

**A HYBRIDISED MODEL FOR POST-OCCUPANCY EVALUATION
PLANNING FOR HIGHER EDUCATION INSTITUTION BUILDINGS**

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by

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i) DEDICATION

In memory of Emma Claire Witwicki

1984-2019

ii) ACKNOWLEDGEMENT

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iii) ABSTRACT

This research has developed a hybrid Post-occupancy Evaluation model for application in the UK Higher Education (HE) sector. This is achieved utilising components found in current industry POE guidance, in conjunction with the findings of a case study of Birmingham City University's newly developed HE facilities, an analysis of publically available POE reports, and a focus group of industry practitioners involved in the planning and implementation of POE at BCU. Upon the completion of the model, a series of five validation interviews are also conducted.

The findings of this research have highlighted a number of contributory factors impeding the widespread implementation of POE. These include a small community of Practice (CoP), inconsistent approaches to POE and low compliance with suggested evaluations. Low compliance and inconsistency of approach directly prevent the achievement of academic objectives realised through POE such as benchmarking facility performance and subsequent iterative improvement of HE facilities. Furthermore, questions are raised as to the innate value industry practitioners place on POE, with practitioners either perceiving the process as a tick box activity, or are concerned with what party accumulates the value generated through implementation of POE. The research also highlighted the requirement for POE to be considered and planned earlier in a development cycle.

To remedy this situation, this research presents a hybridised POE model for user-friendly planning and implementation of POE in the UK HE sector. The model takes into account the findings of the aforementioned research, presenting a formalised and robust process for industry practitioners to follow. In keeping with the requirement for POE to be considered earlier in a development lifecycle than simply the handover and in-use phases, the model is also synchronised with the RIBA Plan of Work stages in efforts to facilitate effective POE planning and maximise beneficial outcomes for the both participants as well as the commissioning organisation.

iv) ACRONYMS

AECO	- Architecture, Engineering, Construction and Owner-operated
BCU	- Birmingham City University
BIM	- Building Information Modelling
BMS	- Building Management System
BOK	- Body of Knowledge
CAFM	- Computer Aided Facilities Management
CoP	- Community of Practice
FM	- Facilities Management
GSL	- Government Soft Landings
HE	- Higher Education
HEDQF	- Higher Education Design Quality Forum
HEFCE	- Higher Education Funding Council for England
HEI	- Higher Education Institution
PFI	- Private Finance Initiatives
PPP	- Public Private Partnerships
POE	- Post-occupancy Evaluation
RIBA	- Royal Institute of British Architects
SFA	- Skills Funding Agency
UEG	- University Executive Group
UK	- United Kingdom
VE	- Value Engineering

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ix) LIST OF PUBLICATIONS

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

This chapter provides the contextual backdrop of this research, covering the extent to which Post-occupancy Evaluation (POE) is utilised in practice, particularly focusing on the application of POE in Higher Education Institutions (HEIs). This chapter goes on to state the: i) research problem; ii) research aim; iii) research objectives; iv) research questions; v) motivation for the study; and vi) the significance of the study. A structure for the research is also outlined.

1.1.1 A Hybridised Model for User-Friendly POE Planning for Higher Education Institutions' Buildings

The Architecture, Engineering, Construction and Operations (AECO) sector is a major consumer of natural resources (Milutienė *et al.*, 2012) and attracts conspicuous academic attention during the design and construction phases of a built asset's whole lifecycle (Kassem *et al.*, 2014; Roberts *et al.*, 2018). Yet, the operational phase of building occupancy and use is the chief contributor to resource depletion, whole lifecycle costs and performance metrics (c.f. Bosch *et al.*, 2014; Liu and Issa, 2014; Lindkvist, 2015; Nical and Wodynski, 2016). POE is a feedback mechanism primarily designed to measure factors including user satisfaction and maintenance costs (c.f. RIBA, 2016; RIBA, 2017a; RIBA, 2017b). Andreu and Oreszczyn (2004) and Turpin-Brooks and Viccars (2006) assert that undertaking a POE on a newly developed built environment asset presents an undeniable opportunity to garner environmental feedback from the facility in question. Furthermore, regarding customer satisfaction, whilst developers are primarily concerned with efficiency and cost (Gervásio *et al.*, 2013), end-users focus more upon the quality of the building's finishes, its environmental performance and services (Turpin-Brooks and Viccars, 2006; Hassanain and Mudhei, 2006; Riley *et al.*, 2010; Choi *et al.*, 2012; Hussanain and Iftikar, 2015).

To measure a building's operational performance, a POE is utilised to determine whether decisions made by design, construction and facilities management professionals meet the

envisaged requirements of end-users and the development's commissioners (Adeyeye *et al.*, 2013; Skills Funding Agency, 2014). Such work has significant implications in the area of soft landings (within a building delivery process) to ensure that future decisions made about similar buildings are based upon lessons learnt from an existing building's operational performance and fulfilling client requirements (Gana *et al.*, 2018). POE's consider, more specifically, factors such as: i) building use; ii) energy consumption; iii) maintenance costs; and iv) user satisfaction (c.f. RIBA, 2016; RIBA, 2017a; RIBA, 2017b). A building's operational performance is measured using: i) project team feedback that recounts the commissioning and construction phases; ii) end-user feedback on finishes and functional performance; iii) technical performance feedback from a building's systems; and iv) a strategic overview incorporating the data from each of the aforementioned evaluation stages (c.f. HEFCE, 2006; RIBA, 2016; RIBA, 2017a; RIBA, 2017b).

1.2 RESEARCH PROBLEM STATEMENT

POE offers a significant opportunity to implement a rigorous and systematic feedback mechanism for the AECO sector. Feedback mechanisms are an essential feature of many engineering and manufacturing based sectors, however, the implementation of a formalised, systematic and rigorous feedback mechanism within the built environment remains an elusive objective. Leaman and Bordass (2005) stated that the implementation of POE could realise 'virtuous circles of improvement' required for constant iterative improvement of built facilities. Without such a mechanism, the benchmarking of performance between different built environment assets (Wauters, 2005; Hassanain *et al.*, 2016), and by extension the iterative improvement of future built environment developments (Göçer *et al.*, 2015), remains a significant challenge. POE in its current form was first highlighted as a concept in the RIBA handbook 1965. The handbook suggested architects return to developments after they have been completed and occupied for a period of time. Much of the initial research in this area focused around the study of 'sick building syndrome' (c.f. RIBA, 1965; Rostron, 1997).

Despite the widely espoused benefits of conducting a POE on a newly developed facility (including: i) transferring operations knowledge accrued to inform future building designs (Cooper, 2001); ii) iteratively improving an existing facility's performance (Göçer *et al.*, 2015); and iii) benchmarking between facilities for improved operations, particularly within the same estate (Preiser and Vischer, 2005; Olivia and Christopher, 2014)), implementation of POE in

practice remains limited, with the bulk of POE research taking place in Higher Education Institutions (HEIs) (c.f. Garbowski and Mathiassen 2013; García-Peñalvo and Conde 2013). Practitioners have hitherto either failed to adopt a POE and/ or lack consistency in approach to its planning (Alborz and Berardi, 2015). Consequently, the opportunity to reduce excessive energy usage, reliance on resources and material wastage is squandered, whilst simultaneously reducing returns on investment and occupant satisfaction (Ahuja *et al.*, 2016). Research suggests that the accrual of value and passive attitudes toward sustainable solutions represent major stumbling blocks that discourages sector stakeholders (i.e. designers, contractors and clients) from completing a POE (Wong and Kuan, 2014). However, increased societal (bottom up) and political (top down) demands for ‘greener buildings’ may aid in dispelling these unduly negative attitudes toward the planning and implementation of POE (Miller *et al.*, 2012).

In efforts to rectify this situation, the UK Government introduced the Government Soft Landings (GSL) approach for all centrally (government) funded AECO developments. Whilst GSL is not a POE strategy in its own right, it is designed to promote an environment where a POE can be readily planned and implemented. However, whilst initiatives such as GSL have been implemented in efforts to standardise POE as an element of a best practice approach to development within the construction sector, many of the supporting guidance documents which have been developed for practitioners have ceased to be supported by the funding bodies which previously funded/supported them (c.f. HEFCE, 2006).

1.3 AIM OF STUDY

This study aims to develop a hybridised model for user-friendly POE, for the planning and implementation of POE within HEIs. To this end, the study analyses contemporary academic literature regarding POE as well as practice guidance documentation. A case study is developed utilising previously completed POE reports prepared by Birmingham City University’s (BCU) Estates Department regarding four recently developed university facilities. Focus group interview data is simultaneously accrued in efforts to analyse the implementation of POE in a real life scenario, and validation interviews with practitioners to validate the developed model.

