air flows, water circuits and system functions that are dynamic and beyond static architectural form. As a “communication booster” (Holert, 2000), it sought to render plausible interactions between heterogeneous entities that would otherwise be hardly comprehensible. It is a hybrid object, fluctuating between facts and fictions, documentation and construction (Latour, 2002, p. 23). It is a snapshot of a specific moment, has its own bias, constitutive knowledge and personal drive. The puzzle between visibility and invisibility, the projected world and the actual world, is difficult to resolve, and the dynamic relationship between image-producer, beholder, the diagram and the actual City Hall is complex.

Foster+Partners’ energy story diagram provided a particular way of seeing. Produced in the design studio, it sought to project the relevant elements of City Hall’s actual building services operation. These projected assumptions and strategies “inscribed” a particular “vision of (or prediction about) the world” into the emerging GLA headquarters (Akrich, 1992, p. 208). The actual sunbeams, irradiation and airflows were displaced and represented in the architectural studio. Would they in actual operations follow predictions?

The diagram contains numerous arrows, which seemed to suggest that the building would function as an autarkic system. But, crucially, Foster+Partners "Energy story" rendered entities inexistent that exceeded these *picture-boundaries*. In Chapter 7 I show that City Hall's actual operation was essentially dependent on significant quantities of energy supply though the grid (electricity and gas). Electrical lighting became the single largest share of energy consumption recorded was also excluded in the "Energy story". Furthermore, energy was framed without taking into consideration the energy embodied in the actual construction of City Hall (e.g. 4,050 tonnes of steel, 13,100m^3 of concrete).

Energy consumption was limited and framed through the scale of the building alone. Decisively, this framing suppressed the fact that that energy is enmeshed in far-reaching heterogeneous associations: through its demand for resources which entails extracting and processing materials across the globe and through the diverse environmental damages related to that.

6.2.2 Cheating with building form

Two different design parties did not seem to be convinced by the transformations of the Planning Application scheme. One was the GOL team around Raynsford, who recognised that the "mask" scheme they had selected had undergone significant transformations. The other group was the Arup engineers, who considered that major environmental design achievements of the previous "mask" scheme had been diluted.

Arup's project manager Thonger seemed to believe in principle that "the right orientation and form of the building gives the best payback in terms of energy efficiency" (Thonger inBuilding Magazine, 2001b, p. 59). He described City Hall's projected solar gains through the spherical shape as less "peaky" than that of a box-shaped building. He meant that principally a box with only four distinct facade orientations (plus roof) receives a more varying solar irradiance pattern in its exposure to changing sun angles during the day (and season). In contrast, a spherical shape principally has a more homogenous irradiance pattern since approximately the same amount of area (of the same orientation) is exposed to changing sun angles. “As a result, less instantaneous cooling is needed. This translates into smaller plant capacity, saving money” and energy (Building Magazine, 2001b, p. 59).

Nevertheless Arup’s engineers did interpret the role of “building form and orientation” for City Hall in different ways to the Foster+Partners’ architects. This had to do with the different vocational perspectives, associated tools, expertise, interests and responsibilities (cf. Bucciarelli, 1994; Feenberg, 1999). Arup’s service engineers were called on to solve challenges through solar irradiance analysis, facade specifications and mechanical plants, rather than through radical experiments with building forms in 3D CAD, cardboard and mesh. Thonger made clear although he “never subscribed” to Foster+Partners’ argument of the surface to volume ratio comparison between cube and sphere of the same volume (Interview Thonger, 2011). He acknowledged it was an interesting concept but, for him, building form and orientation were more about aiming to limit irradiance through effective shading strategies:

> If you don’t get the basics right then […] all of these passive elements are never going to really work particularly well (Interview Thonger, 2011).

Thonger explained getting “the basics right” thus:

> Making sure that you’ve got proper shading in the right direction, and in fact the reality is […] if you’re determined to have […] full height windows, then your orientation is all about trying to make sure you got some sort of self-shading or if not self-shading then you have to put in […] external shading. I’m not sure if it particularly applies to the GLA, ’cos essentially we ended up with […] a circular building and the facade treatment was the same all the way around.

Crucially, Thonger questioned whether Foster+Partners’ arguments of appropriate use of “Orientation form” and “Responsive shading” both foundational elements of the “Triangular Approach” (F+P, 1999a, p. 24) were later in the actual design enacted.

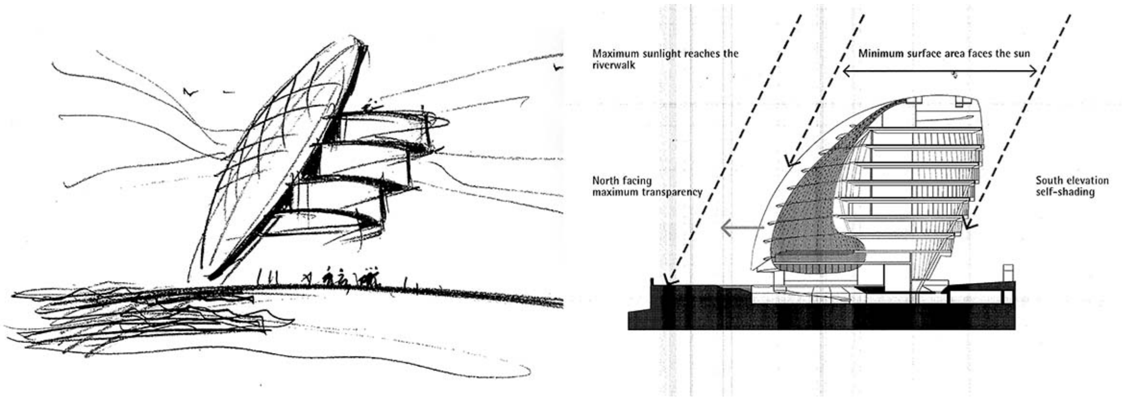

Figure 6.11 Comparison of the "mask" scheme (left) and the Planning Application scheme (right) regarding Foster+Partners' argument: "Developed form of the building responds to sun path" (Juxtaposition: Author 2012, based on Foster+Partners, 1999b, 2004)

To clarify, Thonger pointed to prints of the two drawings shown in Figure 6.11. He argued that the "self-shading image" on the left had

> huge cutbacks and […] providing a fair amount of shading to the one below […] in this sort of guise as drawn, you do get a fair amount of self-shading.

For him, the idea of self-shading was compromised during the design transformations. The orientation of facade elements also changed from one scheme to the next during the planning application. Thonger continued to explain:

> [right drawing:] Now this is another thing, […] it's all very subtle. [Left drawing:] Effectively at this point all of the facades […] were actually vertical; [right:] as you start to tilt the facades over like here. […] You're starting to look up at the sky and actually that means that your solar gain is worse as a result of tilting it up, so in our minds, the engineers' minds, this actually came to be less about solar shading and self-shading and more about proper facade design.

Then Thonger pointed at the print shown in Figure 6.11:

> The problem that seems to happen is as time develops […] you have this image […] of where you think you're going [left], but things subtly change so even from there to there this is a subtle change [right], which means that actually you get very little self-shading, particularly on the first three or four [top] levels.

He explained that these controversial transformations were made through discussion. Thonger recalled the architects asking: “Is this okay and how do you think we’re doing?” While the early versions of the “mask” scheme provided significant self-shading, that benefit was lost in consecutive schemes:

> It became the self-shading thing that really was dropped around this sort of time [with the Planning Application scheme] because in the end it’s not actually responding to the sun path (Interview Thonger, 2011).

From Thonger’s point of view two of Foster+Partners’ *Design Logic Diagrams* were therefore “cheating a bit”: the one claiming “the spherical form of the building is developed to respond to the sun path”, and the other, “the cladding build up is in direct response to the amount of sunlight reaching it” (Figure 6.5 top row third from left, middle row second from left).

Translation processes are not neutral, but enacted through two inseparable mechanisms: first, transformations and displacements; and second, controversies, choices and adjustments (Callon, 1986). Arup questioned one of Foster+Partners’ key design strategies and arguments. The controversy between the engineers and architects arose out of Foster+Partners’ assignment of the “critical” rather than “significant” role (Email Thonger, 2012) of “building form and orientation” and regarding their modified design strategies of building form (compacting, tilting, stepping) that were introduced with transformed shape in the Planning Application scheme. Foster+Partners’ desire to create a more unified design proposal was a major force in eliminating key design achievements of the “mask” scheme that had been previously agreed. As such, Foster+Partners ignored and overruled Arup’s expertise and concern regarding the reduced ability of the then new building form to limit solar irradiance. I assume that the GOL and More London were not fully aware of the consequences caused by Foster+Partners’ change of building form as they accepted and agreed the transformation.

In a clash of values, Foster+Partners preferred the more unified building form, thus accepting that solar gains would increase. These choices have significant consequences for energy consumption, CO_2 emissions and contribute to the global threat of climate change.

This was not an exemplary design move and certainly not a lesson for other design alliances to follow.

6.2.3 Translating spherical form into flat panels - new 3D CAD tools

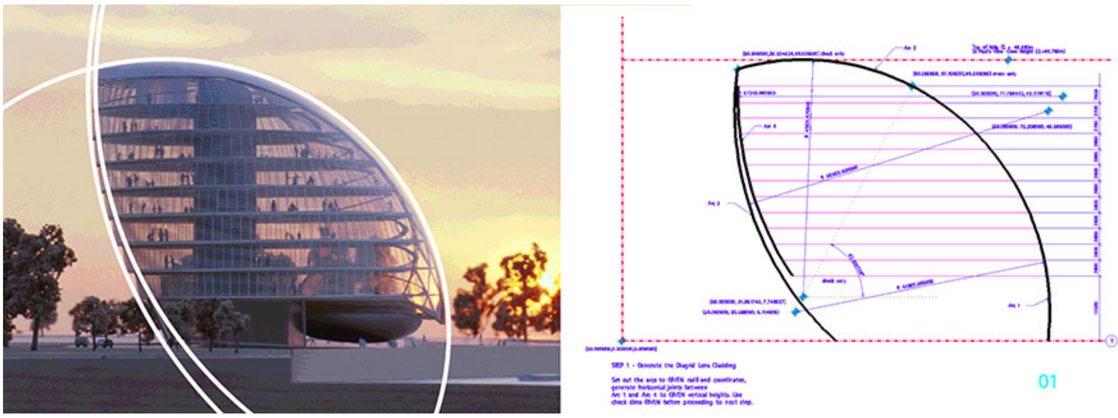

Figure 6.12 Rationalising the vague and complex building shape through simple geometric rules of three arcs (Juxtaposition: Author 2012, based on Richard Davies, 2004, and Foster+Partners, 2004)

In order to progress and transform the compact, tilted and stepped building form design strategies into actual floor plates and facade elements, the design team relied on new 3D CAD tools. Deprived of its manifold contexts, the idea to minimise perimeter to minimise heat loss was strikingly simple. The City Hall design became temporarily reduced into a design problem of geometrical rationalisation and definition. All the heterogeneous issues that the City Hall design had to assemble were pushed into the background. Constructing a spherical building form was not a simple task.

David Kong was one of Foster+Partners' architects who collaborated on the development of City Hall's building form and facade. He recalled a "very rigorous period that overlapped the planning process of rationalising the geometry of the facade" (Interview Kong, 2010). Foster+Partners' building form experiments were supported by the construction managers, MACE, who helped address the question, "How realistic is it to build […] something like this?" Discussed were issues of constructability and costs, both of which were central concerns of More London. Regarding all experiments of compacting, tilting and stepping City Hall's building form, the challenge for the architects was "trying to rationalise that, but not ignore all of the findings that we'd developed and agreed upon with the engineers"

(Interview Kong, 2010). As discussed above, their building form transformations accepted the sacrifice of particular findings.

While also working on other related design issues (see Figure 6.3, spatial programme, appearance, etc.), the architects had "sort of settled on the form" for the Planning Application. Nevertheless they still "were trying to rationalise the geometry" (Interview Kong, 2010). At that point, the form was conceived as an irregular sphere that had the tendency to have double curved facade elements. Mace made clear that More London could not afford to construct double curved facade elements, therefore individual facade panels needed to be flat.

In order to control the building form, to develop the facade and later to tender the building design, the building form needed to be subjected to a set of simple geometric rules. Hyams recalled that after the Planning Application submission the design team had "to start again" to define the building form. He explained that Foster+Partners chose and defined three key design criteria to guide and align the design team:

> So there was a set of rules to how we set the building out, […] going right back to our main principles. […] Developing a building like this on a budget, […] there needs to be a set of criteria. What are the three things we're going to hang onto? The green story was one, the environmental story, the shape [second] and […] the public ramps through the building [third]. So that's what this building is about, those three things. Everything else we won't hold onto and fight for. Those three things we're going to fight for. That was a method of ensuring that what you start off with at the beginning is that you define in practice or as a project for the whole team that you want is still there at the end. And that's a great lesson to learn (Interview Hyams, 2011).

As previously noted, Thonger was rather sceptical about how the "environmental story" was held onto in the Planning Application scheme. Hyams, Kong and others began to transform the geometry of the building through simple geometric shapes that were defined through a basic geometric formula:

> The final form of the building is not a conventional geometric shape. Instead, the form is generated from the constraints of the site, the sun angles and the required

floor areas. The shape is formed by a series of non-concentric circles, the diameters of which are set by design curves which describe the section of the building (Shuttleworth et al., 2003, p. 304).

In this way, a geometrical model was constructed that promised high accuracy in defining the approximately 3,800 individual two-dimensional facade panels – the size of their four corner points, orientation and dimension – for the tender and construction process that followed (Figure 6.12).

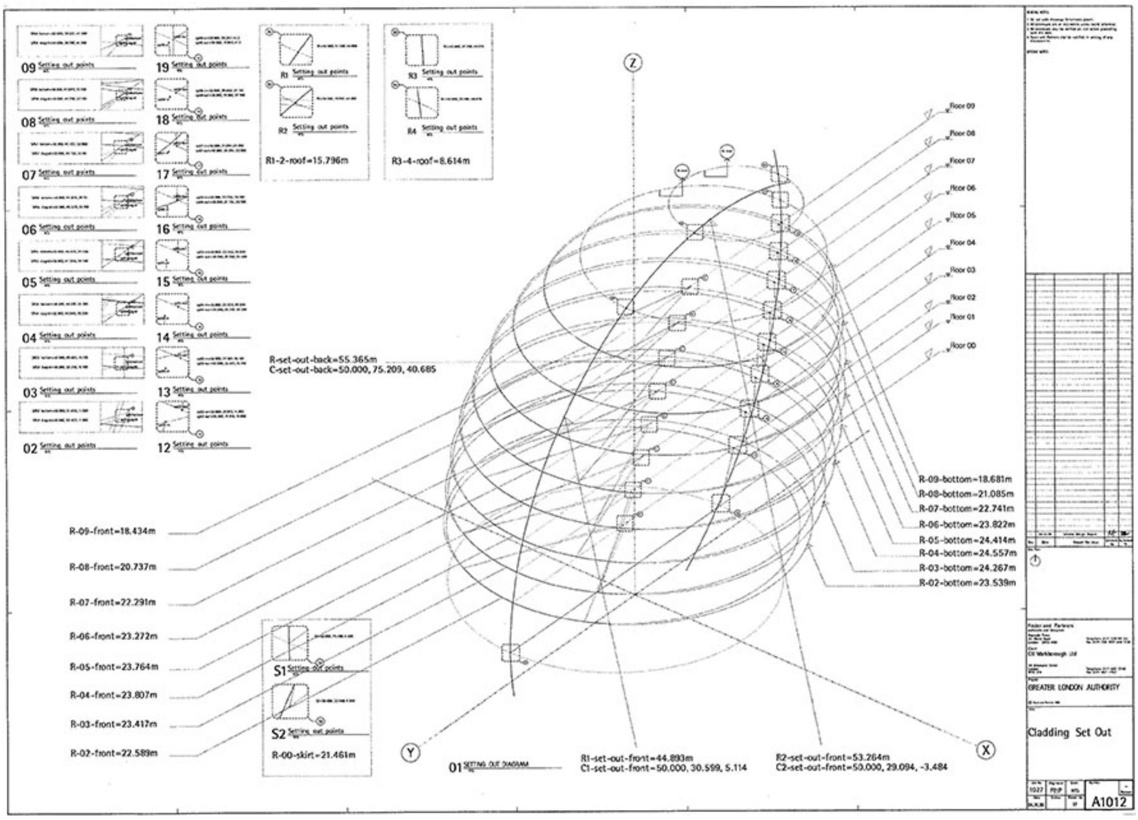

Figure 6.13 Defining the "Cladding Set Out" (Drawing: Foster+Partners, 1999b)

The heterogeneous design practices originating City Hall's form are inseparable from advances in 3D CAD software. Innovative computer tools were necessary to make City Hall buildable. Hyams described the design move away from a regular geometric form into a more random shape as "quite a big move philosophically". He explained that City Hall "was unique for Fosters at the time", while CAD was around for while:

> People drew the way they drew by hand with a computer and just translated the 2D drawings into a computer. It was like really odd that you get a new tool and you use it a traditional way. […] That's what fascinated me. So we set up at Fosters […] a 3D group. And so it was through the development of City Hall that the 3D group became. It started just thinking about how to address form. […] Before they were […] doing very traditional hidden line drawings for perspectives. […] So when City Hall came along, I thought this is a great opportunity to jump onto a different way of working. There was a whole debate at the time in Fosters going on, which was about form. Swiss Re [30 St Mary Axe, "The Gherkin"] was being designed and City Hall was being designed (Interview Hyams, 2011).

Foster+Partners had a specialist in the office with the unique skill to write macros (mini programmes) that could be plugged into MicroStation, their CAD software, which alone was not able to provide the necessary functions. With these macros, the team was then able to generate necessary information including plans, sections, elevations, axonometric projections and so on (Figure 6.13). After that, City Hall was co-developed in a virtual space of three-dimensional coordinates.

Shuttleworth explained the role of CAD tools within City Hall's design process:

> In that way, you can test the various shapes and various versions of the building on the computer. […] For probably a year, we were moulding the shape, making sure the sun angles were right and the view, twisting the building round to confront the Tower of London and that sort of thing – all in parallel on the computer. It was a very interactive process (in Detail, 2002, p. 1107).

He stated that "even three years earlier" the CAD-supported form finding would not have been possible. Detail magazine asked Shuttleworth, "Is the form of the GLA building purely a response to energy aspects, or were you searching for a unique form as well?" He answered:

> It started out by being a building that would use only 25 per cent of the energy required by a comparable structure. The starting point for a low-energy project, therefore, was to get it as compact as possible. Having said that, though, it also has a beautiful shape. […] Probably it's a bit of both: a need to make it low-energy; but at the end of the day, it has to look beautiful as well.

Asked whether Foster+Partners was "also able to control the aesthetic aspects", Shuttleworth replied:

> Yes, obviously we did; but you would be hard pushed to find those points where visual decisions were made that weren't purely the outcome of energy requirements. Inevitably, as an architect, you think visually as well, and everything you come up with goes through your head in terms of your visual judgement. But what really drove the project to start with was the need to ensure it was low-energy. […] There was obviously a lot of consultation with all the City authorities, and there was actually great enthusiasm to have an expressive building on this site.

Shuttleworth claims that building form could be driven "purely" by a singular design issue - energy efficiency. Throughout this thesis I, in contrast, argue for the co-constitutive effect of elements in the complex translation processes. With the Planning Application scheme, the building form accumulated many heterogeneous elements. Seen from a different perspective there were various interpretations of how City Hall's building form emerged. Following the submission of the Planning Application, City Hall's building form became largely stabilised, a necessary choice and precondition in order to progress towards construction since the project came under huge time constraints from the GOL and More London.

Once the geometry of building form was defined and stabilised, the design strategies were transformed by further extending them into constructible and buildable elements. Although City Hall's form was conceived as a spherical shape, it was constructed using 660 unique flat trapezoid facade elements, which formed the office envelope and a total of 3,844 unique glass panels. The definition of the form through the three non-concentric circles required that facade panels were twisted (not vertical). Individual panels were derived from an internal partition grid of 1.5m, often used in commercial office layouts. City Hall's floor plates are staggered in their horizontal position to each other. Geometrical in plan, they are all conceived as perfect circles, whose perimeter is divided into a fixed number of linear facade segments defining two points on which the bottom of the flat glass trapezoidal panels are positioned. The special programmed macros were helpful to flatten and unfold individual panels: "doing forms, flattening them and build models" (Interview Hyams, 2011). Each facade panel has a different shape and a four point defined position (Figure 6.14). This additional design information enabled the facade manufacturers to provide estimates of tender prices, “to produce schedules and cutting lists”, and to use data “for the computer-controlled fabrication of the mullions and transoms” (Interview Hyams, 2011). In addition, the information “also allowed the team to audit the design by comparing the output of a computer model with a mathematical calculation of the panel locations” (Shuttleworth et al., 2003, p. 304). During construction the cladding coordinator for Mace, Gerry Sinnott, pointed out: “It’s the building’s shape that makes the cladding such a challenge. […] It’s not directly comparable to any other cladding scheme” (Building Magazine, 2001a). The simple idea that a sphere has the smallest surface to volume ratio had far-reaching implications. It required huge efforts from the entire design team to transform the idea into building activity that was financeable, construable, manufacturable, buildable and usable.

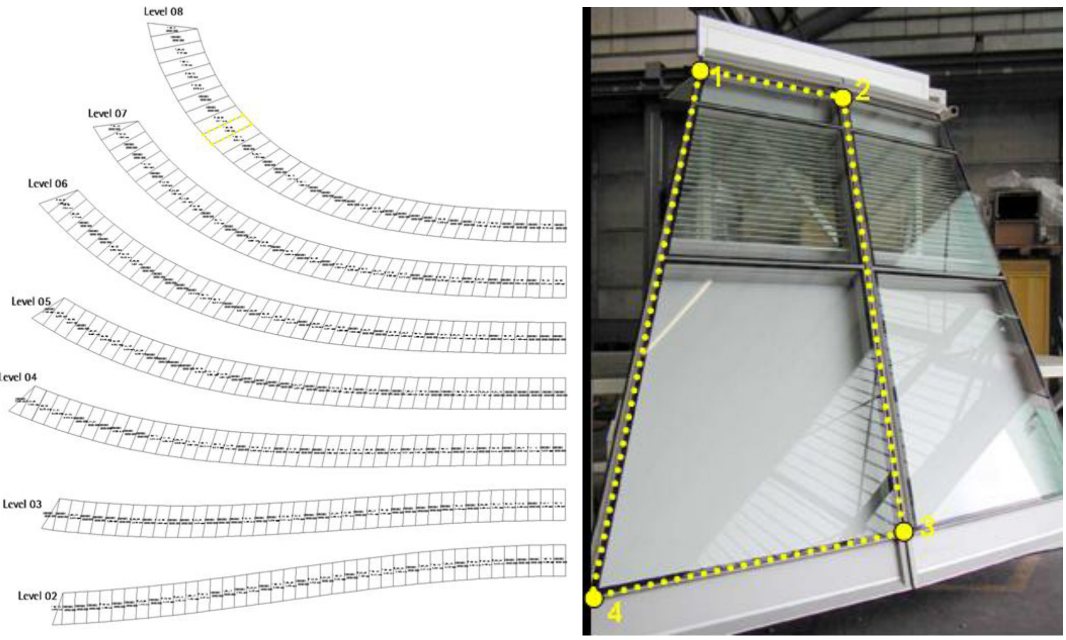

Figure 6.14 Unfolding geometry of facade elements left; facade panel geometric points right (Drawing / Photograph: Foster+Partners, 2004)

6.2.4 Modelling building form and sun - new simulation tools

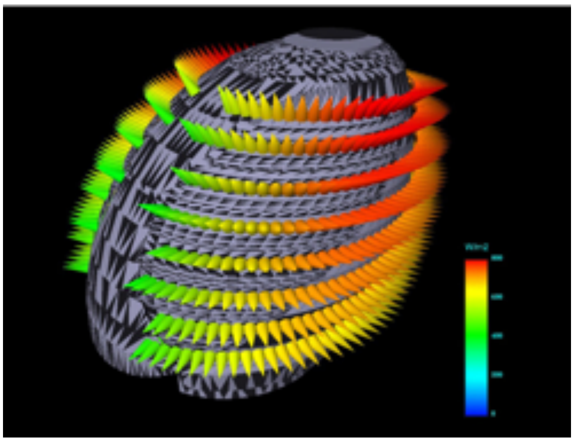

Figure 6.15 Arup simulation of annual peak solar gain in W/m^2 (Rendering: Arup, 2004)

To test, verify and ensure that previous design hypotheses and strategies perform as predicted, Arup embarked on computer solar irradiance analysis of previously unseen complexity. Arup had undertaken preliminary design analyses before (see Figure 6.6, second from top), but could not begin to explore the complex building form more accurately until there was a geometric definition of it. In comparison to Foster+Partners, Arup produced design knowledge through different tools, empirical and ontological perspectives. The redesigned shape underwent testing through the overarching perspective of solar irradiance, understood as an important factor of energy performance (Figure 6.15). Arup looked at the design from changing perspectives (e.g. energy effectiveness of technologies, costs, feasibility) but at this stage the problem of solar-irradiance-modelling was defined as one of direct solar irradiance measured in watts per square metre (W/m^2). The shape was subjected to a constructed *problem-environment* under laboratory conditions. The aim was to establish which differently angled facade panels would receive which solar irradiance in order to define their specific facade build-up and thermal properties. Based on particular constructed settings this isolated computer laboratory environment simulated sun angles, duration and intensity that City Hall's projected form would be exposed to on its actual site.

The dimension of solar irradiance was an important design factor for advancing the facade build-up since the chilled-beam and borehole-cooling strategies had limited cooling capacities and were irreversibly stabilised and locked in during the competition phase. Calculating solar irradiance for a box-shaped building would have been relatively simple, since there would have been only five different facade orientations. But City Hall's unique shape also posed a new challenge to the tools of computer modelling and visualisation software at Arup:

> There are no books that deal with the strange angles in this building. We did computer modelling to find out where the hotspots were over the whole year. We did every single orientation and elevation you can think of (Thonger inBuilding Magazine, 2001b).

Figure 6.15 shows a rendering of Arup's irradiance model, which determined the peak solar gain on each individual panel during the full year. Data for 660 office facade panels was translated into 660 colour-coded cones.

Thonger explained that after the Planning Application Arup

> [started] to do the proper modelling of it, where the thing was reasonably well fixed in terms of its orientation. We had already decided that this was going to be a chilled beam solution, and as a result of having a very limited amount of cooling inside of the building, […] actually that means that you have to treat this facade in a particular way (Interview Thonger, 2011).

The facade design had to guarantee that solar gains were limited in order to allow the building interior design specifications (e.g. temperature range of 22^{o}C ± 3^{o}C in summer) to be met. Thonger described the solar gain analysis shown in Figure 6.15:

> A very sophisticated model, modelling the sun for the whole year, […] we'd never done anything like that before, so this is like a worse-case scenario for that particular location, […] an awful lot of calculation for this lot here, but by that time we'd pretty much [decided] where we were going […] in terms of the systems.

Following the Planning Application scheme City Hall's environmental design strategies and systems had been largely chosen and locked in through partially controversial design practices based on particular conceptions, physical models, crude calculations, "gut feeling", preferences and experiences.

The “sophisticated” solar-irradiance-modelling picture was later widely published as a key diagram that was instrumental in City Hall’s design process. There is a certain irony to that, since precisely this pictorial tool indicated that the redesigned building form of the Planning Application scheme “cheated a bit” and diluted the chosen design strategies of self-shading and responsive cladding (Interview Thonger, 2011). It ‘evidences’ that Foster+Partners proclaimed maximised use of “building form and orientation” produced particular facade orientations of high solar irradiance. The building form of City Hall does not only follow the sunpath. Arup’s rendering indicates that the upper levels of the many faces directed towards east and west would have the highest solar irradiance exposure of 800W/m^2 (red cones). It seems that Foster+Partners had addressed building form and solar irradiance largely through the perspective of the north-south cross-section (e.g. Figure 6.10). In this section the two-dimensional building shape seems to provide sufficient self-shading. But this is just one orientation of many. To support this argument the juxtaposition of the two-building form outlined in Figure 6.4 is helpful. Foster+Partners never presented an east-west section with interrelated sunbeams, probably for a good reason, since it would have jeopardised their intensely propagated building form logics.

Figure 6.15 demonstrates what were then new ways of envisioning relevant information for design processes, but this newly produced design knowledge did not inform the later facade since Foster+Partners and Arup started to develop a “modular system, which effectively could be used regardless of the orientation […] instead of responding to the facade” (Interview Thonger, 2011). In other words, the facade design became adjusted to one of the 660 office facade panels receiving the projected peak solar irradiance.

Consequently, in the continuing design transformations, the solar irradiance testing of the redesigned building form did not stabilise, but eliminated the response facade design strategy introduced with the Planning Application drawing set. Arup managed to convince the design alliance to give up this strategy. The office facades did not respond any more to different orientations and were designed with the same specifications on all 660 office facade elements.

6.3 Expanding the facade design

This part of the chapter focuses on the continuing design transformations of the facade design geared towards materialisation.

The More London, Foster+Partners and Arup team had decided: "Energy efficiency is of primary importance in the design of the GLA Building" (F+P, 1999a, p. 23). The "Triangular Approach" (Chapter 5) was one important device deployed to transform the energy efficiency objective into building design strategies. The diagram suggested that it was most important to maximise the use of "building form and orientation" (F+P, 1999a, p. 24). In response, Foster+Partners developed three fluctuating building form design strategies (Chapter 5 and 6). The spherical form and orientation were stabilised through a set of geometrical rules by late summer 1999. The "Triangular Approach" proposed making use of "passive elements" as the second most important design issue, addressed and transformed by the design team into a set of facade design strategies (besides other strategies, e.g. "deep space natural ventilation"). Arup had even taken the position that, rather than building form and orientation, it "is the facade treatment that is arguably more significant" (Interview Thonger, 2011). The design team attributed a key role to the design of the facade. The continuation and expanding of the facade design towards buildability is therefore the main focus of the second part of this chapter.

The building facade can be understood as a zone that mediates between the outside and inside. At City Hall this zone is approximately 300mm wide. Rather than a simple *envelope,* it should be understood as a complex, layered device. The facade is one crucial element of how a building presents itself in its form, surface and materiality to its surroundings. The facade therefore plays a significant role in the ways people on the outside perceive City Hall and attribute meaning to it.[49]

This facade can be understood through particular characteristics (transparency, translucence, opacity, thermal conductivity, weight, etc.), protective functions (of water,

[49] Etymologically the word facade stems from the French *face* after the Latin word *facciata* and *faciēs*, which refer to the face, to "form, appearance, visage" (Hoad, 1993).

wind, sun, glare, noise, sight, etc.), and supply functions (daylight, air, views out, views in, thermal gains, etc.), amongst others (Hegger, Fuchs, Stark, & Zeumer, 2008).

Design drawings and documents suggest that the Foster+Partners and Arup teams understood and negotiated City Hall's facade development mainly through four elements:

1. Heat loss (framed through U-values)
2. Heat gain (framed through watts per square metre)
3. Glare
4. Natural ventilation (framed through air flow rate per metre of facade)

These interrelated elements demonstrate how the designers, in their studios and offices, approximated and composed the actual world of the City Hall facade through a set of specific issues. Although other factors - for instance daylight entering the building, the question of how the facade would be perceived, or how windows would be opened - were considered to be influential, they were largely faded out in the 'official story' of the design documents:

> Two major factors determine the design parameters: the amount of heat entering the building through the facade in the summer months, which will require mechanical cooling; and the amount of heat escaping through the facade during the winter months, which will require heating (Shuttleworth et al., 2003, p. 306).

City Hall's expected heat losses were addressed through the specific *heat transfer coefficients* of *U-values* (W/m^2K), which indicate how well a particular facade element transfers heat. The then current requirements of *Part L* (Conservation of fuel and power) of the Building Regulations (DOE, 1995) required a minimum U-value target rating of $0.6W/m^2K$ to be code compliant, which was chosen as a reference benchmark against which to measure City Hall's expected U-values.

City Hall's expected heat gains were understood to have significant effects on the building's energy consumption and effectiveness of its cooling system. Potential heat gains were simulated through computer software and addressed through the coefficients of watt per linear metre of facade (W/m) or watt per square metre of facade (W/m^2). Various types of solar shading devices (frit patterns, mesh, blinds, etc.) were additionally considered to further reduce solar gains and provide glare control.

One of the design team's early design strategies was to provide City Hall with a combination of mechanical ventilation and natural ventilation. "Natural ventilation" was conceived to "lead to reduced energy consumption and running costs, and increased levels of fresh air" (Shuttleworth et al., 2003, p. 308). In exploring the natural ventilation flow rates of particular window or vent designs, Arup used their in-house thermal analysis programme *VENT* to help define their sizes and locations.

The extent of the heat losses and solar gains of City Hall's facade was closely related to its heating and cooling systems. Since the design team had already chosen to deploy a borehole cooling system with passive chilled beams, Thonger made clear that the cooling capacity of this low energy system was limited (Interview Thonger, 2011) and that consequently the facade development had to ensure it would limit internal solar gains to the maximum of 60W/m^2 of facade (Arup, 1999, pp. 3-5). Arup's solar-irradiance-modelling suggested that the chosen building form would exceed 800W/m^2 on several highly exposed panels (Figure 6.15; see colour legend and red cones), which meant that the facade build-up design required a tough reduction of solar gains. At this point, other design teams not dedicated to a low energy and passive design approach would probably have raised the cooling capacity of their chillers in order to deal with the solar gains. City Hall's design team went along another path.

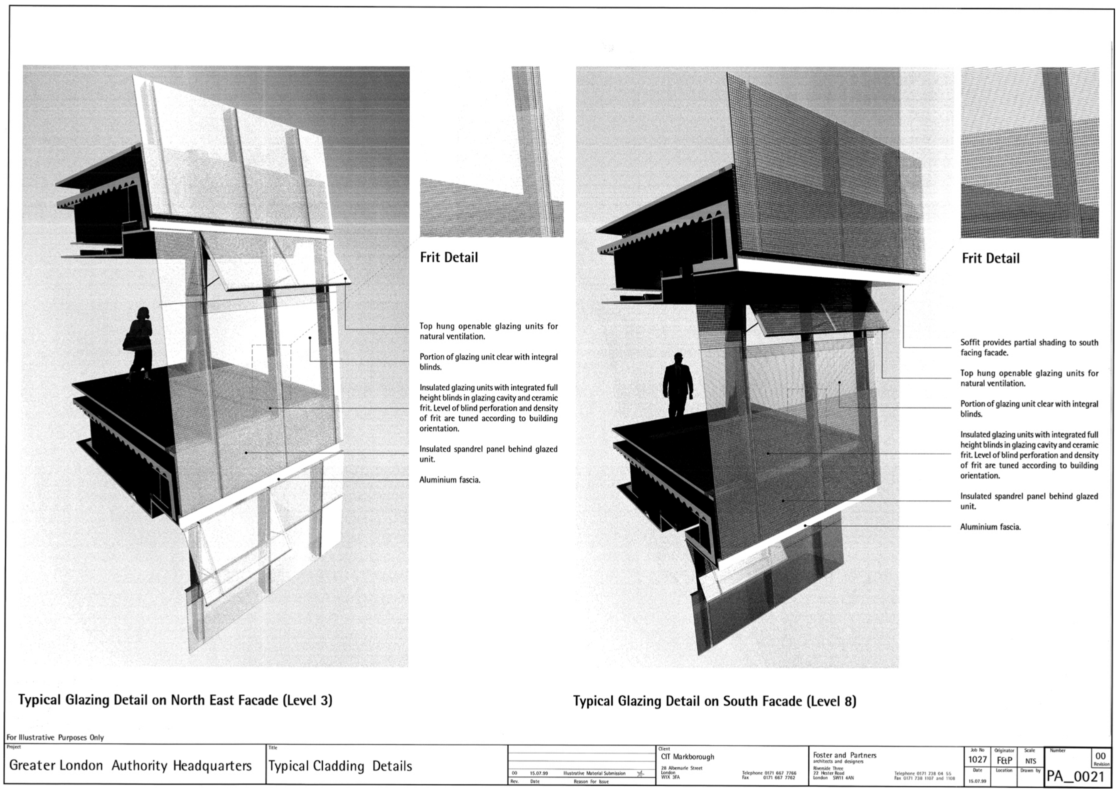

Figure 6.16 One of the first detailed drawings of the facade development, showing full height glazing with "responsive" ceramic frit patterns printed on the glass, 15 July 1999 (Drawing: Foster+Partners, 1999c)

Early models and drawings suggest that the architects at Foster+Partners had a default setting that assumed there would be floor-to-ceiling glazing at City Hall. This might have been partly influenced by the GOL's briefing for a "futuristic", "modern" headquarters expressing "openness" and "accessibility" (TTPM, 1998a). It seemed that at least two worlds clashed: the world of architects' dreams and the world of thermodynamic modelling by engineers. Hyams explained the struggles that came with the emerging facade development in which particular understandings broke down and new ones emerged.

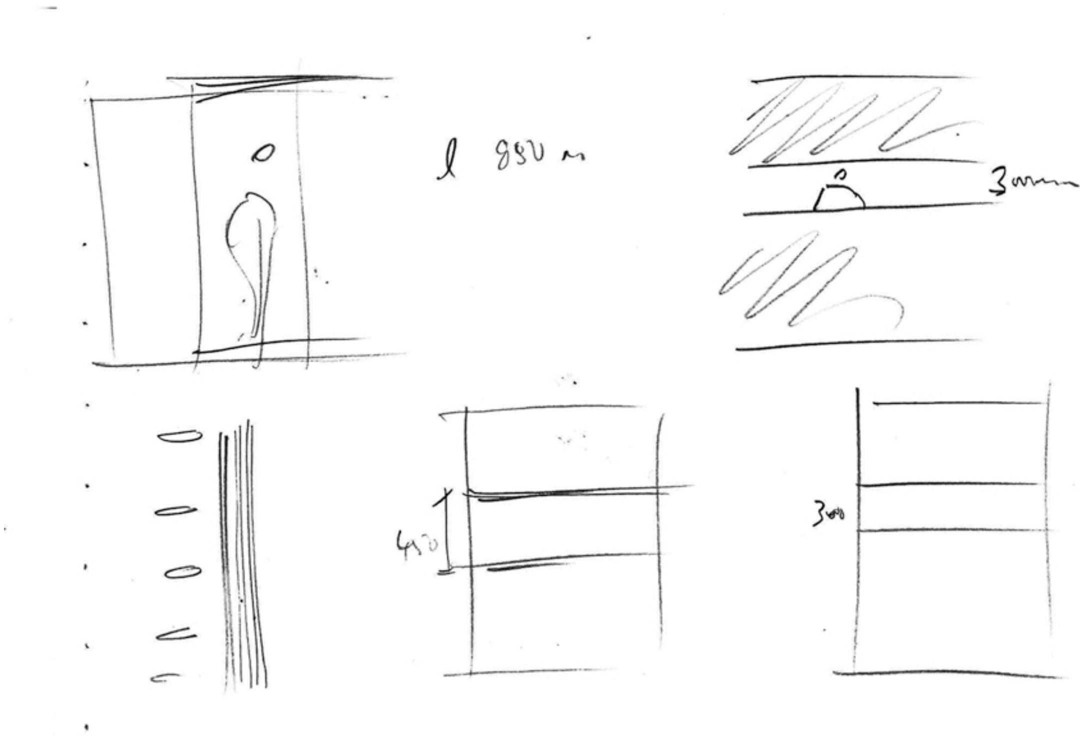

Figure 6.17 Richard Hyams' sketch displaying the "facade journey" from its initial full height floor-to-ceiling glazed facade elements (top left) with limited shading devices (bottom left) to facade elements largely opaque with only 300mm high glazing (top right) (Sketch: Richard Hyams, 2011)

Foster+Partners were building offices "all over the place" and Hyams and his colleagues "looked at them all and thought, actually we can do better than that" (Interview Hyams, 2011). To achieve these ambitions they decided on particular design strategies for the City Hall project: "Make it [transmit] least heat through the skin as possible, as passive an air system internally as possible, natural ventilation and all the things that were normally not seen in offices". He called the picture of Arup's solar-irradiance-modelling (Figure 6.15) the "hedgehog image [...] a really nice image" the first one of its type he had "ever seen" as "visual formal analysis. It was brilliant but I couldn't do anything with it." Hyams translated the data behind this picture into spreadsheets that enabled him "to understand exactly what every single panel on the building was going to do environmentally". He began to understand the interrelation and consequences of differently oriented facade panels, solar irradiance, and a fully glazed faced build-up:

> So there's a whole load of things we had to take into account. But this for me was a day of enlightenment in a sense. When I suddenly understood that this was architecture, this was engineering. And the two had to sit side by side.

Reflecting on the earlier facades of City Hall's design process he said:

> It suddenly dawned on me that [through] the importance of the environmental story that was the moment for me where my kind of whole creative direction literally exploded. […] Because you can't design one without the other. […] I suddenly felt, "oh my god". […] We're all designing things like this that look good on models and have no idea what they're doing. All glazed, floor-to-ceiling glass, all assuming you can put a bit of frit on the glass and it will all be fine. Whereas this is telling me it ain't fine at all.

The drawing Hyams was commenting on (Figure 6.16) shows City Hall's facade design as fully glazed, which "responded" to east, south and west orientated facade panels through on-glass printed ceramic frit patterns and integral blinds. The natural ventilation strategy was projected to have sufficient ventilation through a single openable vent located on top of the facade panel.

It began to dawn on Hyams that there was an irresolvable conflict between the desire to have floor-to-ceiling glazing and the requirement to limit the projected maximum *external* peak solar gain of 850W/m^2 on several facade panels to a maximum *internal* solar gain of 60W/m^2. Hyams pointed out:

> Then I went through what the facade has to do in order to meet the passive air system that we designed the building to. So, actually, if you compared it – if you wanted a complete clear glass approach, the amount of glass you can afford was 300mm, and this [facade element above and below] was all solid. […] So this glass ball isn't a glass ball at all. Because if we're designing this true low energy building, that is how you do it and it's 300 mm.

This process brought new insights into Hyams' understanding of the architectural profession and the worlds of architectural sketching and engineering calculations:

> At this point I was still very much an architect with an architect's head on, looking at shape and form and beauty. And here I was looking at something completely

> different. Still making it beautiful but […] understanding the impact of every line you draw.

Confronted with the solar analysis and the *locked in* approach of passive cooling, the architects at Foster+Partners accepted abandoning their dream of a fully glazed facade. Yet some hope remained; they then thought they could express these findings within the facade design by having a strip of 300mm glass surface in the peak solar gain zones and then gradually move towards fully glazed faced panels in low irradiance areas:

> I thought, wouldn't it be great if it went from that [300mm] up to that [floor to ceiling glazing] all round the building. That was what I was setting myself as a goal for a facade design. Actually what we found out was it goes from 300 to 450. So [the] kind of change over the panels, which I was getting quite in a panic about, was literally that subtle. That was lost on everybody (Interview Hyams, 2011).

The architects eliminated this change since it was considered too subtle and decided to continue with a constant glass height. The "environmental link between this as a study and that as a piece of architecture taught me a hell of a lot […] you can't just create these divisions" (Interview Hyams, 2011). For the Foster+Partners team this was a journey stretching over months in which they explored double glazed units, triple glazed units, external shading, internal shading and different vent layout designs. These options were presented to Liam Bond (More London) who had to agree to pay and take ownership of particular features:

> We were saying it's going to be the best environmental building and what it needed was so much more than ever anyone thought about at the time. (Interview Hyams, 2011)

This journey ended the Foster+Partners team's strategy of "responsive cladding" and dream of floor-to-ceiling glazing for City Hall's offices.

6.3.1 Letting go of the fully glazed facade design

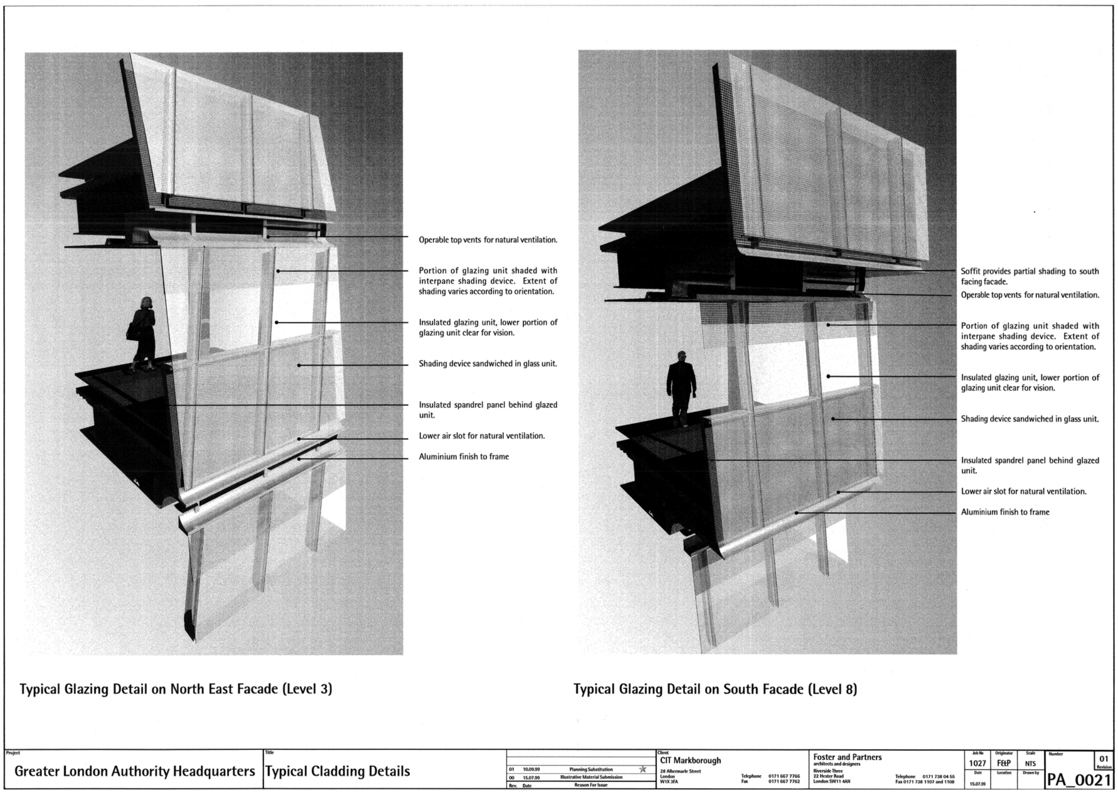

Figure 6.18 Further development of the office facade design introducing the solid spandrel element at the bottom and hidden ventilation vents at top and bottom of the facade panel, 10 September 1999 (Drawing: Foster+Partners, 1999d)

Figure 6.18 shows successive transformation in the office facade development. In comparison to the design previously submitted as part of the Planning Application (Figure 6.16), two key transformations were introduced. First, the team added a solid spandrel element at the bottom of the facade panel. The journey of the facade design stretched over several months and the architects battled for some time over their preference to have as much glazing as possible in the office facades. The double glazed element is conceived to have a solar control interlayer of a metal mesh in order to keep the glazing percentage higher. Sean Afflek called that momentum the “old reluctance” that kept them from “understanding actually what you should do is to make it more solid” (Interview Afflek, 2011). The second important innovation was the addition of hidden ventilation vents at the top and bottom of the facade panel that followed the principle of a traditional sash window. The previous openable window on top with a height of 300mm was replaced by two hidden vents. Arup undertook ventilation flowrate analyses that suggested two 150mm vents located on top and bottom would provide better ventilation than one 300mm single window (as in Figure 6.16). The compact building form strategy (Chapter 5) made natural ventilation more difficult since the floor space was relatively deep - a related effect not previously raised.

6.3.2 Expanding the Scheme Design towards sign-off

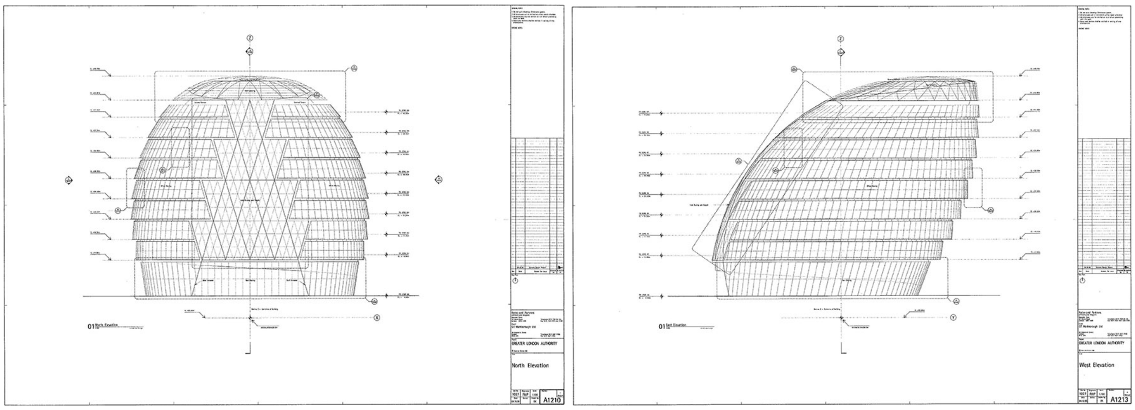

Figure 6.19 Drawings of the north and west elevation of the Scheme Design Report, 4 October 1999 (Drawings: Foster+Partners, 1999e)

In early October 1999, eight months after Raynsford had announced the selection of the More London proposal, both Foster+Partners and Arup completed their Scheme Design Reports to further accumulate design information, outline and detail strategies and specifications for the projected City Hall.