1.4 MOTIVATION FOR THE STUDY

The motivation for this study lies with the lack of a formalised industry best practice POE process tailored to facilitate the benchmarking of HEI facility performance, and subsequent

iterative improvement of facilities constructed. Contemporary educational facilities are routinely utilised for testing innovations and advances in building technology. The use of disruptive digital technologies such as Building Information Modelling (BIM) and Computer Aided Facilities Management (CAFM) have stimulated the development of bespoke higher education buildings. Despite the higher education sector offering a medium for development and enhancement of built environment assets, a systematic feedback mechanism enabling iterative improvement and facility benchmarking for built assets remains elusive. As such, a secondary aim of this research is to develop a systematic feedback mechanism facilitating iterative improvement and facility benchmarking for the POE.

1.5 SIGNIFICANCE OF THE STUDY

This study utilises a number of different analytical methods and techniques, in efforts to interrogate current POE standards and processes. A bibliometric analysis of pertinent POE academic literature is undertaken in efforts to critically analyse the specific academic literature pertaining to prominent objectives emanating from the POE BOK; in this case referring to the need for iterative improvement of HE facilities and facility performance benchmarking. This study contributes to the existing POE BOK, whilst also offering a practical and applied model for application based upon an extensive study of: i) existing guidance documentation; ii) completed POE reports; and iii) practitioner feedback.

1.6 THE STUDY

1.6.1 Research Questions

The following research questions have been developed based upon the research problem statement in conjunction with the main aim set out for the study:

1. To what extent are existing POE processes utilised in UK HEIs?
2. What are the tangible benefits UK HEIs gain from implementing POE in its current form?
3. Are practitioners aware of the value adding implications of POE implementation?
4. What inhibitors discourage the use of POE in the UK HEI sector?
5. How can objectives set out in POE academic literature such as: i) iterative improvement of facilities; and ii) facility performance benchmarking, be realised in practice?

1.6.2 Research objectives

Against this aforementioned contextual backdrop, this research will develop a POE model that delineates the essential key stages to be implemented together with the rationale for these as well as accompanying POE guidance documentation. This hybrid model will provide an invaluable systematic feedback mechanism facilitating iterative improvement and facility benchmarking for the POE. In realising this aim, the objectives are as follows:

1. To identify (using a mixed methods systematic review of pertinent literature) essential stages from both academic literature (the POE body of knowledge (BOK)) and industry practice guidance involved in the planning of a POE in a HEI context. Moreover, to define and delineate interrelations/ connectivity between these stages via the use of data flow diagrams (as a viable processing mapping procedure),
2. To develop (using the findings of the extensive literature review and bibliometric analysis) new theory regarding POE planning in a HEI.
3. To develop a systematic, user-friendly two-stage hybrid toolkit for the planning of POE – where these two stages are: i) a refined review selection; and ii) a refined evaluation selection. The model (which constitutes the product of this research) will be presented as a process map with accompanying white paper guidance documentation.
4. To validate the hybrid model developed via practitioner feedback in a series of interviews, subsequent qualitative analysis of such and possible (at least partial) application on a HEI facility. The ultimate ambition is for BCU Estates to adopt the model as an exemplar of best practice.

1.6.3 Research Methodology and Design

A research methodology outlines the processes selected for: i) detailing the philosophical underpinning of the research; ii) collecting data; iii) analysis of the data; and iv) the reporting of findings. Two of the most common paradigms when constructing a research approach regards the selection of qualitative or quantitative methods. In recognition of the well espoused strengths and weaknesses of both qualitative and quantitative approaches, a mixed method approach is adopted incorporating elements of both paradigms.

This section offers a brief overview of selected methods utilised in this study. These approaches are discussed in significant detail, along with various other methods and methodological approaches, in the methodology chapter.

1.6.3.1 Qualitative Research

Qualitative research is a means with which to investigate and comprehend the meaning individuals or groups attribute to a human or social issue. This can be accomplished through analysis of i) open-ended interviews; ii) direct observations; and iii) written communications (Creswell, 2006; Patton, 2015). Qualitative research is fundamentally interpretive in nature, requiring researchers to ‘make an interpretation of the data’ (Creswell, 2006, Patton, 2015). The process of interpreting the data follows three steps: i) developing a description of an individual or setting; ii) analysing data with regard to themes or categories; and iii) making an interpretation or drawing conclusions about its meaning personally and theoretically (Creswell, 2006). This study utilises: i) a practitioner focus group; ii) a comparative analysis; iii) a thematic analysis; and iv) a series of five validation interviews, all of which are qualitative in nature.

1.6.3.2 Quantitative Research

Quantitative research affords the opportunity to test objective theories through a process of examining the relationships amongst variables (Neuman, 1999; Creswell, 2006). Quantitative research makes postpositivist claims to knowledge (i.e. cause and effect thinking, reduction of specific variables, use of measurement and observation, and theory testing), utilising an experimental strategy of enquiry (Creswell, 2006). However in contrast, Crotty (1998) suggests that most research which is undertaken using qualitative methods, would traditionally have been carried out in an empiricist, positivist manner in the past. Despite quantitative research approaches being commonly associated with empirical approaches, it is possible for a quantitative piece of work to be offered in ‘non-positivist’ form. This study utilises a bibliometric analysis as well as numerous quantifications of arising from the qualitative data analysed in this study.

1.6.3.3 Mixed Methods Research

A mixed method approach, also incorporating both qualitative and quantitative data and analytical techniques, by design occupies the centre point between the two-forementioned methodological approaches (Creswell, 2006). It is important to note, a mixed method approach does not pertain to simply a study containing qualitative and quantitative methods, but utilises both elements in conjunction. The combination of these two approaches can be sequential or parallel as well as used isolation or in combination with one and other, but crucially, used to investigate the same phenomenon (Mills *et al.*, 2010). This process of ‘triangulation’ of data sources, offers a means of converging across qualitative and quantitative methods (Jick, 1979). As previously stated, this research utilises a combination of qualitative and quantitative elements, collected in a post-positivist paradigm requiring the collection of as much reality as possible in efforts to address the problem highlighted in this research.

1.6.3.4 Interpretivism

Interpretivism is an epistemological position concerned with understanding and explaining social phenomena, not necessarily observable by the senses but interpreted by fellow individuals (Crotty, 1998; Matthews and Ross, 2010). An interpretive approach has a number of common features: i) knowledge is derived from people’s interpretations and understandings; ii) individuals interpret the social world and social phenomena differently enabling the exploration of differing perspectives; iii) the researcher interprets other individuals interpretations in terms of the theories and concepts of the researchers discipline; and iv) the researcher works with gathered data to produce a theory (Matthews and Ross, 2010). This study is largely conducted utilising an interpretivist approach, requiring the researcher to interpret elements of the study. These elements (including the: i) focus group transcript; ii) validation interview transcripts; iii) completed POE reports; and iv) industry standard guidance documentation), all require interpretation from the researcher to make sense of theses phenomenon within the aforementioned social world.

1.6.3.5 Inductive Reasoning

Inductive reasoning is a methodological approach that utilises four iterative steps: i) observation of an individual or phenomenon upon which the study focuses; ii) identification of

a pattern; iii) the formulation of a tentative theory; and iv) the development of a theory based on the previous steps as a basis for gaining knowledge (Holland *et al.*, 1989). An inductive strategy allows for meaningful ‘dimensions’ to emerge from observed patterns found in the cases under enquiry, without presupposition of what those ‘dimensions’ would be. As such, induction is a methodological approach for ‘question resolution’ in the context of imperfect information - offering not the ‘best possible answer’, but the ‘best available answer’ (Rescher, 1980). This study utilises a inductive approach, analysing all of the selected data surrounding the phenomenon in question, before synthesising the findings and producing a theory - in this case, what is inhibiting the iterative improvement of constructed facilities within the HEI sector.

1.6.3.6 Case Study Research

A case study is a research approach focusing on the analysis of i) a program; ii) an event; iii) a process; or iv) one or more individuals; analysed using a variety of data collection procedures (Creswell, 2006). Case study research is often predicated upon the triangulation (c.f. Edwards and Holt, 2010) of multiple sources of data emanating from a chosen study or studies to generate robust findings (Yin, 2009). Yin (1994) and Gillham (2000) propose the utilisation of a ‘chain of evidence’ (also referred to as a ‘multi-method approach’) when undertaking case study research. The chain of evidence represents a convergence of several different varieties of evidence, collected in a number of differing ways, but pertaining to the same point (Gillham, 2000). The case study incorporated in this study, examining four of Birmingham City University’s recently developed HEI facilities, utilises: i) the final completed POE reports; ii) industry standard guidance documentation; in conjunction with iii) a practitioner focus group exploring practitioners experiences of BCU’s POE processes, all of which contribute to the ‘chain of evidence’ proposed by Yin (1994) and Gillham (2000).