The Scheme Design was identified as the fourth key scheme in the series of many design transformations that City Hall underwent. In comparison with the third key scheme, the Planning Application scheme depicted in Figure 6.4, the Scheme Design presented three important design advancements (Figure 6.19).

First, the changes of the scheme's building form and orientation are subtle – this scheme set out the building form for the first time in geometric detail, through geometric rationalisation, in a way that allowed it to be tendered and made buildable. The spherical form became a little less round and began to step slightly more between individual floor plates. The second significant change was the redesign of the chamber form and facade that was decided on following acoustic studies. Arup had projected considerable repercussion effects for the flask-shaped chamber so, together with Foster+Partners, transformed the spherical flask form into a stepped cone, which was also expressed in the design of the north facade. The third key change was part of the office facade development. For the first time the office facade was represented not as glazed from floor to ceiling but as being opaque in the lower part (see the horizontal line in the centre of individual levels in Figure 6.19).

The Scheme Design reports were further important devices to align the different parties within the design-to-construction process. More London and the GOL were required to "sign-off "proposed design details in order to continue design development towards tendering and construction (F+P, 1999e, p. i).[50] Many of the previously introduced design strategies were reconfirmed and many new elements became associated in the "Employer's Brief, […] General Description, […] Contractor design responsibilities, […] Quality assurance, Quality control and Testing, […] Standard of Materials" and more (F+P, 1999e). Arup expanded design information through the "Engineering Services Design Brief, […] Description of Mechanical Services [...] Electrical Services" and many others (Arup, 1999).

At that stage the "building form and orientation" were geometrically defined, and key design strategies largely stabilised. The challenge for the design team was to make the "passive elements" and "active systems" perform as predicted. This required a complex coordination exercise of integrating the systems, checking specifications, producing tender documents for contractors, checking their interpretations of elements, comparing prices, and more (Interview Kong, 2010).

The Scheme Design report reiterated many of the previous environmental strategies and targets introduced in the Planning Application, for instance:

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[50] The tender process included dozens of individual tender packages that were issued successively, starting with the "basement structure" setting out the concrete works, the foundation design, the bore hole, and later waterproofing, block work, facades, services, metal works, etc. (Interview Kong, 2010).

> Energy efficiency is the primary importance in the design of the GLA Building. The appropriate use of form and orientation are fundamental to the energy efficiency in buildings. […] The facade insulation performance is being set to improve current regulations. […] Having established a sound basis for a low energy design, the design team has applied passive energy saving techniques to further reduce the building energy usage. The energy consumption will be approximately a quarter of a typical office building (F+P, 1999e, pp. 4-6).

The report intended to provide “a statement of the employer’s general requirements for […] the new Greater London Authority Headquarters” with a “general description and basic standards of performance”. Unsurprisingly, the concept of sustainability that was central to Raynsford’s framing of the overarching function of the GLA (cf. DETR, 1998b) remained absent. Also, central environmental design targets were not reiterated, such as the BREEAM assessment (TTPM, 1998a) or the CO_2 emissions target set at 70kg/m^2/annum (TTPM, 1998e). A BREEAM assessment of the GLA headquarters was nonetheless undertaken after building completion (Section 6.4.2).

During the entire design process there seemed to be no discussion as to whether it made sense to have the north facade of the chamber constructed in full glazing. From the perspective of heat losses (and not solar gains), the decision to deploy full glazing seemed to contradict many environmental design guidelines, since significant heat losses were predictable. It was probably in the interests of GOL and Foster+Partners to expose the inside of the chamber to selected views from the other Thames side, Riverwalk and inside of City Hall. These viewing possibilities enabled through architectural design did not mean that the policymaking activities of later GLA members would therefore become more transparent (cf. Yaneva, 2010).[51] The Planning Application did present renderings of the chamber that suggested that the fully glazed chamber facade would allow stunning views over the Thames towards the City of London.

[51] I am referring to the myth that the construction material glass would automatically render activities behind the glass more “democratic”.

6.3.3 Composing and stabilising the world of facade design

The office facade design of the GLA headquarters did not pre-exist; it needed to be constituted and produced through the teams' design practices. While some rough facade designs had already been introduced with the "box" scheme, the *Scheme Design Report*s introduced, not only in drawn but also in written form, detailed specifications. More London and GOL were to "sign-off" on the facade design and continue towards tendering and construction.

A brief comparison between Foster+Partners' and Arup's *Scheme Design Report* highlights their diverging ontological perspectives on composing the facade design: Foster+Partners' *Scheme Design Report* framed and constituted the office facade as trapezoidal panels of aluminum frames that integrate first a "glass window" element on the top, and second a "solid spandrel element at the base" (F+P, 1999e, pp. 10-11). Following an excerpt from their facade definition:

> The office facade is made up of anodised aluminium thermally broken frames, which span vertically from floor slab to concrete soffit. The mullions, spaced at approximately 1.5m centres, are shaped to minimise visual impact on the office floor. The glass window elements are high performance double glazed units with solar control interlayer and low E coating to limit internal heat gain. The panels are trapezoidal in shape (p. 10).

Their facade world was mainly constructed through materiality ("anodised aluminium", "glass", "mesh", "metal"), material characteristics ("opacity", "clear"), thermal characteristics ("high performance", "thermally broken", "low e[mission] coating", "u-value"), forms ("trapezoidal", "shaped"), positions ("top", "bottom", "floor to floor", "spaced at"), perception ("minimize visual impact"), and processes ("allow to be shaded", "air movement"). The key issues taken into account within the design teams energy efficiency objective were heat losses, solar gains and air movements.

In contrast, Arup's *Scheme Design Report* developed the facade design by focusing on two main perspectives: "thermal insulation" and "solar gain factors" (Arup, 1999, p. 3). The first perspective was addressed through u-values. The overall facade element was set to achieve an overall target rating of $0.6 W/m^2K$, composed of a "high performance glazing" of

1.2W/m^{2}K, and a solid composite panel of 0.2W/m^{2}K. These U-values were chosen with the goal of outperforming the then current requirements of Building Regulations *Part L* of 1.5W/m^{2}K. The second perspective defined the "maximum permissible solar gain" in W/m (watt per linear meter) - In other words, the maximum value of solar warmth tolerated and to be transmitted through the facade element. This value was "270W per linear metre of facade, and where possible achieves the target of 180W/m".[52] These targets were intended to be achieved through varying facade build-ups "in relation to the peak incident solar gain associated with any particular orientation". Arup set out a precise definition of the projected variable facade build-up of 24 mm thickness (inside to out): with or without "internal blinds", "6mm clear float" glass, "12mm cavity" with or without "fixed louvres angled to suit the facade", and "6mm high performance solar control glass" (Arup, 1999, p. 3).[53] Arup's facade design mainly constructed through specific thermodynamic coefficients that defined heat losses and solar gains, specific materials and their buildup.

These two approaches demonstrate how the teams redesigned previous facade design strategies - "responsive cladding" was eliminated and replaced by an increasingly uniform cladding. The two approaches further expanded, specified, and stabilised entities and relationships in the design-to-materialisation translations.

Foster+Partners and Arup each produced a largely divergent framing of the facade design through their respective recognition of different entities, attribution of different roles to entities, and by establishing different relations of dependency. These different practices of framing did not develop independently, but were reciprocally shaped during the transient design development. However, they were not always well aligned. In actual materialisation conflicting perspectives and preferences had to be settled in a particular way, in order that the facade design could become one facade on site. For both the architects and engineers it was important to recognise that other values, interests and responsibilities were involved, and that better solutions could be found if the "multiplicity" (Law, 2004, p. 63) of the facade design were recognised and accounted for. While the design team's interests

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[52] Also in the report defined as W/m^2 (watt per square meter): 60W/m^2 (Arup, 1999, p. 5)

[53] Surprisingly, Arup did not specify the build-up of the "solid spandrel element". I assume that this did not pose a design challenge for them and therefore was neglected.

and values were not well negotiated and aligned during the modification of “building form and orientation” design strategies, it was essential for the design teams’ primary “energy efficiency” design objective (F+P, 1999a, p. 23) that the architects did not ignore or overrule Arup’s expertise and responsibility. They relied on this input in order to successfully translate the energy efficiency objective into the GLA headquarters. Shuttleworth’s team had to let go of their dream of full height glazing in response to the constraints of solar gain control emphasised by Arup. While the architects partially refused to let go of their aesthetic preferences in the “building form and orientation” design, they seemed to have learned this lesson during the expanding facade design.

6.3.4 Solidifying the facade design

Figure 6.20 Office facade development of the tender phase that was built later; facade made up of opaque elements on the bottom and top, with a strip of 1,200mm glazing with integrated louvres (Rendering: Foster+Partners, 2004)

The design team tendered and constructed an office facade design that had a 1,200mm high glass window with fixed but manually adjustable aluminium louvre sunshading, within the storey height (slab to slab) of 4,200mm (floor to ceiling of 2,750mm). The office facade-glazing ratio was only about 25%. Compared with the beginnings of the facade development, the design team ended up with a relatively closed office facade. Today, City Hall is the only building in the entire More London development built between 1999 and 2011 that does *not* have a floor-to-ceiling glazed office facade design.

The build-up of the materialised design "is a vented triple-glazed flush facade". The two internal glass layers form the main thermal barrier, comprising top- and bottom-insulated spandrel elements and in between a low emissivity double-glazed unit:

> The cavity between the two skins houses shading blinds, which provide both solar shading and glare control. Natural buoyancy effects drive air movement within the cavity which cools the blinds, thereby enhancing the efficiency of the system. The vented cavity also provides the air inlet for the natural ventilation. An automatic top opening vent allows the hot air to escape at high level when the lower vent is opened (Shuttleworth et al., 2003, p. 306).

In the materialised design the team also introduced a second solid spandrel on the top of the facade panel. It partially contradicted the stepping strategy which was stabilised in the Planning Application scheme: the steps cast shadow mainly on facade areas, which were redesigned as opaque facade zones not requiring any shading after the Scheme Design (see Figure 6.20 right).

The team's "natural ventilation" strategy became enacted through a highly complex system that included two vents, one of them motor-driven, controlled and steered by a sophisticated building management system (BMS). Under each window a vent at low level can be manually opened by occupants to allow direct air intake. In response, a BMS-controlled motor opens a vent at high level to allow for circulation and exhaust.

While Foster+Partners and Arup foregrounded the design-issue-complex of heat losses, solar control, glare control and natural ventilation in the City Hall design reports and design documentations (Figure 6.21), my interviewees also mentioned a vast set of other heterogeneous facade design issues that were pushed into the background or suppressed in the official design documents.

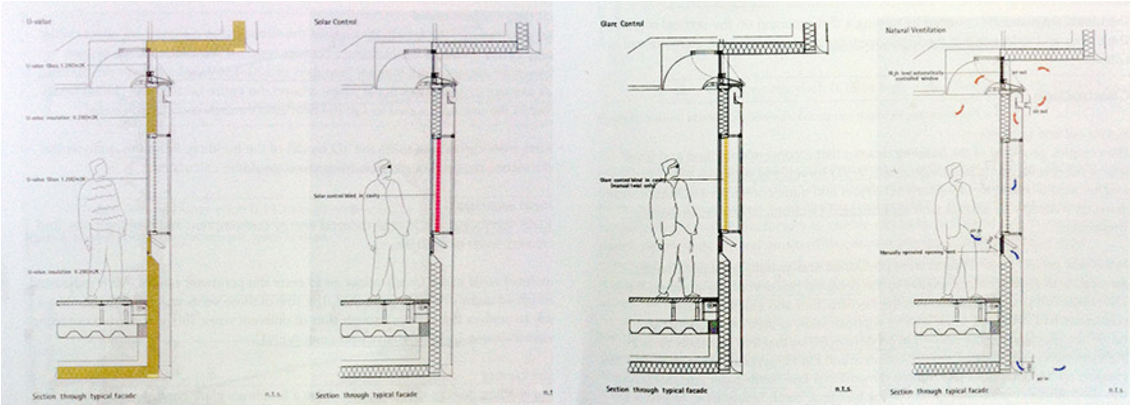

Figure 6.21 Facade design framed through (from left to right) heat loss, solar control, glare control and natural ventilation (Drawing: Foster+Partners in Shuttleworth et al., 2003, p. 307)

For Kong (Foster+Partners) the natural ventilation strategy was linked to a factor that he termed a “psychological advantage”. He argued that the team at Foster+Partners felt that it was important to incorporate natural ventilation, the ability to open windows, “a bit of that outside noise coming in”, to have “fresh air coming in”. It was “an environmental influence within the building that also affected the psychology”. Kong stated that integrating a natural ventilation approach is rare in office buildings and that the Foster+Partners team “fought quite hard to have that in, because [when] you think about how the natural ventilation occurs in the building [...] there’s a vent integrated in the double skin, a micro switch with another vent in the top, so it’s quite a complex integration”. Kong argued that occupants he spoke to were “very pleased and […] they quite like the idea of [not being in] a sealed box” (Interview Kong, 2010).

Afflek (Foster+Partners) added to the co-constitutive facade design issues issues of occupier control, maintenance, reliability and warranty. He argued that it is “really complicated […] trying to step your way through and trying to weigh up completely different criteria to try and make an informed judgement” (Interview Afflek, 2011).

Over a period of more than 24 months, more design issues became increasingly associated during the expanding facade design practices. The design alliance gradually constituted the facade design through a small set of manageable elements. In order to develop and progress the facade it was necessary to define a set of key criteria in order to progress. But defining these sets of criteria was a difficult and responsible task: How far to follow the many associations that are co-constitutive of its design? What elements have not been recognised as potentially relevant design issues? The energy consumption recorded in City Hall's actual operation process (next chapter) exposes that the main consumption is through electrical lighting, not heating or cooling. The lighting issue was not foregrounded and did not enter the main design-issue-complex. When addressing heat losses and solar gains the designers largely neglected to consider how to maximise daylight for the interior. The designers of the facade did not expand the design-issue-complex to consider the reciprocal shaping of heat losses, solar gains and maximising daylight, the latter as a strategy to reduce projected lighting energy consumption.

Temporarily alternative design issues were brought to attention by switching between different framings and representations – specifications (e.g. U-values), reports, physical models, solar-irradiance modelling, drawing sets, cost analyses, 3D geometrical coordinates, projected user behaviours, and many more. But City Hall's design documents and my interviews both indicate that heat losses and solar gains were the design issues that remained foregrounded, and were key factors in the complex shaping of the facade design.

The design team chose "energy efficiency" as a primary design objective in the translation processes of design briefing to materialisation. As shown above for the facade design, this design objective was largely framed and expanded through foregrounding the design issues of heat losses and solar gains. But questions of how to perceive the many transient facade design versions, especially Foster+Partners desire to enact fully glazed facades, were important co-constitutive forces in the translation processes. They were largely pushed in to the background in official design documents and press statements. The architects created physical models (Figure 6.7), sketches, renderings (Figure 6.8) and drawings (Figure 6.18, Figure 6.19, and Figure 6.20). These were important tools in the cognitive moves of "rethinking […], re-interpreting, re-looking, re-doing everything once again" (Yaneva, 2009, p. 200) and were central in order to further transform and advance the facade design towards the actual building. Many of Foster+Partners' arguments and statements regarding City Hall's building form and facade development centre around questions of function and performance. The issue of perception and aesthetic preferences played a crucial role in their translation practices. However, this question remained largely suppressed in design reports and press announcements; although Shuttleworth in a rare statement explained that they as architects obviously also did control the "aesthetic aspects" (in Detail, 2002, p. 1107).

6.4 Materialising design transformations on site

6.4.1 Reframing energy efficiency

The construction of City Hall started on site in April 2000 and the shell and core were completed in October 2001. Its complex geometry posed new challenges within the construction process, which brought into being a ten-storey building of 18,734m^2. During those 18 months 13,000m^3 of concrete were poured, about 4,000 tonnes of steel were welded or bolted together, and 3,844 unique facade panels were adjusted.

Within the "energy efficiency" design objective one question that was largely ignored in the briefing-to-strategy translations was that of "embodied energy". It can be defined as "the sum of the energy requirements associated, directly or indirectly, with the delivery of a good or service" (Cleveland & Morris, 2009, p. 162). Embodied energy was not foregrounded and not integrated into the key design-issue-complexes.

During the GLA property search Raynsford's team had declared that as "environmental issues" both "construction and operation of the building" would be part of the evaluation criteria (TTPM, 1998g, p. 6). TTPM's design briefing specified that the GLA headquarters was mandated to use "sustainable building materials" (TTPM, 1998e). TTPM did not specify what they meant by this. In response, the More London team failed to develop for themselves a definition or to choose an existing material specification guideline to translate this requirement into their design practices.

The construction materials for building City Hall were fabricated across Europe and most probably involved resource extracting and processing far beyond.[54] Between 1998 and

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[54] The diagrid (the structure of the chamber facade), the chamber facade, the facade of London's living room and the internal facade all came from Seele (Gersthofen, Germany). Seele sourced the glass from St Gobain (France). The 660 unique office cladding panels came from Schmidlin (Aesch, Switzerland). City Hall's seven elevators were

2002, and even today, the question of how to account for these networks of sourcing, transporting and producing is still highly contested. Afflek declared:

> Embodied energy, wow that's something which you never really got the handle on at all. You create this device which is gonna save your energy but how much energy have you wasted to install this device on your building and does that really bounce? So it is really complicated […] even today (Interview Afflek, 2011).

City Hall's design objective of "energy efficiency" remained framed and limited in operational terms. While Kong and Afflek stated that material sourcing was discussed as a design issue, it did not enter City Hall's design practices in any depth. I argue that it is surprising that much thought was spent on operational energy efficiency, while the question of which role embodied energy would play in the "energy story" was not even addressed. The question of embodied energy is still a field characterised by a dearth in knowledge. Some studies suggest that the embodied energy of an office building may be around 15% of its total lifetime operational energy usage (Institution of Civil Engineers, 2012). There are many factors that might distort such assumptions. But is seems reasonable to assume that City Hall's low energy design is associated with more embodied energy through its more complex facade build-ups and building service systems. Foster+Partners's declared performance target of "energy consumption will be approximately a quarter of a typical office building" (F+P, 1999e, pp. 4-6) was problematic as the relative importance of embodied energy compared to total operational energy increased fourfold. It gained proportionally and significantly in weight and responsibility.

But the question of material sourcing for City Hall cannot be limited to the singular question of embodied energy. It is a significantly compressed matter compared to "sustainable building materials". Just to follow one material: where did the aluminium for the 680 facade elements come from? Where and how was the bauxite won that is its main

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produced in Finland by Kone. The spiral staircase came from Wagner Biro in Austria. The structural steel was sourced within the UK by West Coal (Northowarm). Suspended ceilings were produced by Astec Projects (Reading, UK) (Detail, 2002, p. 1203; Interview Kong, 2010).

constituent? Which regions and which people were implicated and under which conditions in the extracting and processing of the raw materials?

Without having any detailed information, City hall's material sourcing arguably implicated a complex dynamic that is multifaceted in scope and involves a far-reaching geography of resource extraction, material processing and environmental damage. It has its own specific and unknown "ethical significance […] of the greatest social and cultural importance" (Hagan, 2001, p. 76). To push such questions into the background is not an exemplary practice for designers to follow.

6.4.2 Meeting BREEAM 98 for offices

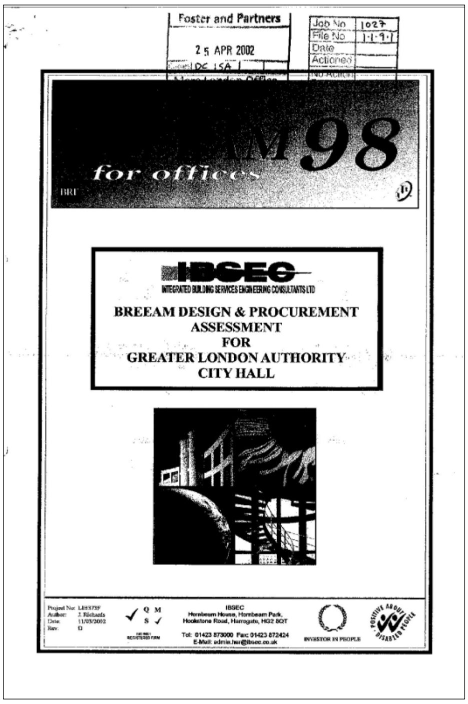

Figure 6.22 Cover of the BREEAM 98 for Offices design and procurement assessment of City Hall (IBSEC, 2002, p. 1).

BREEAM was one key device chosen in the initial design briefing of the GOL to translate the "commitment to environmentally progressive objectives, the principles of sustainability" (Interview Raynsford, 2010) into the design practices of the GLA headquarters. BREEAM was deployed to align the GOL's interests and the design teams' interests in the joint action plan of accommodating the GLA. The BREEAM device was reconfirmed during the design competition as an "important cornerstone for setting environmental standards" (TTPM, 1998e) within the GLA headquarters design competition. Within the design-briefing-to-design-materialisation translation processes, the BREEAM assessment was set as an "obligatory passage point" (Callon, 1986, p. 206).

The initial GOL briefing asked for a minimum rating of "very good" (minimum 55% score). In the final presentation to Raynsford and his advisors, the More London design team promised that their proposed "mask" scheme would achieve the then highest possible rating of "excellent" (minimum 70% score). In March 2002, two months before the opening, the GLA headquarters was assessed through BREEAM 98 for Offices and was awarded the rating of "excellent" with a score of 76.6% (IBSEC, 2002, p. 3).[55] In Figure 6.23 I depict the amount of credits awarded to the building within the nine distinct assessment areas, each differently weighted according to the BREEAM system.[56] The More London team thus managed to successfully translate the BREEAM requirement as one key design target into their design practices, since the BREEAM assessors confirmed the required "excellent" assessment rating.

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[55] Later in 2003 City Hall also underwent a BREEAM "post construction review" in which its "excellent" rating was confirmed.

[56] Through the BREEAM weighting individual credits achieved in different assessment areas do not have the same weight (e.g. 5 credits in "Management" and 16 credits in "Health & Comfort" are each weighted with 15%).

assessment area	weighting	max/ achieved	issue score	total score
Management Overall policy & procedural issues	**15%**	**5/5**	**15.0%**	**76.6%**
Health & Comfort Indoor & external issues	**15%**	**16/13**	**12.2%**	
Energy Operational energy & CO2 issues	**25%**	**17/14**	**21.7%**	
Transport Transport related CO2 & locational issues		**13/12**		
Water Consumption and leakage related issues	**5%**	**6/3**	**2.5%**	
Materials Env. implications of materials selection	**10%**	**11/7**	**6.4%**	
Pollution Air & water pollution issues (excl.CO2)	**15%**	**10/7**	**10.5%**	
Land Use Greenfield & Brownfield site issues	**15%**	**2/1**	**8.3%**	
Site Ecology Ecological valve of the site issues		**7/4**		

Figure 6.23 Diagram proportionally depicting the credit weighting of City Hall's BREEAM 98 for Offices assessment (Diagram: Author 2014, based on IBSEC, 2002)

In Chapter 4 I pointed out that BREEAM 98 for Offices claimed to “ensure a broader coverage of sustainability and environmental issues” (BRE, 1998, p. 1) and argued that the GOL chose BREEAM as one key translation device to explicitly define the heterogeneous challenges implicit in the concept of sustainability for the specific context of the GLA headquarters design practices. Crucially, BREEAM is criticised for compressing (Farmer & Guy, 2005, p. 22) the “explicit qualities of human well-being, social equity and environmental integrity” (Leach et al., 2010, p. 5) into a narrow set of 51 distinct design issues and 87 available credits. Callon highlights that “displacements” occur throughout the manifold translation processes but that “some play a more strategic role than others” (1986, p. 223). The displacement through BREEAM was a very strategic one since the commitment to the concept of sustainability in the context of GLA design practices is clearly not equivalent to a commitment to a BREEAM assessment.