1.7 DATA COLLECTION

The collection of largely textual data informing this study has been undertaken utilising three separate sources: i) analysis of industry practice guidance; ii) interrogation of previously completed POE reports pertaining to BCU facilities; and iii) conducting semi-structured focus group interviews with industry practitioners.

Since the inception of POE during studies on ‘sick building syndrome’ in the 1970s, numerous POE guidance documents have been produced with the aim of aiding practitioners with the planning and implementation of POE. The primary document for the UK HE sector with regards to POE is the Higher Education Funding Council for England’s Guide to Post-occupancy Evaluation (2006). As such this document (representing a secondary data source and first data collection stage) was used to develop a delineated POE process map which in turn could be used to map and compare completed POE reports pertaining to the UK HEI sector.

The second data collection stage involved the analysis of completed POE reports pertaining to BCU’s facilities, supplied by the BCU Estates department. These completed reports offer a snap shot of the state of POE, particularly: i) planning; ii) implementation; and iii) knowledge management at the completion of a POE. Publically available POE reports which have been published upon completion have also been analysed, to offer an insight into the differences in POE planning and implementation between differing HEIs.

The third and final data collection supplied the study’s primary data, and was comprised of a semi-structured focus group interviews with practitioners with direct experience of BCU’s POE processes. The focus group attendees included: i) the Director of Estates; ii) the Deputy Director of Estates; iii) individual Building Managers; iv) the Head of Facilities Management; v) the Head of Security; vi) the Head of Information Technology (IT); vii) the soft landings representative; and viii) the external consultant conducting the university’s POE’s.

1.7.1 Data Sources

The data utilised in this study was comprised of both primary and secondary data. The secondary data incorporates previously completed POE reports in conjunction with industry standard guidance. The primary data will be comprised of practitioner feedback regarding their direct experiences of the planning and implementation of POE within BCU, and is collected using semi-structured focus groups.

1.7.2 Data Analysis

This section offers a brief overview of selected data analysis techniques utilised in this study. A comprehensive overview of these approaches is discussed in the methodological chapter

1.7.2.1 Componential Synthesis

A qualitative componential synthesis of published literature sought to thematically group the subject matter of papers published and ascertain the trajectory of future research into digital asset management. Future research suggestions emanating from applicable academic literature was collated to offer an overview of the research in the field, and to offer an indication of the direction of future research on this field.

1.7.2.2 Bibliometric Analysis

Bibliometric analysis has been developed and utilised across multiple disciplines due to its ability to visually represent a large body of literature (van Eck and Waltman, 2010). In contrast to manual analysis, bibliometric analytical software such as Gephi (Bastian *et al.*, 2009) or VOSviewer (van Eck and Waltman, 2010) avoids introducing researcher bias and removes time and resource limitations relating to the practical number of studies selected (He *et al.*, 2017). Furthermore, VOSviewer's clustering function represents an advancement on previous mapping techniques, allowing deeper observations of connectedness than were previously possible using alternative software such as Statistical Package for the Social Sciences (SPSS) and Pajek (c.f. van Eck and Waltman, 2010).

1.7.2.3 System Flow Diagrams

Using system flow diagrams of the delineated POE processes as a comparative tool, the processes of both BCU POE's as well as publically available POE reports (pertaining to the University of Nottingham and the University of Sheffield) are compared and contrasted to identify differences in the planning and implementation of POE in different institutions.

1.8 RESULTS

The results of this study present multiple contributions to knowledge, in conjunction with a hybridised model for the user-friendly planning and implementation of POE within UK HEIs. Table 1 presents the contributions to knowledge emanating from the research. In context to the utilisation of case study research, there is a requirement for the collection of supporting evidence to develop a 'chain of evidence', facilitating a triangulation of evidence pertaining to the research output (Gillham, 2005). Likewise, the utilisation of a postpositivist paradigm relies

on a multitude of methods being implemented in efforts to capture as much reality as possible (Denzin and Lincoln, 1998).

Table 1 - An Overview of the Contributions to Knowledge Emanating from this Research.

Chapter No.	Chapter Title	Contribution to Knowledge
4	Post-occupancy Evaluation	<ul style="list-style-type: none"> • The finding of a small CoP identified through the bibliometric analysis. • A scarcity of literature pertaining to ‘iterative improvement’ and development of ‘benchmarking’ criteria realised through POE, despite these being prominent academic objectives. Identified through the bibliometric analysis.
5	Delineation of the POE Process	<ul style="list-style-type: none"> • Inconsistent approaches to POE planning and implementation identified through process mapping and comparative analysis. • Iterative improvement of the process itself identified through process mapping and comparative analysis. Institutions improve upon their POE processes as they garner more experience of doing such evaluations. Development stops when an estate or series of buildings is completed. Can create issues around comparable data points, as processes evolve and evaluations are either scheduled, or undertaken differently.
6	Focus Group Transcript Data Analysis	<ul style="list-style-type: none"> • Requirement for a formal review of POE findings at the outset of a new development identifies through case study. • Scarce dissemination of POE findings, both: <ul style="list-style-type: none"> ○ internally and; ○ externally. • Pre-agreement of POE participation identified through practitioner focus group. • Crucial importance of appropriate scheduling of evaluation elements identified through practitioner focus group.
7	Hybrid Model Development	<ul style="list-style-type: none"> • Requirement for a ‘host’ construction process for POE processes and procedure to run parallel and simultaneously - RIBA Plan of Work 2013. Identified through validation.

Utilising these contributions to knowledge, a sequential POE process for application within the UK HE sector has been developed. Figure 1 shows the hybrid model in its raw form, detailing the POE process in its stand-alone format; as the thesis unfolds the development of the model is elucidated upon.

Figure 1 - A Visualisation of the Hybrid Model for User-friendly POE Planning and Implementation within HEIs

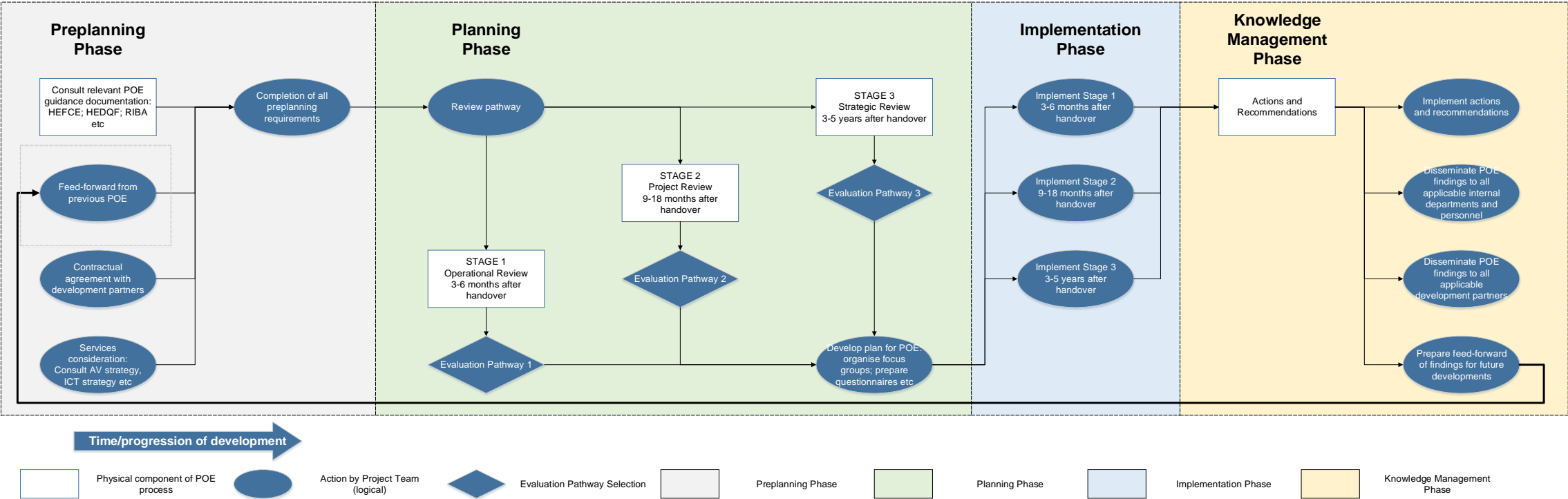


Figure 2 - A Visualization of the Hybrid Model for User-friendly POE Planning and Implementation within HEIs synchronized with the RIBA Plan of Work Stages (2013)