Since energy efficiency was declared a primary design objective and since City Hall’s actual energy consumption caused controversy between different parties during design development and operation, I briefly attempt to unpack how “energy” credits were attributed in assessment. This area addresses operational energy consumption and related CO_2 emissions. Out of the 17 possible credits for energy, City Hall achieved 14. These 14 credits contributed just 11.5% to the total weighted BREEAM score of 76.6% (Figure 6.23).

BREEAM 98 calculates the overall energy score by looking at results in three distinct credit categories. The first possible credit for “sub-metering” was not achieved. Second, one credit for “check-metering” was achieved. The third category is most influential allowing for a maximum of 15 credits and City Hall achieved 13 of them. Credits are awarded on the basis of the energy calculation software, ESICHECK. The software processes heterogeneous design information in order to predict City Hall’s annual CO_2 emissions (e.g. gross floor area in m^2; U-values W/m^2 K of wall, window and roof types; heating and cooling features; location; exterior and interior temperature guideline values; projected occupation days and hours). How the BREEAM assessment report actually arrived at the 13 achieved credits remains concealed.

The result of this software-constructed prediction is that City Hall’s energy use would result in CO_2 emissions of 8.17 $kg/m^2/a$ (IBSEC, 2002, p. 13). This value was far lower than the "challenging" CO_2 emissions target of 70kg/m^2/a defined during design briefing updates (TTPM, 1998e, p. 2). On the basis of the projected CO_2 emissions, the assessment reports declared that 13 out of 15 credits were awarded "mostly due to the electricity being completely derived, under contract, from renewable sources" (IBSEC, 2002, p. 13). It seems that City Hall achieved the 13 credits predominantly through a contractual procurement commitment to source electricity from certified renewable sources. This commitment was the responsibility of the GLA as building occupiers, and not under the control of the More London design team.

In other words, it seems that City Hall did not achieve these 13 credits solely as a result of its low energy design strategies – through the characteristics of its form, orientation envelope, heating or low energy cooling systems – but by buying renewable electricity. Based on the particular credit awarding system of BREEAM 98 – the BRE constructs the specific conventions of how to frame, measure, evaluate and credit specific aspects of building's design and operation – City Hall achieved the highest BREEAM rating possible.[57] In consequence, BREEAM did not just assess the achievements of the More London team's design practices, but also mixed other heterogeneous elements that were beyond the design team's influence, for instance the operational practices of the occupier.

As I demonstrated in the previous and in this chapter, BREEAM was not adopted by the More London design team as an important device to inform the choice and development of design strategies. In City Hall's design practices the BREEAM assessment was an important reference, but did not play a huge role in the making of day-to-day design decisions. Thonger stated, "Yes, we followed BREEAM, […] but […] we don't tend to have to do a lot of extra stuff for BREEAM" (Interview Thonger, 2011). In Hyams' view BREEAM played just a marginal role: "We never really talked about BREEAM all the way through the job if I remember". He stated that BREEAM was not yet a dominant framework in architectural design practice as opposed to "not like you do now. BREEAM is on every meeting agenda every week, it's just asked. Whereas then it wasn't" (Interview Hyams, 2011).

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[57] It is beyond the scope of this dissertation to explore the manual and the definitions it uses.

BREEAM, as deployed by the GOL with the intention to act as powerful device "for setting environmental standards" (TTPM, 1998e), was not significantly adopted within Cities Hall's design-briefing-to-materialisation translations, and thus did not exert much power and influence on City Hall's contingent design trajectory.

On 29th July 1997 the new Labour government announced it would bring back a local government for London. Five years later, on 23rd July 2002, City Hall was opened by the Queen and the first elected Mayor of London, Ken Livingstone. On 16th May 2002 the design team had almost finished their work and handed City Hall over to the GLA. Under the GLA's responsibility, City Hall underwent an eight-week fit-out development.

Upon formally opening the new home of the GLA the Queen said:

> Thank you for inviting me to open City Hall, this remarkable building, which now becomes home to the Mayor of London and the London Assembly. This striking new addition to the capital's skyline is situated amongst some of our best-known landmarks which, over the years, have come to represent not only London but Great Britain for millions across the globe (Queen Elizabeth II, 2002).

At least for the Queen, City Hall seemed to present a successful translation of the GOL's ambition to create a landmark building, but City Hall's low energy objective was not recognised.

6.5 Conclusions

This chapter explored how the design strategies chosen with the "mask" scheme (i.e. the compact building form, the borehole cooling strategy, Chapter 5) were transformed, expanded, redesigned, adjusted through diverse tests, simulations, renegotiations and choices in the quest to make them perform as predicted, further stabilised and materialised.

This chapter focused first on the transformation and redesign of the building form and orientation introduced with the Planning Application scheme. As part of the continued design transformations the design team had significantly redesigned, modified and crucially weakened their design strategies of tilting and stepping building form that were aiming to reduce solar gains (see Chapter 5). Within the manifold heterogeneous design issues associated with building form and orientation the architects were keen to simplify and clarify the advancing building form. The previous, more hybrid building form was increasingly abandoned through diverse model exercises (Figure 6.3) and was merged into modified building forms of more homogenous shapes. Against initial resistance from the GOL, the architects succeeded in pushing through a more “unified scheme” and “a more fluid, dynamic shape” (Norman Foster in, Detail, 2002, p. 1090). This transformation was not neutral, but had far-reaching consequences. With this design move Foster+Partners gave preference to the perception of building form - despite ‘official’ arguments that drew on rather functional explanations - thus accepting higher solar irradiance and the dilution of the self-shading strategy (tilting and stepping) that they had developed and agreed upon with Arup.

The emergence of conflicting design priorities must be seen as a central mechanism of translation process, since multiple heterogeneous issues are built into conflictual relations that shape each other. Different expertise, responsibilities, interests and values clashed between the architects and the building services engineers in the development and redesign of building form and orientation. It was the responsibility of Foster+Partners responsibility to translate the GOL’s interest in a landmark building into design strategies, form and materialisation. If that translation had failed, hardly anyone would hold Arup accountable. This different responsibility for building form also partly explains the dissent over the role of “building form and orientation” between Foster+Partners and Arup in their low energy design maxim. Foster+Partners defined the role as “critical”, Arup just as “significant” (Email Thonger, 2012). The transformation was an enormous modification as building form was deemed more important than low energy design optimisation. Foster+Partners seemed to have overruled the engineers who themselves did not insist on vetting this transformation. The architects failed to take full advantage from the mutual exchange in which engineers “learn about the architectural assumptions, and in exchange the architects learn from these” engineers (Yaneva, 2009, p. 152) in order to achieve the best low energy performance possible. Foster+Partners in part violated both the design teams’ chosen primary objective of energy efficiency and the responsibility to minimise the energy consumption impact as far as possible.

The second part of this chapter focused on the expansion of the facade design. For Arup, "the facade treatment that is arguably more significant" than building form (Email Thonger, 2012). Nevertheless, "building form and orientation", the facade design and the design of building service systems developed in interplay, were enmeshed in multiple heterogeneous design issues at once, and the design practitioners had no choice other than to break down the actual intricacy into alternating small workable design issues and interdependencies (e.g. facade build-up, heat losses, solar gains and air movements).

With the geometrical rationalisation and definition through 3D CAD, the facade design became increasingly expanded, tested, modified and rearranged towards tendering and construction. The design team had chosen a low energy cooling strategy that included chilled beams and a borehole-cooling source (Chapter 5). This strategy had been agreed with the GOL and thus irreversibly stabilised. During the continued facade design, the limited cooling capacity of this approach, in combination with the partially diluted self-shading strategy, triggered a long battle between architects and engineers over Foster+Partners desire to have a 'fully glazed' office facade. Through many experimental moves back and forth, transformations and renegotiations the architects changed their preferences, gave up the "old reluctance" (Interview Afflek, 2011), eliminated their dream of floor-to-ceiling glazing, and adopted Arup's design arguments to make the facade more solid.

One important finding was that architects and engineers could not be locked into fixed roles and values systems – for instance, the preference of perception over performance. The architects' roles and preferences fluctuated as the design alliance progressed and confronted different design issue sets. While Foster+Partners accepted increased solar irradiance of the redesigned building form, they changed preferences, accepted to let go of their desire for fully glazed facades, and instead took other passive design strategies seriously in order to assemble the only largely opaque office facade at the More London development. It was the engineers who changed preferences, this time decided to veto, and thus prevent the assemblage of yet another floor-to-ceiling glazed office building.

This chapter has demonstrated the power of visuals – sketches, diagrams, drawings and renderings - in the translation process. Although different individuals might interpret visuals in different ways (Henderson, 1999), or might refuse them, these visual devices helped align various practitioners in their design activities in the joint action plan towards design materialisation (e.g. the "Triangular Approach" in Figure 6.6), and to participate in the production, accumulation and exchange of design knowledge (e.g. the Planning Application drawing set, as example Figure 6.13). They acted as tools of investigation and negotiation (e.g. Arup's solar irradiance simulation Figure 6.15) and rendered design transformation easier by seeking to stabilise previously introduced strategies in the attempt to make them succeed (e.g. Foster+Partners' "Design Logic Diagrams - Building Form" Figure 6.5).

In the GOL's contingent translation processes, a vast number of heterogeneous elements have been associated, re-ordered, eliminated, tested, simulated and modified in order to arrive at the actual set of design strategies that make up the GLA headquarters. The design team managed to assemble a set of design strategies that are normally not found in most office designs, for instance largely solid facades, chilled beams and borehole cooling source, openable windows (vents), displacement ventilation, heat recovery and grey water tanks. The design protagonists I spoke to share a proud attitude, without exception, towards their overall design achievements. One central design target of the environmental design briefing was the BREEAM assessment following building completion. This target was successfully translated into City Hall's design practices, since the actual City Hall was assessed as "excellent". Whether the design teams also successfully translated other key projected environmental performance goals could only be verified in actual operation and this will be addressed in the next chapter.

Chapter 7

Occupying, managing and measuring

7.1 Introduction

This chapter explores City Hall in operation between 2002-03 and 2010-11. In May 2002 the GOL's initial plan to find, design and build a domicile for the GLA that was associated with an ambitious environmental design agenda had been completed. The design team had in principle fulfilled their tasks, and about 500 GLA members began to take up their work in the new headquarters. The evolving design briefings were largely translated into hypotheses, design strategies, building forms, technological choices and materialisations (Chapters 5 and 6). These translations were then put on trial in operation. Actual materials, devices and occupants could have deviated from or violated their projected roles and behaviours. Would the actual world of City Hall follow the world of predictions? Success was not assured.

City Hall's materialised design was based on an ambitious agenda. Raynsford declared:

> I was particularly keen that this new building […] performed well in energy terms and therefore was seen as an exemplar, which others should follow. So that was part of the brief […] there was a commitment to sustainable development as one of the overarching objectives of the Greater London Authority and it was important therefore that the building that the authority occupied should be compatible with that (Interview Raynsford, 2010).

Given this ambition and responsibility, the actual operation of City Hall was exposed to increased public interest. Predicting environmental performances during design development was risky, since actual performance depended on a variety of rather unpredictable elements, for instance forms of occupancy, management and methods of measurement.

This chapter consists of three main parts. The first part briefly reflects on the coefficient of kilowatt-hours per square metre per year (kWh/m^2/a), which was centrally deployed to understand and assess the environmental impact of City Hall's operation. Since operational performance did not only depend on the materialised deign as handed over, but was also co-shaped by City Hall's building infrastructure management, the second part of this chapter looks at its role and responsibilities, the heterogeneous world in which its activities were embedded, and four key building updates introduced to improve energy efficiency.

The third main part aims to explore how City Hall's building infrastructure management constructed knowledge about the headquarters environmental impact in actual operation. I examine recorded results for the period between 2002-03 and 2010-11. I then compare results for 2010-11 with three key environmental performance targets that were defined during City Hall's design development to guide and align the multifarious translation processes targeted towards design materialisation.

7.2 Framing City Hall's environmental performance

All translations of City Hall's design were tested once the building was in operation. Performance predictions through the kWh/m^2/a (kilowatt-hour per square metre per year) convention were one link between City Hall's design practices and its operation practices.

7.2.1 The kilowatt-hour per square metre framing

The magazine *Building Design* stated on its July 2005 cover page: (Figure 7.1):

> Ken's gas guzzler […] London mayor's 'sustainable' City Hall is missing energy consumption targets by 50% (Building Design & Bennett, 2005, p. 1).

Building Design publicised an explosive political issue, since the GLA and mayor Ken Livingstone had a constitutional responsibility to promote the concept of sustainable development and because City Hall was promoted by the design team as an exemplar of sustainability.[58] The magazine seemed to suggest that the annual kWh/m^2 could be one meaningful indicator to account for the sustainability of the GLA headquarters: "City Hall […] failed to meet sustainability targets". The home of the GLA was accused of missing its "energy consumption targets" by using "376kWh/sqm in 2003-4 compared to the 236kWh/sqm it was designed to use" (Building Design & Bennett, 2005, p. 1). The controversy in *Building Design*'s cover story called into question the validity of the GOL's and the design teams' environmental performance predictions.

[58] Ken Livingstone was the Mayor of London from May 2000 to May 2008.

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Friday July 29 2005

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London mayor's 'sustainable' City Hall is missing energy consumption targets by 50%

Ken's gas guzzler

Ellen Bennett

Norman Foster's City Hall, which is billed as an exemplary sustainable building, uses 50% more energy than it was designed to do.

Figures obtained by *BD* show that the home of London mayor Ken Livingstone and the Greater London Assembly actually used 376kWh/sq m in 2003/4 compared to the 236kWh/sq m it was designed to use.

The figures have emerged just weeks after Livingstone launched the London Climate Change Agency with the pledge to use strong political leadership to "make London the most sustainable city in the world".

The Greater London Authority, Foster's and engineer Arup have repeatedly cited City Hall as an exemplar building in terms of sustainability. The GLA's website states: "The energy strategy for City Hall enables it to run on a quarter of the energy consumed by a typical high-specification office building." This would be roughly 250kWh/sq m, compared to the 376kWh/sq m that City Hall actually consumed last year.

Local MP and Liberal Democrat mayoral candidate Simon Hughes said: "These figures are really worrying. Some of us who were not great fans of the building were persuaded of its merits by its environmental selling points. If the reality is so far adrift from the predictions, then the mayor and the assembly should immediately review what's happening and see whether there are methods for reducing energy consumption in their control.

"If there are more serious and fundamental reasons why City Hall isn't living up to its environmental specifications, somebody must be held to account.

"All of us are rightly challenged to be more energy efficient in our building construction and use; icon buildings must set the example and not promise one thing and deliver another."

Hughes pledged to raise the issue with the mayor.

Building Research Establishment senior consultant Tony Johnson said: "The building is not performing as well as the designers predicted and is not performing so much better than good practice that it should be held up as an exemplar building. Exemplars of sustainability should be aiming at much lower energy consumptions — around 120kWh/sq m for offices."

Johnson added that the Energy Performance of Buildings Directive, which comes into force next year, will force public authorities to publish figures on their building's energy consumption.

Foster's declined to comment but a GLA spokesman said the building housed more people than it was designed to do and that it was also used as a conference centre and tourist attraction. He said: "Comparisons with the design target would be misleading because the building is used in different ways than was envisaged."

Further evidence that the mayor's well-publicised sustainability aims are not always put into practice emerged at a meeting of the Greater London Assembly Environment Committee on Tuesday.

Its report on environmental aspects of the mayor's planning decisions revealed that environmental considerations were not always effectively included in the planning decisions; that the planning department has not implemented all of the environmental policies; and that the mayor has approved schemes that do not comply with his environmental policies, such as HOK's Royal London Hospital.

The report said: "There is evidence of a lower emphasis placed on adherence to environmental policies than on other policies from the London Plan."

Giving evidence to the committee, head of planning decisions Giles Dolphin admitted some applications "slipped through the net". He added that the 18-strong department was understaffed and had to be cautious about directing planning refusals because of the cost of fighting an appeal.

See Leader page 9

Thermal image of Foster's City Hall building, which has failed to meet sustainability targets and uses 50% more energy than intended.

City Hall energy use

Electricity
2003/4: 225kWh/sq m
2004/5: 281kWh/sq m

Gas
2003/4: 86kWh/sq m
2004/5: 95kWh/sq m

Bennetts library is Stirling favourite

Bennetts Associates' Brighton library is the bookies' favourite to win this year's coveted Stirling Prize, but architects contacted by *BD* this week were rooting for Zaha Hadid.

It is Hadid's first time on the shortlist, and her BMW Central Building in Germany is second favourite to win at 4-1, according to bookmaker William Hill. The Brighton library is at 5-2.

The other projects on the shortlist are the Scottish Parliament building by EMBT/RMJM, Foster's McLaren Technology Centre, Brighton's Jubilee Library by Bennetts Associates and the Fawood Children's Centre by Alsop Design.

But there was no place on the list for Terry Farrell's acclaimed Home Office HQ or another widely admired project by Foster's, the Millau Viaduct, France.

The shortlist was praised by some of the country's leading architects, with many tipping Hadid as the likely winner.

"There are some really great buildings on this list, and I am glad that Zaha is on it," Richard Rogers told *BD*.

Colin Fournier, who was nominated for last year's award for his Kunsthaus building in Graz, Austria, called it an "excellent" selection and said Hadid deserved to win.

But Ron Arad claimed the list was uninteresting.

"I think it is time to imagine something new in architecture that is not so predictable," he told *BD*. But when pressed on which scheme he would support to win, he added: "I remember seeing Zaha's BMW project and it is very impressive."

The winner will be announced on October 15 at the Museum of Scotland, walking distance from the Scottish Parliament — a controversial contender for the prize.

BD's verdicts, page 4

Figure 7.1 *Building Design* cover story entitled "Ken's gas guzzler: London mayor's 'sustainable' City Hall is missing energy consumption targets by 50%" (Cover: Building Design & Bennett, 2005, p. 1)

Energy is an elusive topic. Energy consumption in itself is not visible; what is understood as energy consumption critically depends on the methods of measurement, ways of representation and ways of experience (Shove, 1997). *Building Design* defined energy consumption according to annual kilowatt-hours per square metre (kWh/m^2/a).

The kilowatt-hour (kWh) is a physical measurement unit of power, which is defined as energy over time. One kilowatt-hour correlates to the energy that an energy convertor with the power of one kilowatt consumes or releases in one hour. The kilowatt-hour is a common billing unit for energy (electricity and gas) delivered to consumers. The energy consumption of buildings is often represented in kilowatt-hours in relation to a particular building area in square metres for the duration of one year ($kWh/m^2/a$).

The measurement unit of $kWh/m^2/a$ is an insufficient indicator to account for the sustainability of a building, since it only addresses one facet and ignores many of the multidimensional issues implicated in the concept (cf. Leach et al., 2010). Also, as sole indicator of the energy efficiency of a building, the convention of $kWh/m^2/a$ has limitations. If *Building Design* stated that City Hall consumed $376kWh/m^2$ in 2003-4, then the coefficient does not say more than the sum of all City Hall's 'energy convertors' used 376 kWh per square metre in that year. Crucial operational and heterogeneous factors that codetermine the amount of kWh consumed are left out, for instance the number of GLA occupants, their behaviour and working hours, the number of visitors, the actions of building infrastructure managers, variations in annual mean external temperatures and other climate parameters. In addition, the coefficient of $kWh/m^2/a$ does not provide any information about the type of energy consumed, which might vary significantly in terms of associated carbon dioxide and equivalent emissions ($kgCO_2e/kWh$).[59]

The coefficient $kWh/m^2/a$ is thus associated with numerous factors specific to the actual operations of City Hall. Reducing the energy consumption of buildings is a task of great importance, but the framing through $kWh/m^2/a$ has limitations since it depends on a range of heterogeneous factors. It is also necessary to explore and understand the energy performance of buildings through different analytical framings and in relation to other factors. Furthermore, in accounting for environmental impact or the sustainability of City Hall the coefficient in isolation is inadequate.

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[59] For instance, grid electricity $0.5246kgCO_2e/kWh$, natural gas $0.1836kgCO_2e/kWh$ and renewable electricity generated on-site $0kgCO_2e/kWh$ (Carbon Trust, 2011a).

7.3 Managing and updating City Hall

Figure 7.2 City Hall, home of the GLA and open to the public Monday to Friday; foyer, above the chamber, below visitor centre and café (Photograph: Author, 2012)

In May 2002 City Hall was handed over to the GLA. The design team had completed its task to develop the headquarters which Foster+Partners ambitiously promoted as “a model of democracy, accessibility and sustainability” (F+P, 2002). All the assumptions, calculations, predictions, hopes and dreams of the design team were then put to the test in actual operations. The responsibility to enact these ambitions in making the translations of design-briefing-to-design-materialisation perform as predicted was then in part handed over to the new authority. Its challenge was to become an exemplary building occupier and manager. The GLA acknowledged that “City Hall is designed to minimise its impact on the environment” and declared that the “GLA will ensure City Hall is operated efficiently to maximise the potential of the design” (GLA, 2004a). At local management level this responsibility was largely in the hands of City Hall’s facility management team.

7.3.1 The building infrastructure: Management's roles and responsibilities

The facilities management (FM) of City Hall is a broad field comprising the coordination of people, processes, spaces and technologies. It is both bound to ongoing operations and strategically orientated towards the future. In response to changing parameters (e.g. exterior temperature, occupation levels) the FM team has to negotiate a complex set of diverse and interrelated issues in a form of "heterogeneous engineering" (Law, 1987): energy management, environmental impacts, maintenance, optimisations of operating conditions, compliance with regulations, availability of agreed services, running costs, investment costs, security, safety, wellbeing, comfort and quality of the space.

City Hall had been in operation for approximately two years when, in 2004, the GLA began to realise that actual energy performance fell behind the designers' predictions (GLA, 2004b, p. 2). Through the GLA's constitutional responsibility to follow and promote sustainable development (UK Government, 1999, pp. 35-36), the institution had to live up to its own aspirations and was thus under pressure from public scrutiny. The FM team and the mayor were aware that "without improving energy utilisation the GLA will be exposed to adverse press" (GLA, 2008). Energy consumption seemed to be a preferred (but deficient) criterion of accountability (as demonstrated in the article of the *Building Design* magazine).

As part of the GLA's mission to "improve the sustainability of its own operations" and to develop "effective management systems" (GLA, 2004a), the GLA increased the FM team from one to five managers in 2007. One became the Head of Facilities Management at the GLA, one responsible for resilience, one for catering and events, one for questions of security, and one for the building infrastructure of City Hall.

Rennie Kraus became the building infrastructure manager of the GLA headquarters. He is a trained electrical engineer and is responsible for City Hall's facade, structure, mechanical and electrical services. Kraus is supported by a small number of GLA employees and by external "contractors" who assist him in measuring particular material flows within City Hall, programming building management systems, and carrying out smaller maintenance works, repairs and updates (Interview Kraus, 2011).

Unlike a standard office building, City Hall hosts a lot of events for numerous visitors. Kraus commented, “we’re almost an event-based organisation”. City Hall hosts a range of different activities, and it is the responsibility of the FM team to “manage the spaces, manage the cleaning, manage the catering, manage the infrastructure and sort it all out” (Interview Kraus, 2011).

Kraus not only had to ensure that City Hall, as a working environment, supported the GLA staff, but that operational practices also had to follow the GLA’s and the mayor’s overarching principles: “So we have to be in tune with what his [the mayor’s] policies are, and make City Hall appear to be in line with the policy” (Interview Kraus, 2011).[60]

Kraus never mentioned the “Core GLA Environment Policy and Environment Procedure” (GLA, 2004a) in interviews or emails, despite his role also being defined by this policy introduced by Mayor Ken Livingstone. This policy set out “the GLA's aims to improve the sustainability of its own operations; influencing the sustainability of London and enabling it to lead by example”. It applies to “areas where the GLA impacts on the environment, through the management and administration of City Hall (including the catering operations)”.

In Chapter 2 I highlighted the importance of providing context-specific interpretation and definition to the concept of sustainability (Leach et al., 2010, p. 171). While it is beyond the scope of this thesis to enter an in-depth discussion on the above policy, I briefly point out that the role of the FM was defined through a set of building operation related issues that transgressed the single issue of improving energy efficiency. The objectives defined for City Hall’s building infrastructure management are related to a wide set of issues, aims, responsibilities and routines, which cannot be meaningfully understood through the narrow analytical frame of measuring the annual kilowatt-hour per square metre.