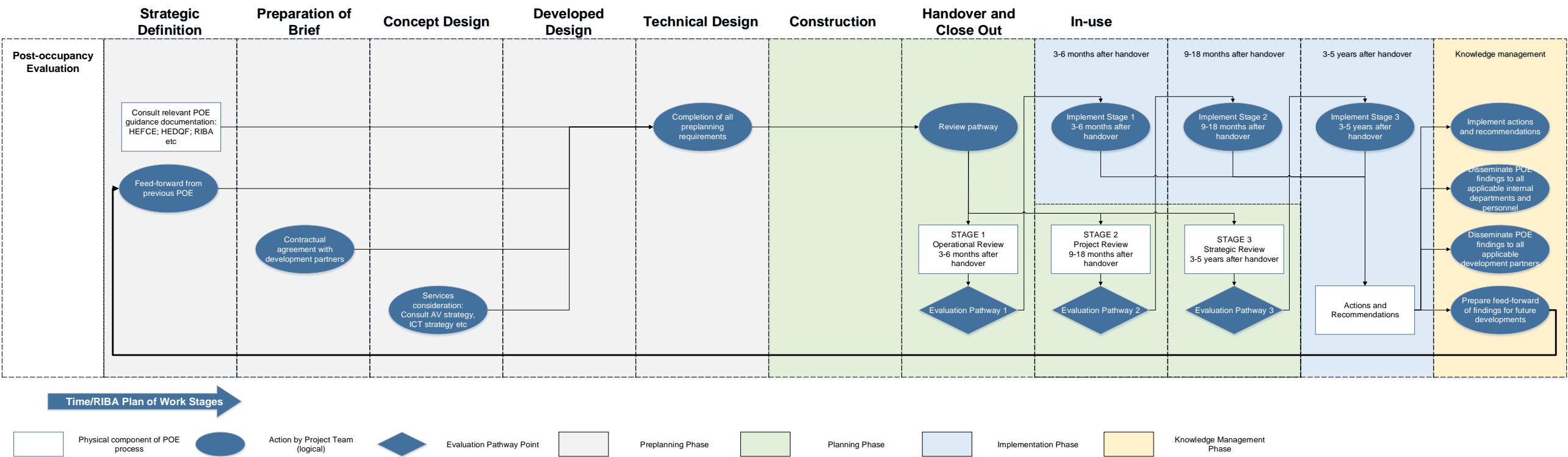


Figure 2 shows the same POE process, organised to correspond to the RIBA Plan of Work 2013 stages. It was found over the course of the research, that for application within the UK higher education sector, a ‘host’ process familiar to industry practitioners was required to ensure the execution of the POE model at the correct temporal points (c.f. Figure 55 for details).

The final model has been validated by practitioners, through a process of five validation interviews conducted with professionals who were familiar with planning and implementing POE, particularly within the HE sector. The final hybrid POE model acquired a validation score of nearly 90%, validating the model.

1.8.1 Limitations

Using an interpretivist epistemological lens as part of an inductive research approach has several significant limitations. First, interpretivist researchers assume that access to reality is only through social constructs such as the prevailing academic discourse on POE (Antwi and Hamza, 2015). Second, and as a branch of positivism, the interpretivist philosophical position also emphasises qualitative vis-a-vis quantitative analysis (Symon *et al.*, 2016). The subjective nature of qualitative research can: introduce researcher bias into the study; be subject to literature searching practices that may omit significant research; and introduce translation errors (cf. Mallett *et al.*, 2012). Third, the interpretivist approach cannot be generalised because the data and findings elucidated upon are heavily influenced by the researcher’s personal views and values (Kiernan and Hill, 2018). These limitations apart, all research has a beginning and one significant benefit of an interpretivist approach is the generation of new theories that can signpost future research direction.

1.9 ETHICAL STATEMENT

Given the confidential nature of this investigation, a strict rigorous two stage ethical process was adopted. During the first stage, the PhD researcher sought ethical approval from both supervisors at the host HEI before commencing any research. This involved completing an ethical pro-forma checklist approved by the Director of Studies, First and Second Supervisor’s. At this stage, a series of control measures were implemented to mitigate risks posed to both the PhD research and host HEI – these risk control measures included: i) presenting the research to senior management within the Estates management team to secure their support for the ongoing programme of research; and ii) ensuring that any research papers [to be published]

that used materials and documentation produced by Estates first sought written approval from senior members of the Estates management team. During the second stage (and prior to conducting the interviews), local ethics processes were followed as required by the Estates management team. Estates management granted consent provided the following conditions were met, namely that: the research findings would be shared with the Estates management team who could implement any recommendations emanating from the work; that members of the Estates management team are consulted with on any data utilised for the research; that all participants were assured of strict anonymity and confidentiality and that they had the right to withdraw from the process at any stage (Wiles *et al.*, 2008). Finally, prior to commencing any interviews or focus groups, the participant's permission was requested to record the discussions held and reassurance given that the recording would not be disclosed, divulged or misused (deliberately or otherwise) in any way or form (Oliver, 2010).

1.10 STRUCTURE OF STUDY

1.10.1 Chapter One - Introduction

The first chapter of this study presents the: i) background context of the study; ii) research problem; and iii) aims and objectives of the study. In conjunction with these can be found statements regarding: i) the significance of the study; ii) the motivation for the study; iii) the scope of the study; iv) a brief description of the research methods employed; and v) the ethical considerations of the study. Finally, the chapter outlines the overall structure of the research, offering a description of each chapter.

1.10.2 Chapter Two - Research Methodology

Chapter two offers a detailed overview of the methodology selected for this research. The chapter elucidates on the: i) specific research methodology; ii) methods employed; as well as iii) philosophical underpinning of the study. A three stage approach is presented, each stage offering evidence supporting a 'chain of evidence' case study research approach (c.f. Gillham, 2005; Yin, 2009).

1.10.3 Chapter Three - Advancements in Asset Management

The third chapter offers a crucial contextual overview of advancements in asset management. The chapter presents a detailed literature review of the ongoing advancements within the built environment, with particular focus on the digitalisation of asset management, traditionally referred to as ‘cleaning and maintenance’. The chapter touches upon the requirement for stringent data and knowledge management procedures, to ensure that facilities management practitioners in particular, are maximising the value of their systems and processes. The chapter also investigates inhibiting factors preventing wider implementation of asset management advancements in practice. The chapter presents a componential synthesis of ‘future research’ suggestions to identify trends in ongoing asset management research within the built environment sector. This chapter offer a contextual background to contemporary systems and practices within a buildings lifecycle, many of which have direct implications for the planning and implementation of POE - both POE and BIM fall under the remit of softlandings.

1.10.4 Chapter Four - POE Literature Review and Bibliometric Analysis

Chapter four reviews literature regarding current practitioner guidance documentation for the planning and implementation of POE at HEIs. Guidance documentation such as the HEFCE: Guide to Post-occupancy Evaluation (2006) and the Higher Education Design Quality Forum (2010) are discussed. The chapter goes on to present a bibliometric analysis of pertinent POE literature. Utilising the VOSviewer software tool in conjunction with Web of Science bibliometric data, a protocol was developed utilising a three step approach. The first step of the search protocol used the term ‘Post-occupancy Evaluation’ to capture all of the POE literature available through the Web of Science database. The next two search terms were used cumulatively with the first (step two utilising two search terms and step three utilising all three search terms), to identify specific themes and objectives identified within the wider POE BOK. This was done to identify contemporary research pertaining to recognised academic objectives regarding POE.

1.10.5 Chapter Five - Delineation of POE Process

In chapter five and whilst utilising industry standard guidance documentation, the POE process for HEIs is delineated using system data flow diagrams, indicating key decision points and scheduling considerations. The resultant POE process system data flow diagram can in turn be

utilised as a comparative tool, offering a template with which to plot previously completed POE reports, facilitating critical analysis of the decisions and scheduling choices made by practitioners when planning POE's. Following a call for the publication of POE reports in the early 2000s (c.f. Bordass *et al.*, 2001; Cohen *et al.*, 2001; Bordass and Leaman, 2007), reports made public are also analysed to identify differences in the planning and implementation of POE between differing HEIs.

1.10.6 Chapter Six - Practitioner Focus Group Analysis

The sixth chapter of the study interrogates the primary feedback data regarding the planning and implementation of POE at BCU collected in a semi-structured focus group with applicable Estates personnel with direct experience of BCU's POE processes. A series of qualitative analysis methods are employed such as SWOT analysis for the purposes of developing themes, and producing an overview of the: i) strengths; ii) weaknesses; iii) opportunities; and iv) threats of BCU's POE processes from the practitioner's perspective with direct experiences of the planning and implementation of POE at BCU.

1.10.7 Chapter Seven - Hybrid Toolkit Design and Operation

Chapter seven details the development of the hybridised POE model for HEIs. Utilising the delineated POE process in conjunction with the focus group data collected from applicable Estates personnel, a hybridised POE model is developed for HEI application. The model takes into account: i) POE requirements emanating from academic literature; ii) practitioner feedback and requirements; and iii) data and knowledge management requirements pertinent to the ever increasing digitalisation of the UK built environment sector.

1.10.8 Chapter Eight - Hybrid Model Validation

The eighth chapter details the findings and subsequent analysis of the five validating semi-structured interviews. These interviews were conducted in efforts to validate the POE model for HEIs with a group of practitioners' alternative to the interest group (BCU Estates Department). Where applicable, alterations and tweaks are made to the POE model for HEIs based upon the feedback of this focus group.

1.10.9 Chapter Nine - Discussion of Results, Conclusions, Limitations and Recommendations

Chapter nine offers a detailed discussion on the study's findings. The chapter details: i) the aforementioned findings of the study; ii) analysis of those findings; and iii) interpretation of the analysis of those findings. The chapter then goes on to conclude the study, and as such offers conclusions based upon the findings of the study. Emanating from the findings and subsequent discussion, recommendations are made and presented in this chapter. Finally, limitations of the study are discussed, in the context of an interpretivist approach, acknowledgment of the limitations of this approach are crucial in ensuring scientific vigour of the presented study.

1.11 CHAPTER CONCLUSION

Within the first chapter, the focus of the study has been presented. This has included: i) the background to the study; ii) the aims and objectives; and iii) the significance of the study. Furthermore, a chronological structure outlining each chapter within the thesis is also presented.

Preliminary investigation into the requirement for a formalised feedback mechanism for the built environment, particularly with regard to the HE sector, has highlighted a number of important considerations. Firstly the AECO sector is a major contributor to global climate change. Whilst much research looks into the design and construction phases of a development, up to 40 per cent of a buildings environmental impact occur within the occupation phase of a buildings lifecycle. Secondly, despite significant advances in design and construction process through disruptive technologies such as BIM, which in of itself can act as an information repository, many buildings in practice remain untested prototypes as no evaluation is undertaken to identify successes and failures. Without such a process, it will be difficult for the AECO sector to improve the quality and performance of it built assets, subsequently rendering the objective of reducing the sectors significant environmental footprint a near impossibility.

CHAPTER 2

RESEARCH METHODOLOGY

2.1 INTRODUCTION

The development of a research approach requires the researcher to contemplate four questions pertaining to the nature of their study (Crotty, 1998). There is no scientific consensus on which methods; methodologies; theoretical perspectives; and epistemologies have primacy, as such researchers are required to carefully select and justify their selections (Crotty, 1998; Patton, 2015; Creswell and Poth, 2018). Crotty (1998, p.2) states four questions a researcher should ask:

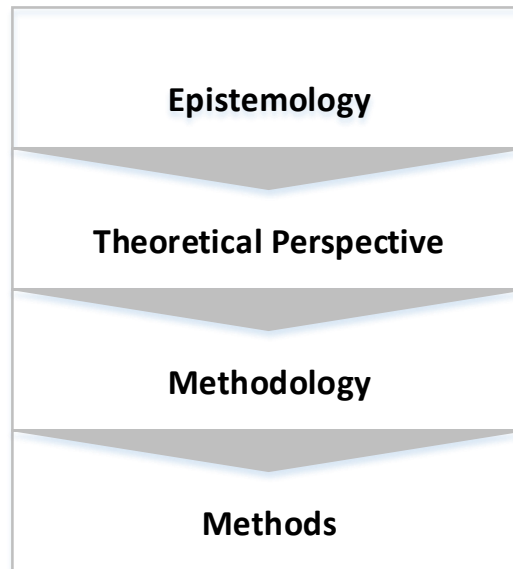
1. *“What methods do we propose to use?”*
2. *“What methodology governs our choice and use of methods?”*
3. *“What theoretical perspective lies behind the methodology in question?”*
4. *“What epistemology informs the theoretical perspective?”*

Each of these four components of the research approach are intrinsically linked, with each level informing the next and cascading through all four points of consideration, namely: i) methods; ii) methodology; iii) theoretical perspective; and iv) epistemology. It is critical that a researcher designing a research approach for their study comprehends these four interconnected considerations. As such, the methods refer to the techniques or procedures that will be utilised in the study (Crotty, 1998). The methodology describes the strategy or the plan of action for the research (Creswell, 2006). The theoretical perspective describes the philosophical stance that informs the chosen methodology (Creswell and Poth, 2018). Finally, the epistemological position details the way of interpreting the world and making sense of it, in simple terms, *“how we know what we know”*, and in turn informs the theoretical perspective (Crotty, 1998, p.8).

The hierarchy of the four considerations is equally important. Figure 3 offers a visual representation of the hierarchy of the aforementioned considerations for developing an appropriate and robust research approach. Before the methods can be selected, the researcher must have developed a robust methodology. Similarly, before the methodology is developed, a researcher must have adopted a theoretical perspective. Before a theoretical perspective can

be adopted, an epistemology regarding the researchers interpretation of reality, must have been selected.

Figure 3 - A Depiction of the Theoretical Foundations of Social Research (Crotty, 1998)



This chapter sets out various methodological components and philosophical positions that were considered and describes the approach selected for the purposes of undertaking this research.

2.2 PHILOSOPHICAL CONSIDERATIONS OF RESEACH METHODOLOGY

The development of a research methodology is not limited to the strategy and research methods selected but must consider both rational and philosophical assumptions underpinning the study (Dainty, 2008). A researcher's selected research methodology is irrevocably linked to the researcher's philosophical positions regarding: i) ontology; and ii) epistemology (Crotty, 1998; Dainty, 2008; Saunders *et al.*, 2012). As such, the underlying philosophical positioning of the researcher influences the selection of research strategy and method (Crotty, 1998; Saunders, Lewis and Thornhill, 2012).

2.3 ONTOLOGICAL CONSIDERATION

The term ontology denotes the philosophical study of being, or more precisely 'what is the nature of reality?' (Crotty, 1998). Two contrary viewpoints have arisen around this question, namely: i) objectivity; and ii) subjectivity (Crotty, 1998). The objectivist view states simply that reality exists and is thus tangible, complete and independent of a given individual's

understanding (Dainty, 2008). By this line of reasoning, reality is unchanged irrespective of any perceived meaning attached to it, and thus is independent of human understanding. This position can be referred to as ‘objective positivism’ (Guba, 1990). In contrast, the subjectivist view suggests that an individual’s own mental activity is the only unquestionable fact of our experience (Crotty, 1998). Table 2 offers a comparison of the key differences between subjective and objective philosophical positioning.

Table 2 - A Comparison of the Key Differences between Objectivism and Subjectivism

	Objectivity	Subjectivity
Interpretation of reality	Presupposes an independent reality that can be grasped (c.f. Ratner, 2002; Dainty, 2008).	Consciousness the only unquestionable fact of our experience (c.f. Guba, 1990).
Evidence	Quantitative (c.f. Crotty, 1998)	Qualitative (c.f. Ratner, 2002)
Weakness	Claims to be non-biased - this has been challenged (c.f. Ratner, 2002).	Investigator’s values are said to define the world that is studied (c.f. Ratner, 2002).

Giddens (1974) asserts that many academic authors regularly ‘confuse’ two overlapping themes: i) objectivism and subjectivism; and ii) rationality and irrationality. As such, associating objectivism with rationality, and subjectivism with irrationality. It is suggested the confusion of these two dimensions happens in such a way as to obscure the logical distinctions presupposed by any form of sociological or historical study (Giddens, 1974).

2.4 EPISTEMOLOGICAL CONSIDERATION

Epistemology denotes the study of the theory of knowledge regarding its nature, scope and limitations (Collins, 2010). Alternatively put, “...how do we know what we know?” (Crotty, 1998, p.8). Starting from the objectivist ontological position, postpositivism and interpretivism offer a philosophical mechanism for attaining knowledge in epistemological terms (Crotty, 1998).