As building infrastructure manager of the GLA headquarters, Kraus conceived his main task as “wrestling the energy performance down” (Interview Kraus, 2011). While he explained that City Hall’s design strategies – the building form, the thermal insulation, the passive

[60] Rennie Kraus referred to Mayor Boris Johnson who has been in office since 1 May 2008.

cooling system – all contributed to energy savings, he explained that the activities of the GLA FM team were fitted around that and the FM team tried "to use […] the building to its best advantages". He explained that the borehole cooling system is a low energy cooling source, that the space heating system is powered by gas boilers, but that all other building services are electrically powered: "The building generally is electric." City Hall's kitchen, warm water generation, lighting, air-handling, the pumps for the borehole water, the lifts and IT are all based on electricity:

> So the building has an enormous electrical appetite. […] My tasks have been to try and control how much electricity it needs by changes in technology, changes in regimes and how we manage things, so if I try to get the electricity down and controlled, then I'm in a better position with the building (Interview Kraus, 2011).

Although Kraus interpreted his key task as reducing City Hall's electricity consumption and carbon dioxide emissions, his activities were somewhat more diverse since the key task of energy efficiency had to be seen in relation to other heterogeneous issues. In part, the building infrastructure management's focus on energy efficiency was influenced by the GLA's choice to select and employ an electrical engineer for that role.

Before I explain the central activities that Kraus undertook as building infrastructure manager, I attempt to provide some insights into the practical world of his responsibilities.

7.3.2 Managing a complex building

City Hall is "composite, heterogeneous, and physically localised" (Akrich, 1992, p. 205). Kraus is mainly responsible for City Hall's facade, structure, mechanical and electrical services. His day-to-day working world is made up of eleven floors, 18,734 m^2 of gross floor area, 13,100m^3 of concrete, 4,050 tonnes of steel, 3,844 unique facade panels, seven lifts, six air-handling units (AHUs), two boilers, two 120m deep boreholes, 3,312 luminaires, four building-management systems, 1,950 data points, 14 motor control centres, approximately 400 intelligent unitary controllers (IUCs), supply and control wiring, ducts, switches, plugs and much more. This infrastructural sphere of responsibility cannot be meaningfully understood without including the 500-900 humans occupying and operating the building (through switches, vents, presence, plugs, etc.), and the diverse flows of materials (electricity, gas, water, etc.) that traverse City Hall's technical infrastructure, transformed through boilers, pumps, luminaires and more. Consequently, the operation of City Hall can only be meaningful understood in the reciprocal shaping between technological, social and material elements.

This heterogeneous assemblage that was brought into being by the designers contained particular hypotheses about how the projected occupants would use the building. City Hall suggested specific ways of how it could be operated (openable vents, adjustable blinds, etc.) and its design was based on particular assumptions of how it might be operated (operation hours, equipment, etc.). The building came to be occupied by more than 500 individuals, each with their own preferences for fresh air, temperature, use of devices and so on. It was Kraus's responsibility to explain this heterogeneous machine to the hundreds of occupiers, to understand their needs and modes of working, to fine-tune, adjust and optimise the building infrastructure, to meet the requirements of its diverse users, and to mediate between these facets of City Hall, which became inseparable once it was in operation.

Figure 7.3 City Hall's main plant room with air handling units left and right (Photograph: Author, 2011)

Figure 7.4 City Hall's main plant room with the arrival point of the borehole extraction pipe in the front (Photograph: Author, 2011)

Figure 7.5 City Hall's boiler plant room in the basement (Photograph: Author, 2011)

Figure 7.6 City Hall plant room in the basement with grey water tanks (Photograph: Author, 2011)

7.3.3 Updating City Hall

With building completion many elements of the multiple translations from design briefing to design materialisation had been largely stabilised. But City Hall is not generally a fixed or static object. Rather, I propose conceiving the building as a heterogeneous assemblage that is occupied, used and changed in an ongoing manner (cf. Latour & Yaneva, 2008). Seen this way, City Hall's design continued to transform after the handover from design team to occupier. While key decisions taken during the design process could not be destabilised (e.g. the flawed building form and orientation strategies), others have become transformed and adapted.

The GLA building infrastructure management team was committed to "improve the sustainability of its own operations, […] improve its environmental performance, […] improve energy efficiency", and to introduce "new, more energy-efficient technologies and techniques" (GLA, 2004a).

As noted above, the building infrastructure team interpreted their central task as wrestling the energy performance down – these activities had to be negotiated against questions of compliance with the mayor's and GLA's objectives and questions of acceptability, feasibility and cost-benefit assumptions. Through a process of measuring, interpreting and projecting, Kraus' team attempted to improve City Hall's operational processes. Interventions aimed to optimise the interplay of City Hall's physical elements (fabric, structure, mechanical and electrical services) together with modes of occupation (routines, habits, etc.) and procurement practices. Changes were made in all these areas; some were easy to achieve, some involved huge financial investment, and some involved changes to City Hall's material structure. Below I briefly outline four selected key interventions that have been put into practice. These modifications could have been adopted in the initial design practices, but were either not recognised as relevant design issues or were rejected on the basis of costs that neither More London nor the GOL wanted to cover.

7.3.3.1 Retrofit of door enabling maintenance of air inlet grilles

First, one of the key improvements that Kraus and his colleagues made in 2008 was to retrofit a missing access door to the AHUs (Interview Kraus, 2011). Foster+Partners and Arup seemingly forgot to include a door for maintenance access in their planning documents and design. GLA members complained that the air supply in the building was feeling “stuffy” and, in order to counteract this, they manually opened the vents below the office windows. As a first response, the BMS was established to run the AHUs at their maximum capacity without significant change. The FM team then realised that there was no access door to check the inlet grilles where the AHUs pull in the air from the air duct. They knocked an opening through a wall in the basement to gain access to the grilles for fresh air intake and found that they were clogged with rubbish, which blocked the air from coming in. Cleaning these grilles was a new maintenance activity added to the FM team’s routines:

> They’re now set into the maintenance regime, […] which wasn’t there previously ’cause we didn’t know we had […] the problem until we ran out of air, and we’ve never had a complaint with air since. […] A simple improvement […] made a big difference (Interview Kraus, 2011).

The simple intervention of knocking a hole into a wall led to substantial improvements in air quality and savings in electricity. Dirt and rubbish were elements that were not projected in the design studios and thus not associated or addressed in the multiple translations of design materialisation.

7.3.3.2 Retrofit of voltage optimisation

The second key update introduced to City Hall’s building services was voltage optimisation in 2009. Kraus explained that this strategy takes advantage of the voltage harmonisation within the European Union. To adjust to historically different nominal voltage levels of electrical supply within the EU (mainland EU 220V, UK 240V), electrical equipment is required to operate at approximately 230V ± 10% that is between approximately 207V and 253V. Kraus explained that, typically in the UK, electricity is provided at between 235V and 236V. The basic principle of voltage optimisation is to reduce the incoming voltage level through an electrical transformer. The FM team installed “this device which sits between […] the main switch and the rest of the installation and it drops the voltage in the building to about 220V, and that saves us about 14% per annum on electricity” (Interview Kraus, 2011). The cost of this intervention was approximately £85,000. It enabled considerable savings in energy usage and bills. The payback time was projected to be approximately 3.5

years (GLA, 2008). There seems to be some disagreement about the percentage of savings – a GLA document states that the annual electricity savings of City Hall through voltage optimisation is only 8% (GLA, 2011). Still, an 8% reduction of annual electricity consumption is a major achievement. This efficiency improvement is enabled through a boxed electrical transformer that is locked away in City Hall's basement. It is an achievement not exposed to the direct sensual perception of GLA staff or visitors and is therefore difficult to communicate. In comparison to the design team's intensive efforts to optimise City Hall's building form, this strategy is a simple and effective strategy to improve the goal of energy efficiency.

7.3.3.3 Retrofit of photovoltaic panels

Figure 7.7 Photovoltaic modules on the roof and eyelash of City Hall (Photograph: Sunny Portal, 2012)

Third, the retrofit of photovoltaic modules is a well-communicated update to City Hall. During the design practices initial attempts to integrate photovoltaics (PVs) failed as the extra costs were rejected by both More London and the GOL. At that stage, PVs did not qualify as a strategy that provided "value for money"(Interview Griffiths, 2010). According to Hyams (F+P), even the proposal to prepare City Hall's roof with studs for the later installation of PVs did not succeed. It would have saved a lot of money (Interview Hyams, 2011). The GLA continued to apply for funding to install PVs on the City Hall roof following occupation. First attempts failed but in 2006 an alliance of GLA, More London, the London Climate Change Agency, Foster+Partners, Arup, the Department of Trade and Industry (DTI) and others was successful. The PV modules retrofit was funded by the London Climate Change Agency with £540,000, which was set up by mayor Ken Livingstone in 2006 to tackle climate change by promoting decentralised renewable energy projects, and by a grant of £190,000 from the DTI's Major Photovoltaic Demonstration Programme, which is managed by the Energy Saving Trust (London Development Agency, 2008).

A total active cell area of 417m^2 of over 28,000 individual photovoltaic cells with a capacity of 67kWp (kilowatt-peak) was installed.[61] These comprised 617 modules in nine different sizes, 51 translucent modules of 52.4kWp on City Hall's roof and 46 bespoke translucent glass-glass laminates of 14.6kWp at its eyelash (Figure 7.7). They were projected to generate 50,000kWh/a. City Hall's spherical shape thus posed a significant challenge to the team that designed, developed and installed the photovoltaic modules. Adjusting the solar modules to City Hall's spherical form required the design and manufacture of custom trapezoid-shaped solar panels. More London's spherical building form strategy was not well suited to the installation of PV cells in the most ideal orientation. Ideally, they should face within 45 degrees of south and are sloped at an angle of 30 degrees to the horizontal (Carbon Trust, 2011b).

The architects argued that City Hall's form would reduce solar gains through self-shading. Regarding PVs, this logic largely turned against itself. It was a predominantly aesthetic design decision to have all photovoltaic modules sit flush on City Hall's spherical shape. Most photovoltaic cells on the roof are tilted north rather than south, and the cells on the eyelash are much steeper than the ideal angle of 30 degrees. The installation would have been much simpler, financially cheaper and made more effective use of energy had standard rectangular solar panels been placed in an ideal orientation as add-ons on the top of City Hall's roof. But that would have compromised City Hall's monolithic shape.

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[61] Kilowatt-peak (kWp) is a measure of the nominal power of a photovoltaic solar energy module under laboratory illumination conditions.

Technology, money, efficiency and perception become inseparable in the retrofit of photovoltaic cells.

Since operations commenced, City Hall's photovoltaic cells have not reached their predicted electricity generation of 50,000kWh/a, and have instead delivered between 30,000 and 38,000kWh/a. This amount is approximately 1% of its total electricity demand and equals approximately £2,700 in electricity bill savings. In principle, this can be translated into a payback time of 280 years for the investment of £750,000.[62] But payback evaluations should be framed through the UK Government's Feed-In Tariffs scheme for electricity-generation of renewable or low-carbon sources.[63] Confronted with the contribution of photovoltaic cells to the total electricity consumption, Kraus commented: "1%, […] I think 1% is fine"(Interview Kraus, 2012). So how should the intervention of PVs be evaluated? Kraus' team was committed to obtaining "best value and achieving value for money" (GLA, 2004a) and, in the case of the photovoltaic retrofit, it becomes obvious that *value* is a term open to interpretation. From a financial perspective the photovoltaic modules did not provide value for money. But, crucially, value was associated with potential symbolic value: as a pioneer project of the mayor's policy target to increase PV electricity generation within London, the PV modules are perceived by passers-by on the river walk, provided they are familiar with the appearance, principle and contribution of PV modules. Some oppose the enactment of PV electricity generation sine the production of PV cells largely depends on significant energy and material resource inputs. Nevertheless, in February 2008, during the official opening of City Hall's photovoltaic panels, Ken Livingstone declared:

> Reducing carbon emissions in order to tackle climate change is the biggest challenge facing this planet. This renewable energy scheme is an example of City Hall leading by example (London Development Agency, 2008).

The integration of PVs failed during the multiple translations from design briefing to design materialisation. But following City Hall's building completion, the retrofitting of

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[62] Based on 35,000kWh/a, a constant price of 1kWh = £0.076265 (City Hall's day tariff with EDF in 2011) and no interest rate.

[63] See https://www.ofgem.gov.uk/environmental-programmes/feed-tariff-fit-scheme/tariff-tables

photovoltaic modules in February 2008 succeeded, and was a key intervention chosen by the GLA in its attempt to promote City Hall as an exemplary building in renewable energy generation. It was not the voltage optimisation intervention that was chosen to be communicated to the public, despite the fact that it was cheaper and led to more significant reductions in energy demands.

7.3.3.4 Retrofit of increased energy efficient lighting

The fourth key adaptation to improve City Hall's energy efficiency was to begin replacing 1,200 tungsten luminaires with either fluorescent or LED lamps and a refinement of the ways in which lighting is controlled. According to Kraus and the GLA, lighting is the single largest source of electricity consumption in City Hall, estimated at approximately 42% of all electricity usage. In comparison, the generalised ECON 19 guideline suggests lighting should account for only 26% of total electricity usage for type 4 office buildings (DETR, 1998a, p. 20).

Figure 7.8 Different types of lighting on floor 6 (Photograph: Author, 2010)

For Kraus' team the question of lighting brings together heterogeneous elements. Generally, good quality lighting is important for building occupiers, but what that means in practices remains contestable. Lighting is important for human sensory input (which relies to a large degree on sight), for comfort and well-being, and as an architectural design element. Lighting brings together four crucial elements: lamps, control gears (a ballast or driver for the lamp), luminaires (the casing of the lamp) and controls (e.g. a switch). Key characteristics of lamps are their efficiency (measured in lumen per watt lm/w),[64] expected lifetime, costs and ability to render colour. The affectivity of lighting depends on the lamp efficiency, its control (whether the right light is on at the right time) and its suitable lumen level for a particular purpose.

City Hall contains more than 3,300 luminaires, which are partially equipped with two or more lamps. Kraus declared that the lighting design of City Hall's fit-out was partially deficient as one of the lighting designers

> made a mistake. […] Lighting design in the offices […] is fine, but on all the common spaces he put in twelve hundred bloody tungsten halogen lamps, […] 90 watts each (Interview Kraus, 2011).

Kraus argued that the tungsten downlights are not an efficient lighting source as90 watts of tungsten halogen generate about 85 watts of heat and only 5 watts of light:

> There's a major cost-saving if you can get rid of the halogen in terms of the energy it's taking and […] the heat it gives to the building that you have to cool.

In other words, the tungsten lamps have two negative aspects: a low luminous efficacy and a relatively high heat radiation, which increases the cooling loads when cooling is required:

> There's so many lights in this building, we're finding that it's […] budget amongst other things which are the constraints on being able to do the changes that you want to do; […] we've still got quite a distance to go with that, but it will improve.

[64] Lumen (lm) is a unit to describe the amount of light that a lamp produces.

In total, City Hall contained 1,200 90W tungsten lamps as circular downlights inserted within the ceiling soffit (see luminaries for instance on the ceiling of the elevator lobby shown in Figure 7.8). In non-public areas the FM team has started to replace some of the tungsten halogen lamps with fluorescent lamps described as a "utility type lighting". Kraus explained: "If I can save 30 kilowatts by changing the lights to fluorescent, that's a significant saving and will drive the cost down." But the fluorescent lamps do not fit within the luminaires - they stick out. This was considered acceptable only for non-public areas. In the public areas the FM team began to replace the 90W tungsten lamps with 9W LED lamps. But this also required changing the luminaires costing £80-300 each. Given the total number of 1,200 lights, this was still a big investment (Interview Kraus, 2012). Kraus' choices were driven by the trade-off between investment costs, the duration of lamp lifetimes and the overall lease agreement between the GLA and More London (25 years, from 2002 to 2027). For the lighting upgrade, "cost benefit […] is significant". The FM team works with payback timeframes of three to three and a half years. They monitor the changes over time to prove interventions have been effective. Manufacturers' predictions of life expectancy, light output and electricity consumption of lamps can be checked once they have been installed.

Kraus considered the tungsten lighting partly responsible for City Hall's failure to live up to Foster+Partners' prediction that the building would consume only 25% energy of a typical office (F+P, 1999a, p. 5). The lighting designer "could have started with a more efficient lighting system, and it would have been nearer the25%. They didn't […] follow the guidance or stay as close to it as they could [have done]" (Interview Kraus, 2011). Updating the lighting sources was only one part of the FM team's strategy towards lighting; other interventions targeted the ways in which lighting was controlled.

Here I have explained four selected adaptations by the GLA building infrastructure team that are relevant for my perspective of translation. Foster+Partners and Arup "inscribed" (Akrich, 1992, p. 209), through the multiple translations from design briefing to design materialisation, particular hypotheses and assumptions into City Hall. In actual operation, some elements deviated from their predicted performance, for instance the air handling units that did not operate as they should have. In order to deal with the complexity of City

Hall's design, Foster+Partners and Arup chose particular alternating and small workable design issues and interdependencies. In the construction of design strategies rubbish clogging the air inlet grilles was not captured as a potential force that would affect operation. The materialised lighting design had significant consequences for operational energy consumption, and was an element largely neglected in translation. Kraus and his team's updates therefore present particular corrections and refinements to the initial design translations.

The updating of City Hall will continue further in the future. Kraus' efforts are directed towards achieving the projected energy consumption targets launched by Foster+Partners, that City Hall would use only 25% energy of a typical office building:

> Since I've been here I may have been driving it [the electricity] down towards the 25% […]. I have been tackling it and I've been […] wrestling the energy performance down. […] We're not there yet, we've still got a distance to go, but I'll get there (Interview Kraus, 2011).

In order to compare predicted environmental performances with measured performance, I will now explore how City Hall's building infrastructure management produced knowledge about the headquarters environmental impact and describe its key findings.

In order to compare predicted environmental performances with measured performance, I next explore how City Hall's building infrastructure management produced knowledge about the headquarters environmental impact of operation and what its key findings were.

7.4 Approximating the actual environmental impact

7.4.1 Creating knowledge about the environmental impact of operation

The GLA assigned a central role to City Hall's building infrastructure management in its commitment "to improve the sustainability of its own operations", to "reduce the organisation's environmental impact", to "lead by example", to "maintain high standards of energy and environmental management", to "continuously improve its environmental performance" and to "monitor performances" (GLA, 2004a). The "environmental impact" of the GLA as an organisation, of the "core GLA" defined as "the Mayor, the London

Assembly and their staff", and of City Hall as the GLA headquarters, are in principle different analytical perspectives. Yet the latter two in particular are interrelated and cannot be neatly disentangled.

From their design studios and offices, Foster+Partners and Arup approached the question of how to frame the environmental impact of City Hall's operation largely through the issue of energy efficiency and carbon dioxide emissions. The GOL, Foster+Partners and Arup each defined specific performance predictions to guide and align the heterogeneous design practices in developing City Hall that were defined through the coefficients of $kWh/m^2/a$ and $CO_2/m^2/a$. In part 7.4.4 I compare these predicted performances with measured performances in an attempt to evaluate the translations of design briefing to design materialisation.

I have already argued that the 'environment' is a vague concept that resists being defined in an unambiguous way (cf. Schlosberg, 1999). Following this, I suggest that the 'environmental impact' of City Hall's operation is also difficult to define. City Hall's environmental impact can be seen as the short- and long-term consequences of the (system-like) interactions between heterogeneous elements: the building as materialised by the designers (the arrangement of e.g. spatiality, forms, materiality, and devices) that enabled and suggested particular forms of occupation and usage; the diverse activities of occupants and building infrastructure management (e.g. opening vents, switching on lights, and management, procurement and commissioning practices); diverse material flows (e.g. electricity, gas, water) upon which many occupational activities depend. Essentially, the building infrastructure management's understanding of City Hall's environmental impact depended on the scope of material flows and material transformations that they themselves took into account, recorded and re-represented. In other words, 'environmental impact' was understood in terms of how the GLA itself created knowledge, in turn omitting several other aspects in this process (e.g. emissions of nitrogen oxides and sulphur dioxides released during gas combustion were not monitored).

In May 2002 the GLA began to operate City Hall. Since then the FM team has started to collect and transform data, producing diverse representations. As time has gone on the FM team has expanded the scope of data collection. Thus City Hall and its occupation has increasingly become better known. Meters play a key role as instruments of control and knowledge production (Akrich, 1992), and did so in the attempts to define and construct the environmental impact of City Hall's operations. The FM team's practices of taking meter readings have transformed significantly. Initially, they recorded key utilities on a manual basis: main meter readings were taken once a day, Monday to Friday, and written down on a paper-based schedule. Due to cost considerations, the FM team has only gradually begun to retrofit smart meters and sub meters, which were not provided with the design provided by the More London team (GLA, 2004b). The retrofit aimed to produce more refined knowledge of operations. Smart meters are electronic devices that automatically record and store particular activities in predefined temporal intervals (e.g. daily, hourly, half hourly). They do not require to be manually read as information is stored and can be transmitted on request to, for instance, City Hall's external electricity supplier EDF, to GLA internal databanks and to the headquarters' BMSs, which can initiate particular actions (e.g. open or close valves) in response. This way, particular material flows (e.g. borehole water) can be monitored, information stored and retrospectively checked. Sub-meters help the building infrastructure management to advance a more detailed understanding of where, how, when and which quantities of, say, electricity City Hall consumes.

Kraus's team installed additional smart and sub-meters mainly to monitor and control the electricity consumption of specific areas and zones:

> The meter […] can produce accurate data about what's going on. […] That is then sent to a central point, which I have access to, and I can monitor […] all the meters in the building. For instance, I can look at a discrete meter on the seventh floor east, then compare it to a discrete meter on the seventh floor west. It's about energy conservation, energy usage, who's good, who's bad, […] who doesn't turn the computer off, I can tell you (Interview Kraus, 2011).

With the smart meters Kraus and his team claimed that they could monitor particular activities locally. The analysis of this data is crucial in enabling the team to check energy reduction strategies and to consider new interventions.

City Hall's environmental impact through operations was never completely known and its approximation relied on particular trials, comparisons, calculations, expansions of scope, checking readings, taking new readings, and was represented through *Excel* spreadsheets and as specific sets of issues assembled in summary reports.

During the first years of operation information was mostly represented and summarised in yearly "utilities" sheets, produced per financial year. Data collection and representation have since become expanded through more comprehensive "FM Statistics" produced on a monthly basis. The utilities sheets covered monthly and total yearly quantities of measured electricity consumption (in kWh), gas consumption (in kWh), carbon dioxide emissions (in CO_2t) calculated through specific conversation factors from measured electricity and gas consumptions, borehole water abstraction and discharge (in m^3), and mains water (in m^3) (GLA, 2009). Figure 7.9 depicts the summary page of the FM Statistics from December 2011, including a review of the previous twelve months from December 2010 that enabled a retrospective comparison. Multiple issues are assembled in related *Excel* worksheets from which individual datasets and graphs can be retrieved. Beyond grid electricity (kWh), gas (kWh), carbon dioxide emissions (CO_2) and main and borehole water (m^3), the FM Statistics capture additional material flows and transformations. They also represent electricity production through City Hall's photovoltaic modules – data retrieved online beforehand from the external *Sunny Portal* provider.[65] The GLA's waste separation practices are documented in two main categories: residual waste (kg) and waste collected for recycling (kg). A breakdown of the latter is produced by the recycling contractor, *Bywaters.* Next to the selected material flows and transformations, the FM statistics document diverse occupational activities that took place in City Hall during this time. These include room bookings, room use, televised events and visitor numbers, amongst other issues (GLA, 2012). In Figure 7.14 I have attempted to detail the scope of selected measured material transformations and respective quantities for the period April 2010 - March 2011.

[65] See Sunny Portal webpage for information about past and ongoing photovoltaic electricity generation of City Hall [accessed 1 December 2013]: http://www.sunnyportal.com/Templates/PublicPageOverview.aspx?page=8f35bd18-5407-487c-8378-33688c0bbe5a&plant=00cddb27-1baf-4d19-9cdb-b54e4f184056&splang=en-US

The FM Statistics represent selected issues in the attempt to account for City Hall's actual environmental impact. They are devices with which to communicate and render visible material transformations operations that are themselves difficult to comprehend, since they in part elude sensory perception. The ways in which these textual and visual displays have been constructed through diverse transformations - framing and capturing particular activities, meter reading, adding and calculating data - are selective, biased and not value free.

In the next section I explore the quantitative recordings of material flows captured. I begin with the period from 2002-03 to 2010-11, and then analyse material flows between April 2010 and March 2011 in more detail.