2.4.1 Positivism

Positivism and postpositivism are two positive scientific traditions concerning reality and its perception (Denzin and Lincoln, 1998). Positivists assert that there is a reality to be studied, captured and understood (Guba, 1990). August Comte (1798-1857) initial work on empirically based ‘positive knowledge’ of experience, was combined in the early twentieth century with the ‘rigorous and systematic application of rational thought based in logic’, promoted by the philosophers of the ‘Vienna Circle’ (c.f. Giddens, 1974; Hanfling, 1981; Patton, 2015). The

resultant ‘logical positivism’ which arose was influential in the early twentieth century, but has been “almost universally rejected” as a basis of for social science enquiry, due to its narrow definition of science and knowledge (Campbell, 1999, p. 132; Patton, 2015).

2.4.2 *Postpositivism*

Postpositivists on the other hand contend that “reality can never be fully apprehended, only approximated” (Guba, 1990, p.22). An early proponent of postpositivism - Werner Hiesenberg - developed uncertainty principle in conjunction with Niels Bohr in the field of Quantum mechanics. Development of this theory directly challenges the positivist claims to “certitude and objectivity” (Crotty, 1998, p.29), as the mere act of observation may alter what is being observed. Eminent methodologist Donald T. Campbell asserted that postpositivism ‘tempers positivism’ by proposing that: i) discretionary judgement is unavoidable in science; ii) proving causality with certainty in human affairs is problematic; iii) knowledge is relative as opposed to absolute due to it being inherently embedded in historically specific paradigms; and iv) as all methods are imperfect, multiple methods, both quantitative and qualitative, are required for the generation and testing of theory (c.f. Campbell and Russo, 1999, Patton, 2015). As such, research aligned with the postpositivism paradigm relies on a multitude methods in efforts to capture as much reality as possible (Denzin and Lincoln, 1998).

2.4.3 *Interpretivism*

Interpretivism is an epistemological position concerned with understanding and explaining social phenomena, not necessarily observable by the senses but interpreted by fellow individuals (Crotty, 1998; Matthews and Ross, 2010). Blaikie (1993, p96) states:

“knowledge is seen to be derived from everyday concepts and meanings - the social researcher enters the social world in order to grasp the socially constructed meanings and then reconstruct them in scientific language.”

The accounts generated may be considered at two levels: i) redescription of everyday accounts; or ii) the basis for developing theories (Crotty, 1998; Matthews and Ross, 2010). An interpretive approach has a number of common features: i) knowledge is derived from people’s interpretations and understandings; ii) individuals interpret the social world and social phenomena differently enabling the exploration of differing perspectives; iii) the researcher

interprets other individuals interpretations in terms of the theories and concepts of the researchers discipline; and iv) the researcher works with gathered data to produce a theory (Matthews and Ross, 2010).

Using an interpretivist epistemological lens has several significant limitations. First, interpretivist researchers assume that access to reality is only through social constructs such as the prevailing academic discourse on POE (Antwi and Hamza, 2015). Second, and as a branch of positivism, the interpretivist philosophical position also emphasises qualitative vis-a-vis quantitative analysis (Symon *et al.*, 2016). The subjective nature of qualitative research can: introduce researcher bias into the study; be subject to literature searching practices that may omit significant research; and introduce translation errors (cf. Mallett *et al.*, 2012). Third, the interpretivist approach cannot be generalised because the data and findings elucidated upon are heavily influenced by the researcher's personal views and values (Kiernan and Hill, 2018).

2.4.4 Phenomenology

In contrast to postpositivism, phenomenology focuses upon the phenomena which “present themselves immediately to us as conscious humans” (Crotty, 1998, p.78). Roche (1977, p1) asserts that phenomenology's description of “experience reveals facts about consciousness, about the ways man [individuals] experiences the world, as well as directly revealing facts about the world.” All phenomenological approaches share a common objective, Patton (2015) states this as:

“a focus on exploring how human beings make sense of experience and transform experience into consciousness, both individually and as shared meaning.”

As such, phenomenology requires careful methodological planning to capture and describe how individuals experience a certain phenomenon (Moran, 2000). In particular how individuals: i) perceive it; ii) describe it; iii) feel about it; iv) judge it; v) remember it; vi) make sense of it; and vii) talk about it with others (c.f. Patton, 2015). Although a number of themes define phenomenology, an overarching set of ‘dogmas’ have not developed, effectively meaning phenomenology has not been ‘sedimented into a system’ (Moran, 2000).

2.5 QUANTITATIVE AND QUALITATIVE RESEARCH APPROACHES

When conducting research, a multitude of approaches can be utilised to resolve a particular research problem but can be conveniently classified into three broad categories; namely: i) quantitative approaches; ii) qualitative approaches; and iii) mixed methods approaches (Creswell, 2012). Both qualitative and quantitative methodological approaches should not be considered as dichotomies, but as representing alternative ends of a continuum (Newman and Benz, 1998). When undertaking research and subsequently selecting the type of enquiry to be utilised, researchers are mindful of, and guided by the aims and objectives as well as the data which is available or planned to be collected. Notably, research projects can contain elements of either qualitative or quantitative approaches, but be defined by the predominantly utilised approach.

2.5.1 *Qualitative*

Qualitative research is a means with which to investigate and comprehend the meaning individuals or groups attribute to a human or social issue. This can be accomplished through analysis of i) open-ended interviews; ii) direct observations; and iii) written communications (Creswell, 2006; Patton, 2015). Each of these avenues of analysis yields different data, and as such the researcher is required to select the avenue most appropriate for their inquiry (c.f. table 3).

Table 3 - An Overview of Qualitative Data Collection Techniques

Data Collection Technique	Overview
Open-ended interviews	Interviews utilise open ended questions to garner direct quotations from individuals regarding their experiences (Patton, 2015).
Direct observations	Data garnered from observations consist of detailed descriptions of individuals: i) activities; ii) behaviours; and iii) actions, in combination with a whole host of interpersonal interactions and organisational processes that are ‘part of the observable human experience’ (Patton, 2015).
Written communications	Written communication can be a rich sort of data (excerpts, quotations, entire passages) in terms of: i) organisational, clinical, or program records; ii) memoranda and correspondence; iii) social media postings; iv) official publications and reports; v) personal diaries; and vi) open-ended written responses to questionnaires and surveys (Patton, 2015).

Qualitative research is fundamentally interpretive in nature, requiring researchers to ‘make an interpretation of the data’ (Creswell, 2006, Patton, 2015). The process of interpreting the data

follows three steps: i) developing a description of an individual or setting; ii) analysing data with regard to themes or categories; and iii) making an interpretation or drawing conclusions about its meaning personally and theoretically (Creswell, 2006). The nature of qualitative enquiry requires the researcher to filter the data through a ‘personal lens’ that is dependant upon the specific socio-political and historical realities prevailing at that time (Creswell, 2006; Patton, 2015). Put simply, personal interpretation is unavoidable when conducting a qualitative enquiry (Creswell, 2006). In efforts to mitigate this, qualitative research regularly utilises multiple methods that are both interactive and humanistic, to capture as much reality as possible (Creswell, 2006).

A qualitative research approach is a regularly utilised for conducting POE research (c.f. Martinez-Molina *et al.*, 2017; Coleman *et al.*, 2018; Li *et al.*, 2018). Brambilla *et al.*, (2019) analysed a sample of 35 POE research papers, and found that 33% of them had utilised a qualitative approach (c.f. Brambilla *et al.*, 2019). However, using the search term ‘post-occupancy evaluation’ in conjunction with ‘qualitative’, and searching across ‘all fields’ within the Web of Science research repository, 39 results were found out of a total of 606 (6.436%) research items within the Web of Science database (accessed 4th April 2019) (Clarivate Analytics, 2017).

2.5.2 *Quantitative*

Quantitative research affords the opportunity to test objective theories through a process of examining the relationships amongst variables (Neuman, 1999; Creswell, 2006). Quantitative research makes postpositivist claims to knowledge (i.e. cause and effect thinking, reduction of specific variables, use of measurement and observation and theory testing), utilising an experimental strategy of enquiry (Creswell, 2006). In this context, the researcher tests theory by specifying a narrow hypothesis, then collecting data to either refute or support the stated hypothesis (Creswell, 2006). Quantitative research employs strategies of inquiry such as experiments and surveys, collecting data on ‘predetermined instruments’ which yield statistical data (Creswell, 2006). Crotty (1998, p.14) states that “the distinction between qualitative research and quantitative research occurs at the level of methods.” The discussions at the theoretical and epistemological levels regarding the divide between quantitative and qualitative approaches is centred around the distinction between ‘objectivist’ and ‘positivist’ research paradigms (c.f. Crotty, 1998).