FM STATISTICS	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11
Switchboard Calls													
Calls Received	2,121	2,840	2,926	3,407	2,453	2,968	3,318	3,122	2,840	3,011	2,913	3,246	2,434
Calls Answered	99%	99%	99%	99%	99%	99%	99%	98%	99%	99%	98%	99%	98%
Average Speed of Answer	5 seconds	5 seconds	5 seconds	5 seconds	6 seconds	7 seconds	7 seconds	7 seconds	6 seconds	5 seconds	6 seconds	6 seconds	7 seconds
Calls Made Out of Hours	248	159	121	158	271	198	209	226	358	202	264	196	248
Helpdesk Calls													
Calls Received	914	1,072	1,069	1,353	951	1,168	1,146	1,164	952	1,313	1,245	1,246	961
Calls Answered	96%	94%	96%	96%	95%	96%	96%	94%	96%	96%	95%	96%	96%
Average Speed of Answer	7 seconds	8 seconds	8 seconds	8 seconds	7 seconds	8 seconds	7 seconds	9 seconds	8 seconds	8 seconds	8 seconds	7 seconds	8 seconds
Reception - Visitor Notification													
Number of Visitors	1,580	2,139	1,526	2,402	1,435	1,786	1,978	2,223	2,075	2,164	2,528	2,678	1,765
Total Unnotified	62%	49%	57%	54%	56%	58%	59%	67%	63%	54%	58%	56%	53%
Helpdesk Jobs													
Jobs Logged	563	1,005	585	639	740	693	621	928	692	714	966	874	603
Jobs Completed	92%	92%	97%	97%	97%	95%	79%	97%	97%	98%	98%	97%	97%
Room Bookings													
Bookings Administered	3,960	7,045	6,359	4,501	3,993	5,697	2,894	5,977	4,367	5,010	5,842	5,818	5,369
Rooms Booked Online	25%	16%	17%	32%	23%	19%	41%	22%	29%	28%	24%	24%	19%
Resource Utilisation													
Meeting Rooms	53%	55%	54%	64%	66%	57%	50%	51%	67%	73%	83%	78%	75%
Corporate Shared Desks	29%	37%	40%	43%	36%	49%	59%	74%	85%	98%	72%	93%	72%
Recycled Waste													
Total waste (kg)	13,690	10,610	14,040	13,130	10,524	16,057	16,238	15,931	10,376	17,399	16,734	16,904	16,633
Total recycled	68%	74%	77%	75%	75%	74%	78%	78%	80%	82%	79%	78%	84%
Food Waste													
Compost collection-monthly total (kg)	2,186	2,341	2,860	3,130	1,724	1,665	3,145	2,470	1,896	2,699	2,344	2,344	3,230
Estimated compost produced (kg)	481	252	622	680	375	333	629	494	379	540	469	469	646
Utility Consumption													
Electricity (kWh)	302,160	290,930	267,050	266,420	242,260	244,030	254,380	256,090	251,310	259,980	262,060	282,140	
Gas (kWh)	346,571	229,253	184,631	179,068	74,840	55,120	34,245	16,825	21,694	25,339	55,973	116,141	tba
Water (m3)	177	171	179	189	158	172	239	214	174	208	217	231	
Off-site Archiving													
Retrievals	222%	5%	n/a	tba	58%	54%	24%	34%	65%	6%	28%	45%	28%
Returns	22%	8%	n/a	tba	0%	4%	17%	29%	12%	3%	56%	7%	4%
Televised Meetings													
Number of meetings	165	195	205	280	214	227	269	237	185	316	297	324	249
Televised meetings	6%	5%	5%	6%	3%	4%	6%	7%	1%	5%	3%	5%	4%
Security													
Security check count-Monday to Friday	7,486	9,657	8,557	14,356	8,017	11,640	11,909	11,845	5,819	15,299	7,750	10,333	7,983
Security check count-open weekends	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	5,095	n/a	n/a	n/a
Incoming Mail													
Total mail weight (kg)	614	571	430	615	543	474	515	593	517	670	593	545	713
Total number of bags processed	97	95	83	105	76	67	8	86	78	79	76	71	90
Outgoing Mail													
Total number of items sent	14,460	4,900	6,770	5,861	5,007	9,754	6,318	3,536	8,054	12,799	8,786	4,501	14,480
Total cost (£)	4,382	1,988	2,474	4,376	2,508	9,644	3,038	2,539	3,289	5,900	3,083	2,394	5,296
Post Cross –Charging figures													
Total cost - all departments (£)	262	237	934	633	354	6,953	599	552	98	1,955		249	942
- Communities & Intelligence					73%								
- Culture Team		71%		17%									
- Development and Environment			84%			6%							
- Environment & Housing						2%							
- External Affairs	36%			28%	27%	89%	40%		100%				10%
- Health and Communities	64%		16%			3%							
- London Plan								43%					
- London 2012				55%									
- Marketing												39%	
- Mayor's Fund for London							22%						
- Planning (D&E)								57%				61%	
- PLU/Culture										100%			
- Secretariat		249%					38%						
- Transport&Environment													90%

Figure 7.9 Summary page of the *Detailed Facility Management Statistics,* December 2011, including a review of the period December 2010 - November 2011 (Chart: Greater London Authority, 2012)

7.4.2 Recorded material transformations from 2002-03 to 2010-11

Using GLA data, this section traces City Hall's recorded material flows since its official opening in June 2002. Most annual data from City Hall's FM team is framed according to financial years, beginning in April and ending in March the following year. In Figure 7.10 I have attempted to capture City Hall's quantitative material flows in the financial years from 2002-03 to 2010-11.[66] I have thereby collected particular material flows. I display them in a single diagram in order to 'draw them together'. In this way they can be explored in their quantitative relation and over time.

Since operations commenced, City Hall's FM team has purchased electricity from EDF that has been certified a 100% renewable electricity source through the Renewable Energy Guarantee Origin (REGO). However, "due to concerns over the complete suitability of these tariffs raised by GLA Energy policy advisors the CO_2 calculation utilises the Grid average" (GLA, 2009). Whether CO_2 emissions from grid-sourced 'renewable' electricity should be included or omitted in constructing City Hall's environmental impact was a controversial issue. The FM team based their CO_2 emission calculations on factors of 0.00043tCO_2 per kWh electricity and on 0.0002tCO_2 per kWh gas (GLA, 2009). Crucially, one kWh of grid electricity is estimated with more than double the amount of CO_2 than one kWh of gas consumption. This comparison evidences that kWh (or kWh/m^2/a) in isolation have limited explanatory value. I consider the diverging CO_2 emissions shares for grid electricity and gas in Figure 7.10. Since the validity of CO_2 emission shares of the grid 'renewable' electricity was contented, I visually represent these (and totals) in dotted lines.

[66] Since City Hall was occupied only in June 2002 the data for the year 2002-03 is based on months from June 2002 to March 2003 only (10 months). I stopped exploring the material flows in the financial year 2010/11 when my fieldwork came to an end.

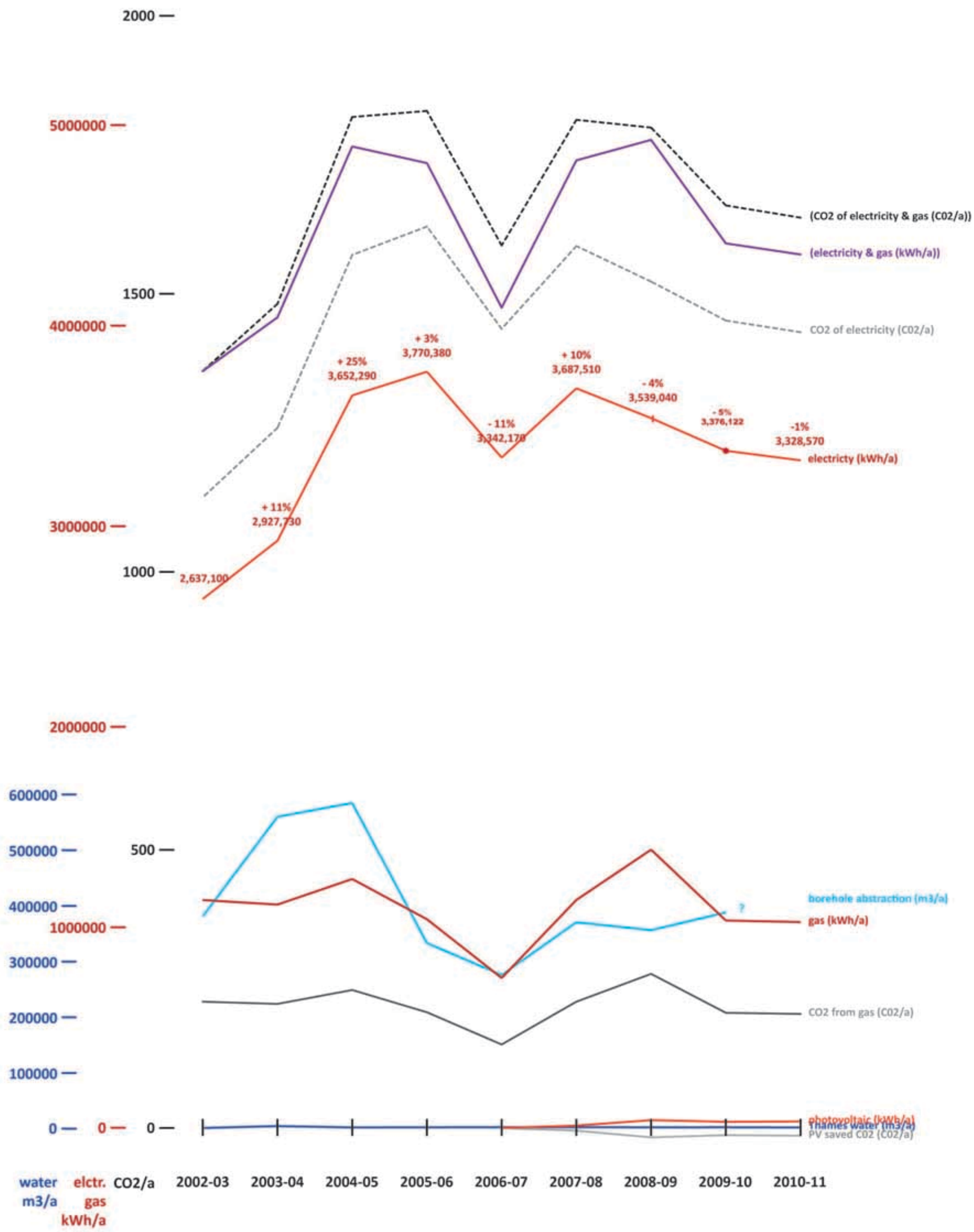

Figure 7.10 Material flows monitored in City Hall, 2002 to 2011 (Diagram: Author, 2014, based on GLA data)

Gas consumption increased slightly in the first years of occupation up to 2004-05, while electricity increased by approximately 39% until 2005-06. For the year 2006-07 the consumption of both gas and electricity was surprisingly low - electricity consumption was 11% less than the previous year - but they rose to previous levels by 2007-08. During one interview I showed Kraus an earlier printed version of Figure 7.10. Kraus admitted that he had not seen a graphical representation of material transformations (nor of electricity in isolation) between 2002 and 2011, and that he was not aware of an apparent decline in the consumption of electricity, gas and borehole water for 2006-07. His first reaction was that the decline and graph might be based on a data error. From his computer he pulled a data set of various readings for 2006-07, but we did not detect any missing data that could have explained the drop. In the end, Kraus' interpretation was that 2006-07 probably had a cold summer and mild winter. Weather conditions are another idiosyncratic force co-shaping consumption. Electricity consumption since 2007-08 dropped annually by 1% to 5%. It seemed that the central objective of "wrestling the energy performance down" (Interview Kraus, 2011) had been partially successful.

7.4.3 Recorded material transformations in 2010-11

In Figure 7.11 I convey the scope of selected material transformations that City Hall's FM team metered and which external contractors recorded in respective quantities for the period April 2010 - March 2011.

During the development phase More London, Foster+Partners and Arup framed the environmental impact of City Hall's design and projected operations largely through the issue of energy consumption. While they dedicated much work both on designing City Hall to reduce projected operational energy consumption and on communicating these efforts, they did not explain why this design activity was of great importance. Some might argue that the reasons were obvious and thus did not need to be mentioned. I suggest instead that by focusing on an ostensibly local and quantitative problem only (e.g. $kWh/m^2/a$), the designers attempted to disconnect the responsibilities that their design specifications and materialisations had beyond the object they created. As a readily quantifiable concern, energy consumption was treated as if it could be addressed on and could be constrained to the local scale of the building only.

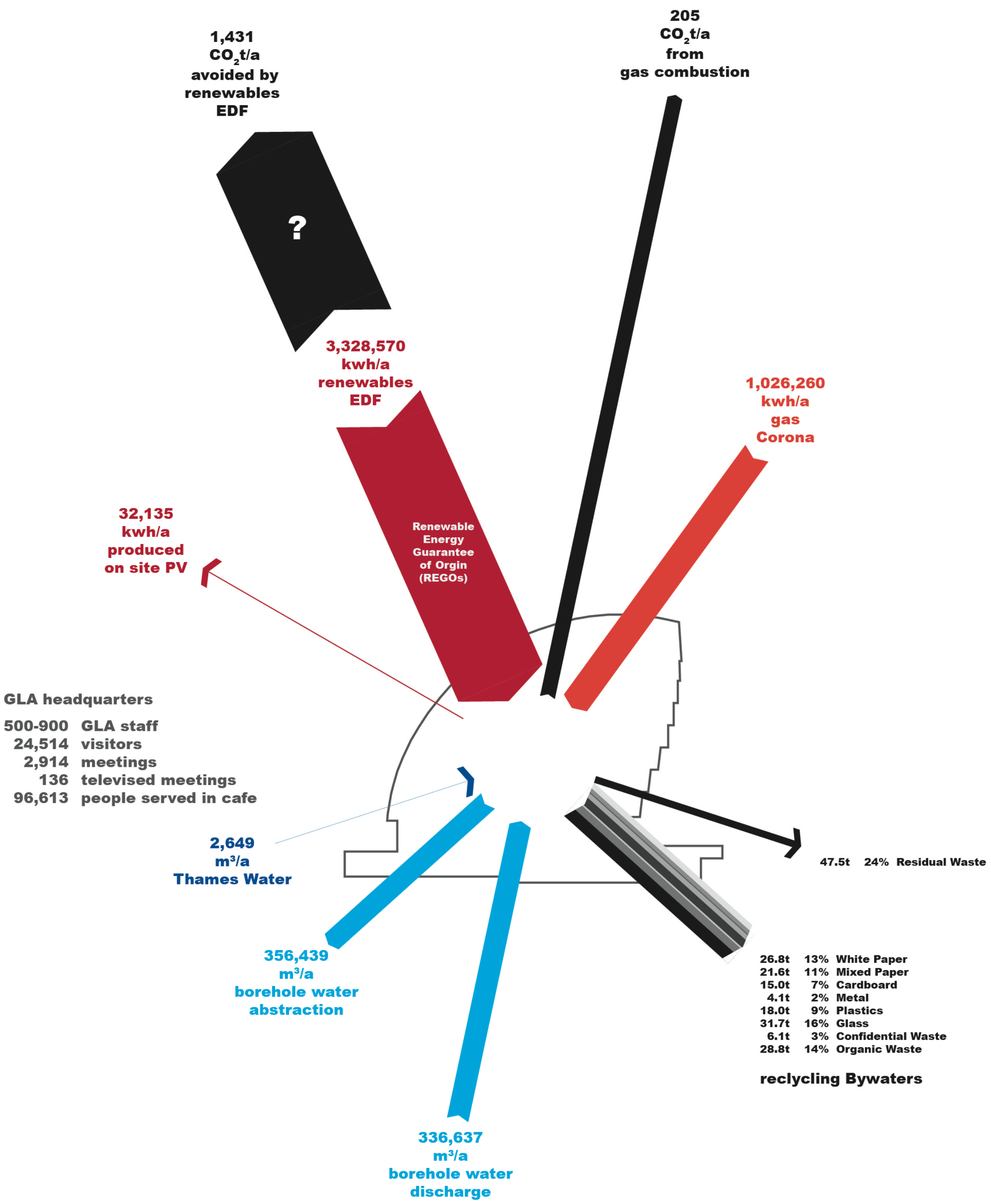

Figure 7.11 Recorded set of City Hall's material flows in operation, April 2010 to March 2011 (Diagram: Author, 2014, based on GLA data)

Largely predetermined through its design practices, City Hall's operation is essentially dependent on the supply of electricity, gas, main water and borehole water that involve specific locations beyond the building site, and that are co-constitutive of carbon dioxide, carbon monoxide, nitrogen oxide and sulphur dioxide emissions, as well as discharge of borehole water that exits the building site to locations further afield (Figure 7.11).

These transformations cannot be comprehensively framed on the local scale of the building only. Neither do they present a merely quantitative, physical, rational or technical problem. Rather, they must be seen as highly political and complex challenges. These material transformations are necessarily bound up with many heterogeneous associations and have a significant (mostly deteriorating) impact on the planet's life support systems, which are a vital precondition for human existence. They involve a complex dynamic that is multifaceted in scope and far-reaching in terms of resource extraction, processing, transportation and the environmental damage produced. They cannot be disconnected from the specific working conditions and questions of wellbeing implicated through these geographies and associations. Material transformations therefore present an important realm of endangerment to humans.

As such, City Hall's materialised design (as a crucial force co-determining consumption) and its actual operational material transformations acquire "ethical significance […] a position of the greatest social and cultural importance" (Hagan, 2001, p. 76). In order to better address challenges of "human well-being, social equity and environmental integrity", Leach, Scoones and Stirling (2010, p. 5) emphasise the particularities of analysis and understandings, since they depend on specific positions and assumptions. They argue that "any negotiation of pathways to sustainability in dynamic, complex systems must therefore be centrally about focusing on framings of systems and their properties" (p. 64). In order to overcome merely quantitative considerations and instead enter into a more comprehensive understanding of City Hall's material transformations, it is important to recognise that these transformations implicate diverse issues, "positions, goals and values of diverse actors" (p. 64) near and far of which some "will gain or lose in the process" (p. 171).

Therefore it is important to extend the assessment of the impact of City Hall's material flows beyond the building scale and to also include heterogeneous factors such as other localities, actors, activities, conventions and materialities associated with them.

Many questions emerge when attempting to trace these heterogeneous associations. To develop a more comprehensive understanding of City Hall's material transformations, the issue of incomplete knowledge must be addressed. A crucial step is to decide which assumptions and statements are borrowed as 'facts', which concealed practices open to debate, and how far to follow these associations?

For instance, City Hall buys 'renewable' electricity from EDF who buys electricity through the UK national grid that is certified by the Renewable Energy Guarantee Origin (REGO) scheme. Where does this electricity actually come from? How is the REGO certification system defined? Where does Corona purchase gas supplies from? According to Corona, approximately 40% of gas is imported from Europe and abroad (Email Dumbelton, 2012). Who is affected by City Hall's CO_2 emissions? What does it mean when Bywaters claims to 'recycle' waste generated within City Hall? With high probability, some shares cannot be 'recycled'. So where do they go and how do they affect areas and groups?

The responsibility for these material transformations and related consequences is intricate and distributed across many actors. It was the responsibility of both the GOL (through its design briefing) and the More London design team (through design development, specification and materialisation) to develop City Hall in a way that it could minimise quantities of actual operational material transformations (Chapter 4 to 6). City Hall was designed in response to a specific (developing) brief of requirements and projected occupation. It was the responsibility of the GLA and its building infrastructure management team to fine-tune the materialised design, to explain the building to its users, to adopt new occupation strategies (e.g. hot desking) and emerging technologies (e.g. LEDs), to adapt to changing requirements and the needs of the GLA. In addition, it was their responsibility to procure electricity, gas and main water from sources that would not greatly impact "human well-being, social equity and environmental integrity" (Leach et al., 2010, p. 5) in accordance with GLA definitions.

The next section explores, Based on the FM team's recordings, the next section explores to what extent City Hall in actual operation achieved the projected environmental performance targets that were defined to guide and align the multifarious translation processes targeted towards design materialisation.

7.4.4 Projected performances and actual recorded performances

In an attempt to align the heterogeneous actors and entities implicated in the making of City Hall and to achieve specific environmental design goals, the involved actors defined and deployed multiple environmental performance targets that were adapted along with the continuing design processes. These entered the design process in diverse forms: statements, design briefs, briefing updates and planning documents. Five central environmental targets were defined during City Hall's design development. I have discussed two of these goals in previous chapters. First, the concept of sustainability displaced early on and compressed into the second target, the obligatory requirement for a BREEAM assessment of minimum "very good", later upgraded to "excellent". While the BREEAM goal had been successfully met just before the handover of headquarters, the third, fourth and fifth targets could only be assessed during actual operations. These three performance goals are explored here in an attempt to evaluate City Hall's environmental performance in operation for the year April 2010 - March 2011.

7.4.4.1 The GOL's CO_2 emissions target of 70kg/m^2/a

The third key environmental performance goal (Figure 7.12) that was included in the GOL's design briefing update in September 1998 (Chapter 5) demanded, in addition to BREEAM, that "the development should also achieve a challenging CO_2 emissions target, set at 70kg/sq.m./annum" (TTPM, 1998e, p. 2). In operations, City Hall's CO_2 emissions were approximated by the building infrastructure management team through conversion factors, since actual CO_2 emissions were not recorded. City Hall's operation relies on significant amounts of electricity supply and related CO_2 emissions were not produced and emitted on site. Although the building infrastructure team purchased electricity that was certified 'renewable', City Hall's CO_2 calculations were based on CO_2 averages of grid electricity. The GLA constructed them through recorded quantities of gas combustion on site and recorded electricity consumption from the grid. Other operational activities with rather small CO_2 effects were not taken into account (e.g. CO_2 effects of main water consumption). A specific CO_2 representation was thus created.[67]

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[67] Thames Water suggests that delivering treated potable water was in 2011-12 associated with emissions of 0.283kgCO_2/m^3 (Thames Water, 2012).

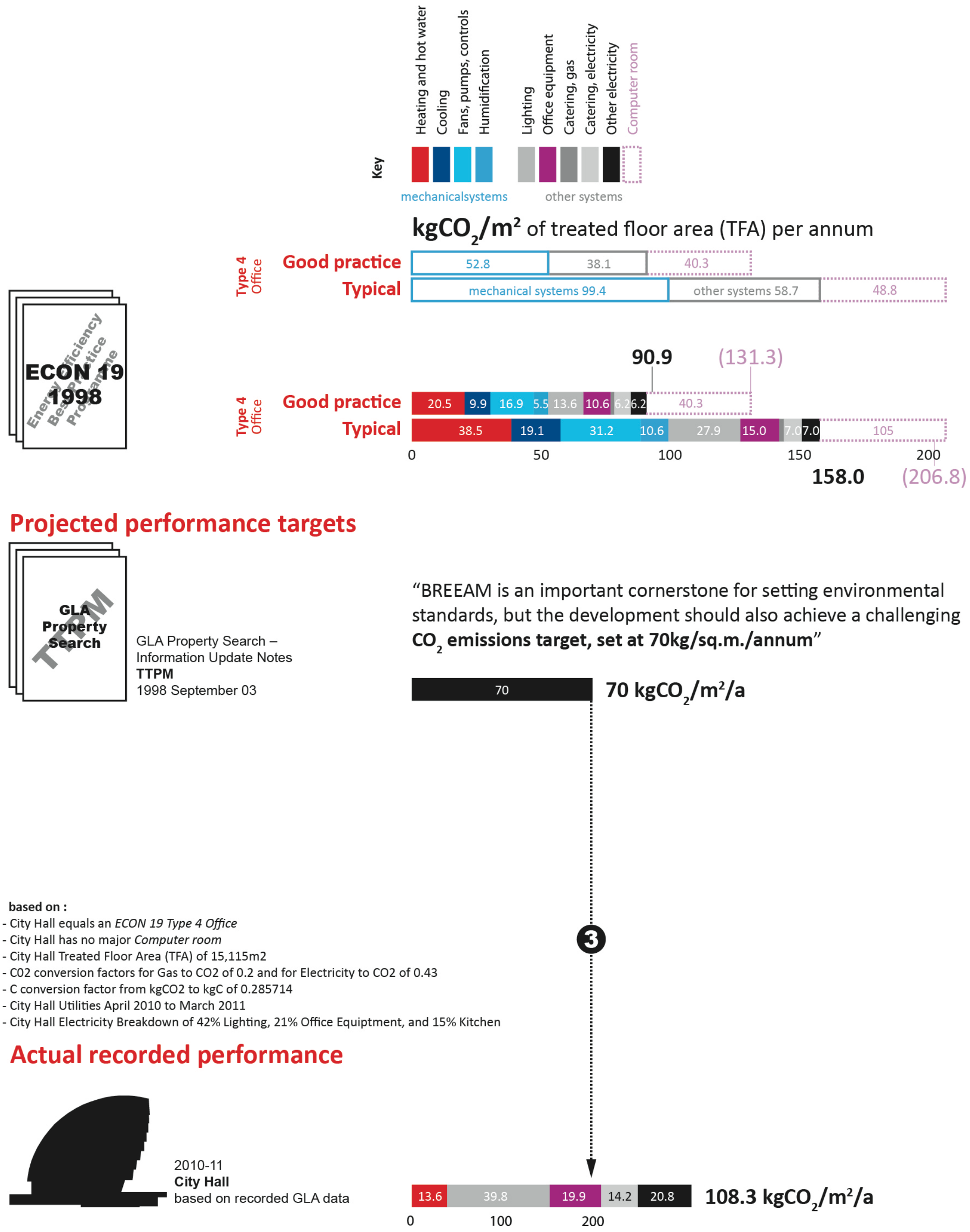

Figure 7.12 Comparison of the third key environmental performance target defined by the GOL during City Hall's design and actual recorded performance in operation framed through carbon dioxide emissions in $CO_2/m^2/a$ of related energy consumption (Diagram: Author, 2014, based on ECON 19 and GLA data)

The GOL's briefing update did not specify how to calculate the CO_2 performance target. Based on City Hall's total floor area of 18,734m^2, the calculated emissions were 87.4kgCO_2/m^2 for the period April 2010 to March 2011. Based on "treated floor area" (the framing used by ECON 19) of 15,115m^2, its emissions were 108.3kgCO_2/m^2. Either way, it seemed that City Hall's operations missed this emissions target by approximately 25%, or even 55%. Although the GOL did not refer to the ECON 19 benchmark system, I juxtapose the CO_2 emission benchmarking of ECON 19 to the GOL's quantitative target in Figure 7.15 in order to compare the two. In total numbers, the GOL's "challenging CO_2 emissions target" of 70kgCO_2/m^2/a was more ambitious than the ECON 19 "good practice" target of 90.9kgCO_2/m^2/a. The comparison between projected performances of best practice guidelines and recorded performances in actual operation is difficult, since these distinct worlds do not neatly match. I therefore highlighted the assumptions on which this comparison is built in Figure 7.12.

7.4.4.2 Foster+Partners' total energy performance target based on ECON 19

The fourth key environmental performance goal was brought into the design process in July 1999 by Foster+Partners in their Planning Application documents. It aimed to convince the GOL of the project, to give credibility to their environmental goals and to guide the team's own ambitions of developing a low energy design building. Instead of focusing on CO_2 emissions, Foster+Partners claimed the GLA headquarters' total energy consumption would be "approximately a quarter of a typical office building" (F+P, 1999a, p. 23) (Chapter 6). This comparison referred to the ECON 19 benchmark system and the recorded performance data suggests that this translation from the Planning Application to design materialisation and actual operation failed. Instead of the projected 116kWh/m^2/a, the recorded energy consumption of City Hall in 2010-11 was 273kWh/m^2/a - that is more than double, about 135% more (Figure 7.13). Foster +Partners' performance goal was missed despite all attempts undertaken by the building infrastructure management after handover to reduce City Hall's energy consumption.

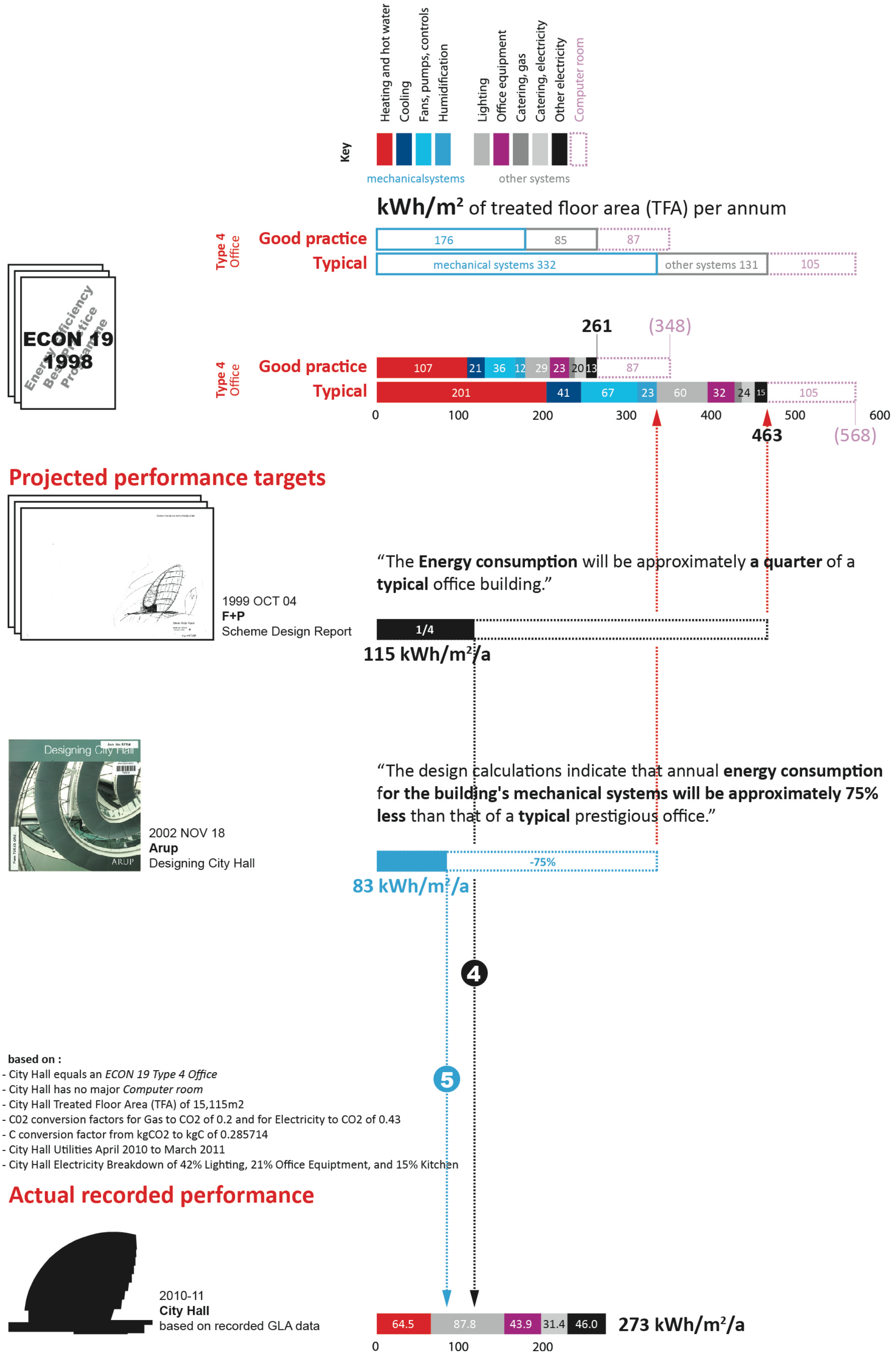

Figure 7.13 Comparison of the fourth and fifth key environmental performance target defined by Foster+Partners and Arup, respectively, during City Hall's design and actual recorded performance in operation framed through energy consumption in kWh/m^2/a and in reference to the ECON 19 benchmarking device (Diagram: Author, 2014, based on ECON 19 and GLA data)

7.4.4.3 Arup's building services energy performance target based on ECON 19

The fifth key environmental performance goal was defined by Arup (Figure 7.13). In contrast to Foster+Partners, Arup declined to take responsibility for City Hall's total energy consumption estimates (including lighting, equipment and catering) and limited their predictions to the mechanical services (heating, cooling and ventilation) only (Interview Thonger, 2011). How City Hall's projected energy consumption should de defined was not well aligned between the two design parties and no consensus was achieved during the design development (Chapter 6). Arup claimed that the mechanical services would consume only 25% of energy of the same services of a typical ECON 19 Type 4 office reference (Arup, 2002, p. 6). This prediction indicated 83kWh/m^2/a for the mechanical services.

Whether this goal was successfully translated into City Hall's design remains unclear to date. Kraus stated that, "as general headlines", City Hall's electricity consumption is estimated to consist of lighting 42%, followed by IT 21% and then kitchen 15% (Email Kraus, 2012b). But City Hall's operational breakdown of electricity use was a controversial matter, which I discussed with Kraus over several months. Surprisingly, despite retrofitting of numerous smart and sub meters Kraus and his colleagues were not able to specify the electricity consumption of the mechanical services (for cooling, fans, pumps and controls) as an isolated share of consumption. Kraus recognised "the need to pick up more data" (Email Kraus, 2012a) and attributed this lack of information mainly to City Hall's multi-stranded power distribution system and limited budgets to install additional meters that would allow a more precise rendering of the building's electricity consumption breakdown. Without this data it is difficult to understand whether the design teams' low energy cooling approach (built on the borehole cooling source and chilled beams) performed as predicted in actual practice, and whether Arup's claim that "the building's mechanical systems will be approximately 75% less than that of a typical prestigious office" (Arup, 2002, p. 6) were achieved. Heating shares are relatively simple to monitor, since City Hall uses only gas for space heating (neither for the kitchen nor warm water supply) and gas meter readings are provided. This share is 64.5kWh/m^2/a. Based on Kraus' estimated electricity breakdown (lighting 42%, IT 21% and kitchen 15%), the remaining 22% of electricity amounts to approximately 46kWh/m^2/a, comprising not only the mechanical services but also all other smaller electricity consumption shares. It can thus be assumed that the actual mechanical services did not consume significantly more than Arup had predicted.

Compared to measured and recorded performance, City Hall's actual operation seemed to have missed two of the central environmental performance targets defined during its design development, while Arup's prediction target could not be verified.

Confronted with Foster+Partners prediction that City Hall's energy consumption would only be a quarter of a typical (ECON 19) office building, Raynsford stated:

> No, it has not performed as well as was anticipated. […] Well, if I would have had the benefits of insight, I would have asked more questions about that [prediction] and perhaps that would have improved the performance if I would have been more demanding, but I just simply wasn't experienced enough. Well, and it was ten years ago (Interview Raynsford, 2010).

The failure of City Hall's performance predictions requires intricate explanation, since actual performance was co-shaped by several elements and practices. Nevertheless, I develop three relevant perspectives: the framing of the performance comparison, the design practices and the operation practices.

First, I argue that the ECON 19 comparison was problematic from the outset when Foster+Partners and Arup chose it as a benchmarking device to guide and align the their practices during the multiple translations of design briefing to design materialisation. Thonger (Arup) considered ECON 19 as a fairly crude but useful tool to provide orientation during the design development (Interview Thonger, 2009). But the comparison is not a straightforward numeric procedure – the ECON 19 guide needed transformation through interpretation, moderating assumptions and adjustments, since City Hall did not match the generalised characteristics of the ECON 19 reference. City Hall's FM team declared that City Hall's

> extended occupancy hours … are not used in the ECON 19 calculation and … although City Hall is compared as a prestige office environment, a number of

> activities, ie broadcasting on a weekend and public open days, are not taken into consideration in the ECON 19 calculation (GLA, 2004b, p. 2).

One question that deserves further exploration is to what extent the strategy of the compact building form – predominantly pushed by Foster+Partners – contributed to increasing lighting demand (through deep floor spaces) and thus to increased electricity consumption. The argument, "a sphere has 25% less surface area then a cube of the same volume" (F+P,1999a, p. 23) was not only associated with heat losses, and solar gains, it was also associated with reduced daylight - a question seemingly not broached in the process.

Third, the GLA's operational requirements deviated significantly from predictions in the design briefing process. When the design briefing was drafted (Chapter 4) the GLA did not yet exist as an authority; any outline of its needs was therefore hypothetical. . Instead of 400 GLA staff, City Hall was occupied by more than 650 staff, thus contributing to higher consumption levels. For political reasons, the building infrastructure management team could not measure actual occupation:

> Anybody who needs to get through that door [City Hall …] might be Boris, might be other politicians, might be political advisors, might be anybody who might not want to be monitored where they go, so we wouldn't necessarily do it. It's bad enough I monitor who turns the computers on and off (Interview Kraus, 2011).

It was through the number of PCs that Kraus estimated actual occupation (in 2002 approximately 400 PCs were in use, in 2012 it was approximately 656) (Email Hardy, 2012). Kraus noted that the GLA committed to the principle of hot desking (i.e. no specially allocated desks) and therefore, in peak times, occupation was assumed even higher than 900 GLA members (Interview Kraus, 2011). Thonger (Arup) also attempted to explain the deviation between energy predictions and measurements through the higher occupation numbers than the building was designed for (Interview Thonger, 2011).

7.5 Conclusions

The attempt to understand City Hall's environmental performance is contingent on a number of elements co-shaping each other: the materialised design, forms of occupancy, management practices and methods of measurement. I started this chapter by reflecting on one crucial link introduced to align design practices and operation practices, namely City Hall's environmental performance prediction framed through the coefficient of kilowatt-hours per square metre per year ($kWh/m^2/a$). I argued that this coefficient in isolation has limited explanatory value to explain City Hall's energy consumption, since many associated heterogeneous elements that co-shape the buildings' actual operational energy consumption are disconnected from it (e.g. occupancy levels, usage). The purpose of the section was to draw attention to the difficulty of conceptualising and framing the projected energy consumptions of actual building operations.

In order to develop a better understanding of City Hall's actual environmental performance, I then introduced the building infrastructure management and its heterogeneous world of operational practices. The team conceived its key task as reducing City Hall's operational electricity consumption. I explained four key building updates introduced by Kraus and his colleagues to further reduce electricity consumption. As a form of fine-tuning, correction or adaptation, these updates aimed to improve design issues that were either not captured or had failed to be successful during the design team's translations of design briefing to design materialisation. These interventions are one way of highlighting the significance of the building infrastructure management's role in influencing City Hall's actual energy consumption.

City Hall's environmental impact from operations has never been completely known. The building infrastructure management's understanding of this impact essentially depended on the scope of issues and indicators taken into account, recorded and represented and what they omitted in this process. It defined this impact largely by monitoring selected material transformations that were metered through calculations and which external contractors recorded. I argued that it is important to extend the assessment of the impact of City Hall's material flows beyond the building scale to include heterogeneous localities, actors and activities that are necessarily associated with them.

The last part of this chapter tied City Hall's operation practices back to its design practices. I reviewed three key projected performance targets that were defined during design development to guide and align the multifarious translation processes targeted towards design materialisation and that could only be evaluated in actual operation. Both the GOL's required CO_2 emissions target of 70kg/m^2/a and Foster+Partners prediction that the GLA headquarters' energy consumption would only be "a quarter of a typical office building" (F+P, 1999a, p. 23) seemed, on the basis of recorded GLA data, to be missed. Although intricate, I discussed this issue from three perspectives: first, I argued that the ECON 19 comparison was problematic from the outset, second that the designers did not pay sufficient attention to the design issue of electrical lighting (according to the GLA it presented by far the largest share of electricity consumption at 42%), and third that in operation the GLA's actual requirements deviated significantly from the requirements predicted in the design briefing process - instead of 400 GLA staff, City Hall was occupied by more than 650 staff members, contributing to higher consumption levels.

Chapter 8

Conclusions

8.1 Introduction

My thesis is an in-depth exploration of City Hall's design (and operation) practices. Beginning in 1997 with the initial conception of functions and responsibilities of the Greater London Authority (GLA), my explorations extended into City Hall's operation practices until 2011. In covering this period, my aim was to connect the design briefing, projected design and actual design in operation. The thesis explored how, in a contingent and complex process, architects, engineers, clients and others assembled (and operated) City Hall through particular conceptions, negotiations, choices and transformations in their studios, offices and on site. Through these practices heterogeneous elements such as materiality and agency, as well as diverse temporal scales and spaces, were drawn together. Hence, I focussed on how environmental challenges were constructed to inform design and how, in response, design strategies and building technologies were developed and expanded. By emphasising the importance of the *making* of City Hall, I have focused on the plural and shifting activities of diverse actors and entities involved in the design processes through a pragmatic approach influenced by positions in the field of Science and Technology Studies (STS).

In this closing chapter I first reflect on the STS- and translation-inspired theoretical framework adopted in this thesis. Secondly, I revisit central questions and present key findings from my empirical chapters (4 to 7) in order to draw out wider contributions for architectural design research and practice. I do this by foregrounding three selected mechanisms (which are themselves interrelated) that are central to translation processes. The final part briefly summarises the contributions that the translation framework can make to inform future research and practice in environmental design.

8.2 Reflections on the STS- and translation-inspired theoretical framework

This thesis explored the design practices that materialised City Hall, which Foster+Partners ambitiously described at the handover to the GLA as such: "City Hall has been designed as a model of democracy, accessibility and sustainability" (F+P, 2002). In order to explore what architects, engineers, clients and others did in their design studios, offices and on site, I took a pragmatic approach towards these heterogeneous assemblages, influenced by debates in the field of STS.

City Hall's design practices involved a lot of work and efforts that spanned several years. They (temporarily) associated more than 100 different actors belonging to different vocations (architects, engineers, government officials, developers, etc.), diverse materialities (glass, foam, concrete, CO_2 etc.), varied technological devices (computers, fans, gas boilers, etc.), different spatial locations (F+P's design studios, diverse other offices, constructions sites, technical details, the "atmosphere", etc.), diverse policy documents and guidelines (Building Regulations, consultation papers, design briefs, BREEAM, etc.), disparate timeframes (construction schedules, lifespan assumptions, future generations) and much more. The STS-inspired approach allowed me to commit to and embrace the heterogeneity that City Hall's design practices necessarily drew together. City Hall was not just discursively established, diverse elements reciprocally co-shaped the design practices and building in emergence: building forms, a unique site, a minister, choices, design briefs, diagrams, negotiations, etc.

One difficulty was how to deal with elements that the design practices left out - the gaps, elements that were ignored and not enrolled in design practice and that, for instance, jeopardised the mediation between projected environmental performances and 'real' performances. The STS approach allowed me to come to terms with this challenge by emphasising that design knowledge and design strategies are constructed and therefore could also have been produced in more desirable or more inclusive, alternative ways (Law, 2004).

One further challenge was how to retrace the heterogeneous assemblages. Given the outlined complexity of the design process, it was an impossible task to describe all the links that made up the City Hall assemblage. The links were immense, continuously extended and partially reshaped. The attempt to trace all associations at once would have been impossible, as well as a banal collection that would not explain much about the associations forged into being (Akrich, 1992, pp. 205-206). The challenge was where to stop tracing associations, and how to find ties that were stronger than others.

In connection with the research questions that have guided this thesis, the adaption of Callon's (1986) concept of translation provided a helpful strategy through which to navigate and analyse the messy and fluctuating practices of environmental architectural design and City Hall. Callon provides a compelling set of vocabulary, principles and elements that enables foregrounding the diverse mechanisms that are central to translation. Callon conceives the initial "moment" of translation as "problematization" (1986, p. 203) in which a group of protagonists defines a problem and action plan. Following Callon, I began my explorations by investigating how Minister Raynsford and the Government Office for London (GOL) set up a shared action plan to (find and) design a headquarters for the GLA, targeted to become a statement of sustainability. Similarly, I used further elements proposed by Callon for analysis.

Crucially, environmental challenges and performance targets in design practices do not become enacted in a linear and simple causal chain. Initial design goals need to be translated into particular mediated parameters, strategies and technological pathways towards the complex materialisation of new buildings. The form of these ongoing transformations is crucial. Translation is thus a compelling approach through which to explore the struggles of how environmental design objectives are created, continuously interrelated and transformed into design strategies and materialised in specific, localised settings. Using the concept of translation, I analysed how environmental problems were constructed as an issue for design, and how they were continuously transformed and adjusted through contingent, complex and dynamic practices. This analytical frame was particularly useful to understanding the partially conflicting preferences between architects and engineers, and between building form and performance. The concept provided a helpful tool to trace agency and power within these practices, and to understand the mediations and struggles between the projected building and the 'real' building

The concept of translation is particularly geared to analyse the inseparable mechanisms of the production of design knowledge, the construction of heterogeneous relationships, diverse displacements and transformations, and, negotiations and adjustments (Callon, 1986, pp. 203,224), which were central in bringing City Hall into being.

Adapting the concept of translation in this way seems to be a novel contribution to the field of environmental architectural design and I propose to further test and develop this approach in this area of research and practice.

8.3 Contributions of translation (as central analytical frame)

8.3.1 Strategic transformations and displacements

In Chapter 4 I explored how environmental problems were constructed as an issue for design, and how they were then transformed into particular targets and goals formulated to instruct and align the architects, engineers and developers in their design proposals. Prior to the architects and engineers of the More London team taking up their work, Raynsford and his GOL team were in 1997 endowed with the responsibility to outline the functioning of and bring into being the GLA, conceived as an innovative and dynamic body that would provide strategic leadership for London at the beginning of the 21st century. The GLA's overarching function was defined in two government consultation papers (DETR, 1997, 1998b) to promote sustainable development. Raynsford expanded his team by including members of Turner & Townsend Project Management (TTPM) to launch a unique developer-architect team design competiton, calling for suitable proposals to accommodate the GLA on the basis of a 25-year lease deal with the GLA. Raynsford proclaimed that the GLA headquarters was set "to be a statement about the new authority, including its commitment to environmentally progressive objectives, the principles of sustainability" (Interview Raynsford, 2010).

To inform the design activities of an initially selected group of 55 competitors , his GOL team drafted three design briefs (TTPM, 1998a, 1998b, 1998c) that contained a range of requirements, for instance a transient spatial programme for 400 GLA staff, a prominent and distinctive building appearance, and beneficial cost-effective innovations. Related to these heterogeneous design elements, the environmental design challenge was predominantly defined as the goal to achieve a Building Research Establishment Environmental Assessment Methodology (BREEAM) rating of at least "very good".

Callon suggests that the "repertoire of translation", amongst others, is "designed to give a symmetrical and tolerant description of a complex process which constantly mixes together a variety of social and natural entities" (Callon, 1986, p. 224). "Symmetrical", here, does not mean that involved elements are equally important. Instead, Callon rejects giving any preference to particular sorts of elements or relationships. Crucially, he argues that displacements and transformations "occurred at every stage. Some play a more strategic role than others." (Callon, 1986, p. 223). In City Hall's translation processes of environmental design briefing to design materialisation, one key strategic transformation was the displacement of the concept of sustainability into a BREEAM requirement (outlined in Chapter 4). One contribution of translation to design practice and research in design practices is to shift attention to these crucial transformations, to what they do and to how they are enacted.

Raynsford was endowed with the power to form teams, assign roles, give directions, oversee activities and sign off the design briefs issued to the developer teams. In the hands of Raynsford and his team of government officials, the concept of sustainability seemed to be a useful frame with which to guide policymaking to instigate particular actions directed towards translating the multiple and heterogeneous issues of the concept into related strategies. But the question of how to translate the concept into design practices for the GLA headquarters to come was neither made part of an in-depth debate nor declared a controversial issue to tackle within the GOL team. Raynsford (and his team) had the power to explicitly foster this debate through his role and responsibility to draft the competition brief(s) for the GLA headquarters. The GOL team could have delivered the challenge of how to interpret and give meaning to the concept of sustainability to the bidders to come. They did not ask developers, architects and engineers to develop a tailored strategy, indicators or vision of what sustainability could mean for the case of the GLA headquarters. In order to exemplify, advance and innovate, architectural approaches towards sustainability may need to reformulate and redesign the existing problem and target definitions.

Given the GOL's environmental ambitions, they had to define targets that went beyond Building Regulations requirements. Sustainability as a concept could not just be materialised – it crucially required transformation. The GOL chose to take responsibility themselves (instead of transferring it to the bidders) through transforming sustainability into a displaced set of design issues that were more building related (see BREEAM below). The three initial design briefs (TTPM, 1998a, 1998b, 1998c) – then representative of the GOL's design intents – were the main devices with which to translate sustainability (and all other design requirements) from the GOL offices into the design studios. They aimed to link and align the activities between the associated actors of politicians, government officials, property developers, architects and engineers in the joint action plan. This way, the design briefs were powerful devices to render transformations easier, to associate heterogeneous practitioners and entities, to attempt to keep the conflictual and unpredictable alliance together, and to preliminarily set out the "the margins of manoeuvre" (Callon, 1986, p. 203). As a result, the concept of sustainability was (largely) abandoned in City Hall's design practices with and through the design briefing. Later on in the design practices neither architects, engineers nor developers deviated from the roles assigned to them (to fulfil the design briefing) by bringing back the concept in order to re-integrate particular design issues captured by sustainability that the briefing had excluded. Before architects and engineers entered the design process, many features of the future GLA headquarters were just vaguely outlined and shaped (e.g. approximate amount of square meters, functional programme, etc).