Crotty (1998) suggests that most research which is undertaken using qualitative methods, would have been carried out in an empiricist, positivist manner in the past. Despite quantitative (positivist) researches approaches being commonly associated with empirical approaches, it is possible for a quantitative piece of work to be offered in ‘non-positivist’ form. Likewise, a qualitative piece of work can readily be understood positivistically, or positioned in an overall positivist setting, in turn meaning even self-professed qualitative researchers to be positivist in orientation and purpose (Crotty, 1998).

Another prominent avenue for POE research is the quantitative research approach (c.f. Göçer *et al.*, 2017; El-Darwish and El-Gendy, 2018; Li *et al.*, 2018). Brambilla *et al.*, (2019) found that 26% of the papers they analysed had utilised a quantitative approach (c.f. Brambilla *et al.*, 2019). However, using the search terms ‘Post-occupancy Evaluation’ in conjunction with ‘quantitative’, and searching across ‘all fields’ within the Web of Science research repository, returned 37 results out of a total of 606 (6.106%) research items (accessed 4th April 2019) (Clarivate Analytics, 2017).

2.5.3 *Mixed Methods*

A mixed method approach, incorporating both qualitative and quantitative data and analytical techniques, by design occupies the centre point between the two-aforementioned methodological approaches (Creswell, 2006). A mixed method research approach incorporates the positivistic elements of qualitative research, with the specific constructivist elements of quantitative research in a single paradigm. It is important to note, a mixed method approach does not pertain to simply a study containing qualitative and quantitative methods, but utilises both elements in conjunction. The combination of these two approaches can be sequential or parallel as well as used isolation or in combination with one and other, but crucially, used to investigate the same phenomenon (Mills *et al.*, 2010). In recognition of all methods having innate limitations, a mixed methods approach, acknowledging inherent biases, could mitigate the biases of one chosen method with the application of another method and its biases (c.f. Creswell, 2006). This process of ‘triangulation’ of data sources, offers a means of converging across qualitative and quantitative methods (Jick, 1979).

Finally, a mixed methods research approach is also frequently utilised for conducting POE research (c.f. Miller *et al.*, 2015; Brown, 2016; Kong *et al.*, 2018). Brambilla *et al.*, (2019)

found that 41% of the papers they analysed had utilised a quantitative approach (c.f. Brambilla *et al.*, 2019). However, using the search terms ‘Post-occupancy Evaluation’ in conjunction with ‘Mixed Method’, and searching across ‘all fields’ within the Web of Science research repository, returned 12 results out of a total of 606 (1.980%) research items (4th April 2019) (Clarivate Analytics, 2017). Notably, of the 606 POE papers found using the Web of Science research repository, only 88 (14.521%) utilised the terms: i) ‘qualitative’; ii) ‘quantitative’; or iii) ‘mixed method’, leaving 518 (85.479%) research papers which do not mention any of the three selected terms.

2.6 RESEARCH METHODS

This section discusses the methodological options which could be employed to achieve the research objectives. These methods include: i) inductive reasoning; ii) deductive reasoning ii) applied research; iii) action research; iv) bibliometric analysis; and v) case study research.

2.6.1 Inductive reasoning

Inductive reasoning is a methodological approach that utilises four iterative steps: i) observation of an individual or phenomenon upon which the study focuses; ii) identification of a pattern; iii) the formulation of a tentative theory; and iv) the development of a theory based on the previous steps as a basis for gaining knowledge (Holland *et al.*, 1989). Rescher (1980, p.5) states:

“induction is an ampliative methodology of enquiry - one designed to provide answers to our information-in-hand transcending questions regarding factual matters.”

An inductive case study approach (in contrast to deductive c.f. Ackermann, 1970) is concerned with the generation of new theory emergent from the data (Maxwell and Anderson Jr, 1975; Knight and Ruddock, 2008). In epistemological terms, an inductive case study utilises empiricism as a basis for garnering knowledge (Doyal and Harris, 1986). Empiricism denotes experiential factors (i.e. hearing, seeing, smelling, tasting and touching) as routes to knowledge acquisition (Knight and Turnbull, 2008). Patton (2015) states:

“Qualitative enquiry is particularly orientated toward exploration, discovery, and inductive logic.”

An inductive strategy allows for meaningful ‘dimensions’ to emerge from observed patterns found in the cases under enquiry, without presupposition of what those ‘dimensions’ would be. As such, induction is a methodological approach for ‘question resolution’ in the context of imperfect information - offering not the ‘best possible answer’ but the ‘best available answer’ (Rescher, 1980). Critics of the inductive reasoning approach have suggested the approach can be susceptible to: i) the researcher’s own bias; ii) generalisation of properties within a selected grouping; and iii) presupposition that the sequence of events which have been observed, will occur in the future exactly as they did previously (c.f. Maxwell and Anderson Jr, 1975; Rescher, 1980). Despite this limitation, a significant benefit of an inductive approach is the generation of new theories subsequent to the observation and analysis of the collected data (c.f. Maxwell and Anderson Jr, 1975; Rescher, 1980).

2.6.2 Deductive reasoning

Deductive reasoning, in contrast to inductive reasoning, requires the specification of the main variables as well as the statement of a specific research hypothesis, before the collection of data (Patton, 2015). Deductive reasoning can be distinguished from inductive reasoning by the fact that it:

“is the truth of inference guaranteed by the truth of the premises on which it is based” (Holland et al., 1989, p.4).

However, this is no guarantee that the inference is of any interest to the researcher (Maxwell and Anderson, Jr., 1975; Holland et al., 1989). As such, a deductive argument is valid when its ‘premises’ provide conclusive grounds for the truth of its conclusion (Copi and Cohen, 1998). Furthermore, in a deductive argument, if it is valid, additional premises can add nothing to the strength of the argument. Copi and Cohen, (1998) put simply:

“If a deductive argument is not valid, it must be invalid; if it is not invalid, it must be valid.”

Only a deductive argument involves the claim that its premises provide conclusive ground for its conclusion (Holland *et al.*, 1989; Copi and Cohen, 1998). In contrast to the mainly empirical inductive reasoning, deductive reasoning uses numerical data in the most part as a route to knowledge (c.f. Anderson, Jr., 1975). Criticism of deductive reasoning have asserted that even if the premises are true, and the argument is valid, it is possible for the conclusion to be false, determinable through a counter example (Copi and Cohen, 1998).

2.6.3 *Applied research*

Applied research is employed where a solution to a specific problem is required, and subsequently can aid a researcher's investigation or contribute solutions to problems faced by practitioners in industry (Neuman, 1999). Applied research generally tends to involve a small advance in knowledge, focused toward solving a specific problem in a specific setting. The descriptive nature of applied research can afford an immediate practical application for findings, but can also somewhat diminish the traditionally central role of theory associated with most research approaches. Subsequently, applied research is often employed by government agencies, social service agencies, educational institutions and businesses (Neuman, 1999).

2.6.4 *Action research*

Undertaking research within an action research paradigm, as with all research, is constituted by more than simply the undertaking of activities (McNiff and Whitehead, 2002). It can be considered a form of practice, requiring the researcher to collect data, reflect upon the actions observed within the data, use the data to generate evidence, and produce a claim to knowledge based on the conclusions drawn from the validated evidence (Stringer, 2007). There are four crucial inter-related contributory factors a researcher must consider when undertaking an action research study, namely: i) ontology; ii) epistemology; iii) methodology; and iv) socio-political intent (McNiff and Whitehead, 2002). Action research requires consideration of the researcher, in particular their view of themselves, and is considered under the paradigm of ontology. In consideration of the philosophical standpoint, conducting action research requires the belief that individuals develop their own identities, and thus others should be allowed to develop their own identities also. From this perspective, researchers are required to accommodate multiple values, perspectives and ideologies facilitating the formulation of solutions to better understand research processes and outcomes (McNiff and Whitehead, 2002). In consideration of epistemology, researchers participating in action research regard knowledge as an active

process, facilitating individuals in the generation of knowledge founded in their own experience of living and learning. It is crucial for an action researcher to consider that knowledge is neither complete nor static, but in a state of constant development resultant from the emergence of new understanding (McNiff and Whitehead, 2002). Methodology designates how researchers plan to undertake their research, within the action research paradigm experience and learning are perceived as processes enabling individuals to make selections regarding identity and interaction with other individuals. This specific characteristic of actions research must be carefully considered due to well established complications requiring negotiation and accommodation in mitigating conflicts in values and perspectives held by different individuals (McNiff and Whitehead, 2002). Socio-political intent is the final consideration, largely concerning the intentions of a particular researcher or institution, for example, positivist views are often adopted in western institutional thinking. Radical new ideas however, can be discredited or suppressed when not conducive to conventional doctrine, by dominant institutional elites in particular (McNiff and Whitehead, 2002).