Instead of inviting an exploration of what sustainability could mean for the GLA headquarters design practices, the GOL (TTPM, 1998a) abandoned the concept by translating it into the request for a BREEAM rating of at least "very good" in the first design brief. BREEAM was thus chosen as the key entrusted device to the guide the transformation of sustainability into the design architectural practices. In 1998 the then new version, *BREEAM 98,* had been updated to "ensure a broader coverage of sustainability and environmental issues" (BRE, 1998, p. 5). The BREEAM choice seemed to have been co-shaped by the Labour party's commitment to work within previous governments' overall spending commitments, since the design target needed to be achievable in alliance with a developer through a lease deal agreement. BREEAM then just began to "kick off […] as a performance tool" (Interview Spring, 2010) and was compatible with developer activities. The displacement through BREEAM was a strategically key, since the commitment to the concept of sustainability in the context of GLA design practices is clearly not equivalent to a commitment to any BREEAM assessment of these practices.

BREEAM 98 transformed sustainability into nine assessment areas, 53 distinct design issues and a maximum of 87 achievable credits. Farmer and Guy argue that BREEAM tends "to compress the meaning of sustainability to a relatively narrow band of pre-defined issues" (2005, p. 22). The concept's intent to address "implications for social justice and perspectives and priorities of poorer and marginalized groups" (Leach et al., 2010, p. 166) were largely lost in translation. The GOL did not attempt to tackle the contested nature of how to give meaning to sustainability in practices. "All these goals of sustainability are context-specific and inevitably contested. This makes it essential to recognize the roles of public deliberation and negotiation" (Leach et al., 2010, p. 5). There are still many unanswered questions on how the GLA headquarters in particular and building design practices more widely impact on environment, on the well-being of people in the neighbourhood, in London and the planet, in the short and long run. The incomplete knowledge and contestation indicates that a more comprehensive shift might be required in order to specify more clearly for the design practices of the GLA headquarters "what is to be sustained for whom, and who will gain or lose in the process" (Leach et al., 2010, p. 171), especially beyond the scale of the building itself.

In my view, the BREEAM device - deployed as a central environmental design target - seemed to contribute to a partial de-politicisation of City Hall's design process. This can be said to be the case in the sense that in the transformation from sustainability to BREEAM, a much wider problem scope became disassociated through narrow framing. Furthermore, 'actual' problems were displaced from the association within the design practices through awarding credits - for instance, the problem of climate change; while "Operational energy & CO_2 issues" (IBSEC, 2002) is one of nine assessment areas of BREEAM that is important to limit climate change, the attribution of credits seems to take away the threat that "[n]aked survival" (Droege, 2012, p. 590) is at stake. Architects and engineers were concerned with energy consumption during later design practices. It was treated as a seemingly local issue, measured in $kWh/m^2/a$, but crucially I did not see any design statement or other document explaining why reducing energy consumption was an important task.

The notion of an exemplar project suggests a model or practices to be copied and adopted. The GOL's translation of sustainability was, relatively speaking, narrowly framed. The GOL neglected to add more comprehensive criteria and to initiate a debate about what sustainability could mean for the GLA design practices. From this perspective, the GOL' s environmental design targets and transformations were not exemplary.

8.3.2 Constructing design strategies between architects and engineers

In the following I recollect key findings from Chapters 5 and 6. In these chapters I explored how the team of CIT, Foster+Partners and Arup translated the BREEAM target, the request to give "'Green' issues […] proper consideration" (TTPM, 1998a) and the many other design requirements of the design briefing into design strategies and building technologies.

The multiple requirements made mandatory in the design briefing then needed further transformation through a particular building site, the alignment of new actors, the accumulation of design knowledge and the development (construction) of design strategies and technological choices. It was the GOL as representative (as quasi client) of the later long-term occupier – the GLA - that largely defined the environmental design agenda. In principle, the architects, engineers and/or the client could have deviated from their envisaged roles to enact the design briefing, or redefined their roles by focussing on what sustainability could mean for the design development of City Hall, thus taking more responsibility for the building they were co-producing (see section above).

The first transient design proposal, the "box" scheme, assembled in only six weeks by the CIT team and presented to Raynsford and his advisors, failed to include a substantial commitment to environmental design strategies (beyond standard office building specification). The scheme was criticised by the GOL for its lack of distinctive appearance, but was not eliminated from the selection process. Reasons seemed to include, among other factors, the prominent location on the Southbank and an attractive lease deal that CIT could offer the GOL - in comparison to other competitors, they had the strategic advantage of wanting to kick-start a much larger development (Interview Shuttleworth, 2010). Through consultation and the first presentation to Raynsford, the initial design briefing (in reciprocity) gradually developed and accumulated additional design requirements including an operational CO_2 target and passive air-conditioning system.

The CIT team then expanded their ambition to win the design competition. They interpreted and transformed the design challenge to predominantly mean energy efficiency (F+P, 1999a, p. 23) and low energy design (Interview Thonger, 2011), thus further compressing the already narrowly defined scope of the BREEAM goal. The team realised that a more distinct building form that could be perceived as a landmark was a crucial “detour” (Callon, 1986) in their translations of energy efficiency to design materialisation in order to win the competition. Additional design knowledge was incorporated, adapted and produced. The ECON 19 benchmarking framework and the “Triangular Approach” were chosen as important devices to develop, guide and align further design practices. By drawing on these two devices out of a vast array of possible design trajectories, Foster+Partners chose to maximise the use of “building form and orientation” as their fundamental basis of low energy design. Addressing the issues of heat losses and solar gains, Foster+Partners, in consultation with the engineers, developed three building form strategies: compacting, tilting and stepping. In parallel, Arup produced a low energy cooling strategy that was based on borehole cooling, chilled beams and natural ventilation. The CIT team assembled the diverse strategies in the “mask” scheme that, together with heterogeneous submission package and the offer to achieve a BREEAM “very good” rating, was selected by Raynsford and his advisors as the winning scheme to house the GLA.

In Chapter 6 I explored how the previous hypotheses and strategies were further transformed, expanded, redesigned, adjusted through diverse tests, simulations, renegotiations and choices in the quest to make them perform as predicted. Following successful selection, Foster+Partners significantly redesigned and modified the building form and orientation in the Planning Application scheme. Against initial resistance from the GOL, they managed to push through this design move to achieve a more unified and fluid building form. This was a significant transformation that accepted higher solar irradiance and the dilution of the self-shading strategy (tilting and stepping) that they had developed and agreed upon with Arup. I demonstrated the power of visuals – sketches, diagrams, drawings and renderings - in the translation processes, for instance in Foster+Partners deployment of building form design logic diagrams as devices to render their building form modification more credible and to further stabilise it.

I then focused on the expansion of the facade design that (in contrast to the view of the architects) Arup considered more significant. With the geometrical rationalisation enabled through 3D CAD advancements, the facade design was expanded, tested, modified and rearranged towards tendering and construction. The limited cooling capacity of the chilled beam and borehole strategy, in combination with the partially diluted building form self-shading strategy, triggered a long battle between architects and engineers over Foster+Partners' desire to have a 'fully glazed' office facade. Via experimental moves back and forth, transformations and renegotiations, the architects changed their preferences and adopted Arup's design arguments to make the facade more solid and thus let go of their dream of floor-to-ceiling glazing.

The design team's translation of their primary design objective of energy efficiency lost sight of the role of embodied energy, which gains significance especially in the low energy objective. In the contingent translation processes of GOL design briefing to design materialisation a vast number of heterogeneous elements were associated, re-ordered, eliminated, tested, simulated and modified in order to arrive at the actual set of design strategies that make up City Hall. The design team managed to assemble a set of substantial passive design strategies that are normally not found in most office designs. One central design target of the environmental design briefing was the BREEAM assessment following building completion. This target was successfully translated into the design practices, since City Hall was actually assessed as "excellent". I pointed out that this achievement in part depended on the GLA's commitment to purchasing renewable energy, a responsibility beyond the influence of the More London design team.

In Chapters 5 and 6 I highlighted how the translation framework can help analyse the ways in which design strategies are constructed between architects and engineers. The process of translation is enabled though the "simultaneous production of knowledge and construction of a network of relationships" (Callon, 1986, p. 203). Here I highlighted the importance of architects and engineers as *translators.* In order to advance the processes of translation from design briefing to design materialisation, and to enable them to succeed, the architects and engineers had to construct design strategies that extended particular hypotheses (about the world of design) towards materialisation. The major findings from both chapters were that the alliance of architects and engineers was conflictual: Consensus was not achieved over the role of building form in their joint low-energy strategy (Chapter 5), not over Foster+Partners' modification of building form and orientation that accompanied the Planning Application scheme (Chapter6), not over the ways in which to frame and predict City Hall's projected energy consumption, and initially not over the glazing ratio within City Hall's emerging office facade design.

In order to address the heterogeneous complexity of design, the two inseparable mechanisms of "production of [design] knowledge and construction of a network of relationships" (Callon, 1986, p. 203) were important in the design studios and offices. The design practitioners had no choice other than to break down the projected and actual intricacy into alternating, small and workable design complexes and interdependencies (e.g. facade build-up, heat losses, solar gains and air movements). Constructing design strategies thus entailed a huge responsibility, since hypothetical design strategies, if materialised, impact on and co-constitute actual design (and in part the world). Are the chosen and alternating – switching back and forth between e.g. building form and facade design – design issue complexes (sets of design-issue-dependencies) sufficient to predict and intervene in the complexity of actual operation?

While conflicts between practitioners and elements during the heterogeneous and complex design practices should be seen as a matter of course that cannot all be reconciled, I argue that it is important to explore how these conflicts between architects and engineers occur and how they are eventually reconciled and negotiated (cf. Beveridge & Guy, 2009; Bucciarelli, 1994; Feenberg, 1999). The emergence of conflicting design priorities must be seen as a central mechanism of translation processes, since multiple heterogeneous issues are built into conflictual relations that shape each other. The translation framework is thereby helpful to avoid locking architects and engineers in fixed roles and values systems, since it conceives those roles as being reciprocally shaped and adjusted to other entities during this fluctuating process. This does not exclude previous educations, experiences or expertise, which are all part of the process.

For instance, City Hall's facade design has been a complex architectural challenge involving heterogeneous elements and diverse functions, and has played a crucial role in perception processes through its exposure. Foster+Partners and Arup approached the complexity of facade design in different ways. Through the exploration of City Hall's expansion of the facade design (Chapter 6), especially within the Scheme Design Reports (Arup, 1999; F+P, 1999e), I demonstrated the different ontological perspectives between Foster+Partners and Arup in understanding the (world of) facade design. While they were part of the same City Hall design project, it seemed as if there were two different facade designs in development. One facade was constructed through materialities, material characteristics, forms, geometrical positions and perceptions, while the other was defined through thermal insulation and solar gain factors. This shows that the facade design is not in principle singular. But these two partial perspectives did not produce a fully comprehensive understanding (that would not be possible), since they both missed elements that in actual operation became important factors (Chapter 7).

It seems crucial to understand that (the facade) design is multi-dimensional and that there is no other choice than to take partial perspectives into consideration. Law, in reference to Donna Haraway, argues to take "responsibility […] for the recognition that we are located in and produced by sets of partial connections" (Law, 2004, p. 69). The architects and designers enacted particular partial perspectives. The decisive question for environmental design then becomes which of these partial worlds is more desirable and less destructive than others. Since different partial perspectives cannot always be reconciled, it is necessary to pay careful attention to the trade-offs and consequences involved. Both architects and engineers should thereby take full advantage of the mutual exchange in which engineers "learn about the architectural assumptions, and in exchange the architects learn from these" engineers (Yaneva, 2009, p. 152) in order to make well-informed decisions and to achieve the best design possible in response to a particular environmental design challenge.

Further expertise and (accepted) responsibilities played a crucial role in shaping the design development. Although part of a design team, Foster+Partners were the experts responsible for assembling landmark building. Arup's contribution to the assemblage was to make sure the building services would perform in accordance with the design briefing.

Questions of power played a crucial role in trade-offs, and it seemed that Foster+Partners were able to push their (fluctuating) preferences more strongly than Arup.

The frame of translation becomes a crucial political dimension since it foregrounds how particular design strategies were constructed in order to make a sensible proposal into architecture (and the shared world).

8.3.3 Supposed equivalences between projected design and actual design

In Chapter 7 I explored City Hall in operation from 2002-03 to 2010-11. Below I recollect key findings from this chapter. In May 2002 the GOL's initial plan to find, design and build a domicile for the GLA that was associated with an ambitious environmental design agenda had been completed. The design team had in principle fulfilled their tasks. The evolving design briefings were largely translated into hypotheses, design strategies, building forms, technological choices and materialisations. These translations were then put on trial in actual operation. Would design intentions perform and last as predicted? Relating operation practices back to design and environmental performance predictions required an understanding of the elements that co-shaped actual performance. I argued that understanding actual operational performance was contingent upon GLA occupancy, management and methods of metering through the facility management (FM) team. Essentially, the FM team's understanding of City Hall's environmental performance depended on the scope of material transformation that the team recorded and re-represented (e.g. emissions of nitrogen oxides and sulphur dioxides were not monitored) - in other words, how the GLA created knowledge about their material transformations and what the GLA omitted in this process.

While City Hall was largely 'stabilised' through its materialisation, the GLA's FM team undertook several adaptations and updates in their central objective to wrestle down electricity consumption. I explained four key updates. One crucial finding was that the cost-intensive PV modules update, deployed as a demonstration project on City Hall's roof, in actual operation only produced 1% of the building's electricity consumption. Surprisingly, voltage optimisation, a much cheaper and rather minor intervention that was not perceivable by GLA members and visitors, brought a significantly higher electricity consumption reduction of 8-14%.

I then tied City Hall's operations back to its design practices in order evaluate how successful the More London design team's translations of environmental design briefing to design materialisation were. Following the successful BREEAM assessment, only three projected environmental performance targets, which had been defined during design development, could be evaluated in actual operation.

Key findings included the fact that the GOL's required CO_2 emissions target of 70kg/m^2/a, on the basis of recorded measurements (and calculations) for 2010-11 was missed by approximately 25%. Foster+Partners' prediction that the GLA headquarters' actual energy consumption would only be only a quarter of a typical ECON 19 office building was, in actual operation, not achieved. Instead, the recorded energy consumption in 2010-11 was more than double - about 135% more. Arup's key performance goal predicted that the mechanical services (heating, cooling and ventilation) would consume only 25% energy of the same services of a typical ECON 19 reference. Whether this goal was successfully translated into City Hall's design remains unclear, since no effective sub-metering has been put in place to date.

The failure of City Hall's performance predictions cannot be explained unambiguously as performance was co-shaped by several elements and practices. I explained three elements that played a significant role: Firstly, I argued that the ECON 19 comparison, chosen by Foster+Partners and Arup in its setup, was already problematic given the fact that City Hall contained many additional functions not contained in a typical prestige office building. Secondly, the design team made huge efforts to lay the foundations of *low energy* and *passive design* in design practices. While the mechanical services seemed to perform almost as predicted, City Hall's FM team contend that a different design issue (beyond heating, cooling and ventilation) became a major force in co-shaping electricity consumption. Based on the FM team's estimated electricity breakdown (lighting 42%, IT 21% and kitchen 15%), electrical lighting was by far the biggest share of electricity consumption. This was a design issue not (sufficiently) raised and largely neglected in design strategies. The FM team considered parts of the lighting design to be insufficient and this contributed to higher electricity consumption. It was likely within Arup's agreed responsibilities to oversee and sign-off on the lighting design. Thirdly, the GLA's actual operational requirements deviated significantly from the predictions outlined in the design briefing process. Instead of 400 GLA staff, City Hall was occupied by more than 650 staff, consequently contributing to higher consumption levels.

One analytical contribution that translation can make for design research and design practices is to highlight how supposed equivalences are put in place between the projected design and actual design. Translation foregrounds the hypothetical dimension of the shared action plan: “In conclusion it is noted that translation is a process, never a completed accomplishment, and it may […] fail” (Callon, 1986, p. 196). Within translation processes

> a series of intermediaries and equivalences are put into place [… practitioners] show graphic representations and […] mathematical analyses […] The choice of each new intermediary, of each new representative must also meet a double requirement: it renders each new displacement easier and it establishes equivalences (Callon, 1986, pp. 216-218).

There were many instances within City Hall’s design practices in which designers sought to render their chosen design strategies more plausible by suppressing the hypothetical dimension of their activities. In Chapter 6 I discussed the power of visual representations: Foster+Partners’ deployment of many “Design Logic Diagrams - Building Form” (F+P, 1999b) were crucial visual devices in their attempt to render their building form modification more credible and to further stabilise it. These diagrams represented specific design complexes (sets of design-issue dependencies) that were constructed within the design practices. They seem to summarise the actual entanglements of building form and orientation that affect Foster+Partners primary objective of low-energy design. The diagrams sought to suggest that the actual world is in its key (energy consumption influencing) factors *equivalent* to the represented world.

The notion of (supposed) equivalences is helpful to emphasise that the projected design and materialised design are not the same. Madeleine Akrich similarly emphasised the importance “between the designer and the user, between the designer's projected user and the real user, between the world inscribed in the object and the world described by its displacement” (Akrich, 1992, pp. 208-209). This links back to the construction of design strategies and the related sets of design-issue dependencies envisaged. In Chapter 7 I demonstrated that the prediction of actual operation is a risky mission, since largely unpredictable elements co-shape actual performance, and design briefing requirements might be violated by occupant needs.

It can be argued that Foster+Partners' strategy of compact building form – deployed with the aim to minimise heat losses - has supported the demand for more lighting precisely through its compact form and deep floor areas. The design issue of day and electrical lighting had not been mentioned in, for instance, the building form design logic diagrams, despite its significant impact and role on electricity consumption of lighting. The issue was omitted in the alternating sets of constructed design-issue dependencies. According to GLA data, lighting electricity accounted for 42% of total electricity use – a constitutive force largely absent in intensive activities of low-energy design. Attention has to be shifted to the supposed equivalences, to their limitations and their related consequences on the environment and human well-being.

8.4 Lessons for future research and practice

In conclusion, the ways in which Foster+Partners and many other architects promote their architectural projects is characterised by a rhetoric of consensus, predictability and feasibility. Controversy, unpredictability and ongoing debates are rendered inexistent. The adjective "sustainable" in connection with the materialised building seeks to assign a particular status quo, a form of *black-boxing*: Sustainability 'achieved' and 'materialised'. These attributes have to be seen within a wider legitimisation and marketing strategy in Foster+Partners' attempt to position themselves as credible leaders within environmental design practices.

As indicated previously in this chapter, I argue that architectural practices should actively engage in debates concerning how (and in how far) sustainability can be translated into particular design tasks and settings. I suggest to step back, to eliminate the adjective 'sustainable' attached to practices and artefacts, and instead to engage in ways the concept is given meaning – how it is enacted - in design practice. To face the controversies over how to enact sustainability seems a more promising approach than to pretend that there is no contestation. In doing so, I see the concept of translation as a useful tool to unpack particular claims, to make them more accountable, thereby supporting the larger project of sustainability that sometimes seems to suffer from a certain fatigue as practices that associate with the concept fail to bring about the necessary reordering in their processes.

These processes are crucially formed along complex chains of translations. The focus on translation allows one to shift attention to crucial moments when, for instance, environmental design goals are constructed to align involved actors, or when these goals become (re-) translated into design strategies, and when important strategic transformations and displacements are enacted. Exploring the occurrence of controversies and their settlements around these moments has the potential to lead to significant innovation in architectural research and design practice.

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Appendices

Appendix 1: Schedule of interviews (2009-2012)

Case Study: City Hall

	Organisation and Role	Name	Interviewed
	CIT / More London		
1.	Development Director	Liam Bond	27.07.11
	GOL		
2.	Minister for London	Nick Raynsford	08.09.10
3.	Project Sponsor	Anne Griffith	02.02.10
	GLA		
4.	Building Infrastructure Manager	Rennie Kraus	25.08.09
5.	Building Infrastructure Manager	Rennie Kraus	23.11.11
6.	Building Infrastructure Manager	Rennie Kraus	26.10.12
	Foster+Partners		
7.	Partner in Charge	Ken Shuttleworth	10.11.11
8.	Project Architect	Sean Affleck	25.10.11
9.	Project Architect	Richard Hyams	29.07.11
10.	Architect	David Kong	09.08.10
11.	Architect	David Kong	07.09.11
	Arup		
12.	Engineering Project Manager and Lead Building Services Engineer	James Thonger	27.10.09
13.	Engineering Project Manager and Lead Building Services Engineer	James Thonger	08.08.11
14.	Lead Electrical Engineer	Mike Summers	12.08.11
	Turner & Townsend		
15.	Architect	Gordon Rautenbach	29.03.10
16.	Mechanical and Electrical Engineer	Jon Spring	19.11.10

Case Study: 7 More London Riverside

	Organisation and Role	Name	Interviewed
	CIT / More London		
17.	Development Director	Liam Bond	27.07.11
	PricewaterhouseCoopers		
18.	Senior Programme Manager	Michael Hayes	02.11.11
19.	Real Estate Director	Paul C. Harrington	02.08.11

Foster+Partners

20.	Partner in Charge	Mikle Jelliffe	28.01.11
21.	Project Architect	Robert Hall	12.09.11
22.	Architect	Consuelo Manna	04.08.11

Roger Preston & Partners

23.	Director of Environmental Engineering	Matthew Thurston	29.09.11
24.	Building Service Engineer	Peter Hale	21.07.11

Building Design Partnership

25.	Project Mechanical Engineer	Peter Brickell	25.10.11

MACE

26.	Construction Manager	Thomas Marsterson	14.10.11

Appendix 2: Calculations of the surface to volume ratio of cube and sphere

Below I calculate and compare the surface to volume ratio of a cube and sphere of the same volume. The aim of this calculation is to question Foster+Partners' claim that "a sphere has 25% less surface area than a cube of the same volume" (F+P, 1999a, p. 23).

Cube	$A_{cube} = 6 \cdot a^2$	$V_{cube} = a3$
Sphere	$A_{sphere} = 4 \cdot \pi \cdot r^2$	$V_{sphere} = \frac{4}{3} \cdot \pi \cdot r^3$

$V_{cube} = V_{sphere}$

$a^3 = \frac{4}{3} \cdot \pi \cdot r^3$

$a = \sqrt[3]{\frac{4}{3} \cdot \pi} \cdot r$

$r = \sqrt[3]{\frac{3}{4} \cdot \frac{1}{\pi}} \cdot a$

$r \approx 0.62035$

$d \approx 1.24070$

$Q = \frac{A}{V}$

$Q_{cube} = \frac{Acube}{Vcube} = \frac{6 \cdot a^2}{a^3} = \frac{6}{a}$

$Q_{sphere} = \frac{Asphere}{Vsphere}$

$Q_{sphere} = \frac{4 \cdot \pi \cdot r^2}{\frac{4}{3} \cdot \pi \cdot r^3}$

$Q_{sphere} = 3 \cdot \frac{1}{r}$ insert $r = \sqrt[3]{\frac{3}{4} \cdot \frac{1}{\pi}} \cdot a$

$Q_{sphere} = 3 \cdot \frac{1}{\sqrt[3]{\frac{3}{4} \cdot \frac{1}{\pi}} \cdot a}$

$Q_{sphere} = 3 \cdot \sqrt[3]{\frac{4}{3} \cdot \pi} \cdot \frac{1}{a}$

$Q_{sphere} \approx 4.83598 \cdot \frac{1}{a}$

$Q_{cube} = 100\ \%$

$Q_{sphere} = x\ \%$

$x = \frac{100\% \cdot \text{Qsphere}}{\text{Qcube}}$

$x = \frac{100\% \cdot 3 \cdot \sqrt[3]{\frac{4}{3} \cdot \pi} \cdot \frac{1}{a}}{\frac{6}{a}}$

$x = \frac{100\% \cdot 3 \cdot \sqrt[3]{\frac{4}{3} \cdot \pi}}{6}$

$x = \frac{100\% \cdot \sqrt[3]{\frac{4}{3} \cdot \pi}}{2}$

$x = 50\% \cdot \sqrt[3]{\frac{4}{3} \cdot \pi}$

$x \approx 80.60\%$

A sphere has ≈ 19.40 % less surface area than a cube of the same volume!