2.6.5 *Participatory Action Research*

Participatory Action Research (PAR) is research with a central principle of self-reflection, and involves learning through action and subsequent reflection. Kindon *et al.*, (2010) describe PAR as:

“a collaborative process of research, education and action explicitly orientated towards social transformation.”

Traditional empirical research focuses on individuals other than the researcher, by contrast action research focuses upon self, as well as self in company with other individuals (Stringer, 2007). This approach results in diminished distinction between the researcher and the practitioner, allowing industry partners to act as critical learning partners and research participants (McNiff and Whitehead, 2002). Utilising an action research methodological approach for this study, allows for development of close relationships with industry partners and contributors. Participatory action research (PAR), although not regularly utilised within the POE BOK, has been utilised in two instances (c.f. Wheeler and Malekzadeh, 2015; Pärn and Edwards, 2017).

2.6.6 Bibliometric Analysis

Bibliometric analysis has been developed and utilised across multiple disciplines for its ability to visually represent a large body of literature (van Eck and Waltman, 2010). Converse to manual analysis, bibliometric analytical software such as Gephi (Bastian *et al.*, 2009) or VOSviewer (van Eck and Waltman, 2010) avoids introducing researcher bias and removes time and resource limitations around the practical number of studies selected (He *et al.*, 2017). Visual representation of bibliometric data also allows an academic topic to be expediently and comprehensively investigated (Cobo *et al.*, 2011). Bibliometric analysis in the context of this study utilises an interpretivist approach, utilising largely qualitative data (key words and phrases found within: i) titles; ii) abstract; and iii) key word sub-sections) as a basis for analysis, albeit some summary statistics are used. VOSviewer constructs distance-orientated network maps where each node/cluster represents the occurrence of a term or author dependent upon the map generated. Nodes/clusters can also be assigned a different colour within a visualisation, differentiating it from other nodes/clusters. The distance between nodes/clusters gives a better indication of the strength of relationship between these items when compared to graph-based maps (Waltman *et al.*, 2010). Data utilised to produce the bibliometric map can be sourced from a number of online repositories, for example: Web of Science; ProQuest; Scopus. A number of different software applications are also available to conduct bibliometric analysis, such as i) Gephi; ii) CiteSpace; and iii) Sitkis (c.f. Chen, 2006; Schildt and Mattsson, 2006; Bastian *et al.*, 2009). However, VOSviewer's clustering function represents an advancement on previous mapping techniques, allowing deeper observations of connectedness than was previously possible using alternative software such as Statistical Package for the Social Sciences (SPSS) and Pajek (c.f. van Eck and Waltman, 2010).

2.6.7 Case Study Research

A case study is a research approach focusing on the analysis of i) a program; ii) an event; iii) a process; or iv) one or more individuals; analysed using a variety of data collection procedures (Creswell, 2006). Gillham (2005, p.1) states that a case study is:

“a unit of human activity embedded in the real world, which can only be studied or understood in context.”

Case study research examines theory using set procedures, with an emphasis of investigating a particular phenomenon within its context (Fellows and Liu, 2003; Yin, 2009; Yin 2012). Yin (1994) and Gillham (2000) propose the utilisation of a ‘chain of evidence’ (also referred to as a ‘multi-method approach’) when undertaking case study research. The chain of evidence represents a convergence of several different varieties of evidence, collected in a number of differing ways, but pertaining to the same point (Gillham, 2000). Critics of the case study research suggest it lacks scientific rigour when compared to other research methods, particularly in terms of the reliability of scaling up findings from a single case study (Yin, 2009). To address this issue, Yin (2012) proposed four fundamental approaches to undertaking case study research, refer to Table 4.

Table 4 - An overview of differing case study approaches

Type of Case Study	Description	Reference
Single case, holistic	Utilises a single case study in conjunction with a single unit of analysis; where a unit of analysis represents the ‘what’ or ‘who’ is being studied.	Gillham, 2005; Woodside, 2010; Yin, 2012; Tight, 2017
Single case, embedded	Utilises a single case study in conjunction with multiple units of analysis.	Gillham, 2005; Woodside, 2010; Yin, 2012; Tight, 2017
Multiple case, holistic	Utilises multiple case studies in conjunction with a single unit of analysis.	Gillham, 2005; Woodside, 2010; Yin, 2012; Tight, 2017
Multiple case, embedded	Utilises multiple case studies in conjunction with multiple units of analysis.	Gillham, 2005; Woodside, 2010; Yin, 2012; Tight, 2017

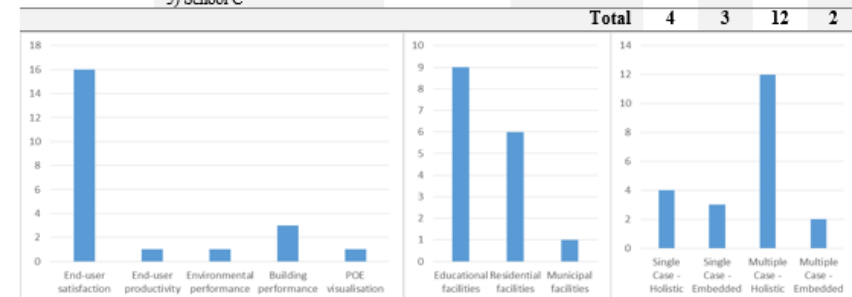
Case study research is often predicated upon the triangulation (c.f. Edwards and Holt, 2010) of multiple sources of data emanating from a chosen study or studies to generate robust findings (Yin, 2009). Utilising a multiple case approach can yield greater advantages such as predicting similar findings or *direct replications*, or alternatively contrasting findings or *theoretical replications* (Yin, 2012). Gillham (2005) and Yin (2012) both assert that data used to build up these observations are organised into six thematic categories, namely: i) documents; ii) archival records; iii) interviews; iv) detached or direct observations; v) participant observation; and vi) physical artefacts.

Table 5 presents a synthesis of differing case study methodological approaches used by researchers investigating POE. A manual keyword search was undertaken utilising the key terms: i) 'POE'; and ii) 'case study'. Birmingham City University's online academic repository 'Summon' was utilised to conduct the search, ensuring access to the complete set of Journals BCU are subscribed to. The top 20 results emanating from this search were selected, and subsequently manually investigated to identify: i) the type of case study (e.g. single-case holistic); ii) the POE context (type of facility the POE is being conducted on); and iii) the POE focus (e.g. end-user feedback). The synthesis reveals that significant numbers of POE studies reviewed have focused upon: i) end-user satisfaction (76.19%); ii) educational facilities (57.14%); and iii) utilising a multiple case as part of a holistic approach (57.14%). Notably, this body of extant literature did not investigate commercial property, but rather focused upon either: i) educational facilities; ii) residential facilities; or iii) in one case, two municipal facilities. This anomaly could be attributed to Preiser and Vischer (2005) observation that a major stumbling block for completing a POE in a commercial context, is the accrual of value for alternative developers and developments.

Table 5 - A Synthesis of Post-occupancy Evaluation Research Utilizing a Case Study Approach

Reference	POE Case Study	POE Context	POE Focus	Single Case - Holistic	Single Case Embedded	Multiple Case - Holistic	Multiple Case - Embedded
Adegunmi <i>et al</i> , 2010	University of Lagos, Nigeria 1) Akingbola Postgraduate Hall	Educational facility	End-user satisfaction	•			
Bonde and Ramirez, 2015	University of Arizona, United States 1) Likins Hall 2) Coronado Hall	Educational facilities	Environmental performance			•	
Brown, 2015	Toronto, Canada 1) Tower A 2) Tower B 3) Tower C 4) Tower D	Residential facilities	End-user satisfaction			•	
Chen, 2003	Suzhou, China 1) Sanyuan Wuxi, China 2) Luzhuang Changzhou, China 3) West Hongmei 4) New Hongmei	Residential facilities	End-user satisfaction			•	
Collinge <i>et al</i> , 2014	University of Pittsburgh, United States 1) Mascaro Center for Sustainable Innovation	Educational facility	End-user productivity		•		
Etzion <i>et al</i> , 2000	Negrev, Israel 1) Erez, Be'er Sheva 2) Asaf, Be'er Sheva 3) Ha'Nizahon, Dimona	Residential facilities	Building performance			•	
Guerra-Santin <i>et al</i> , 2016	Madrid, Spain 1) Apartment A 2) Apartment B Rotterdam, Netherlands 3) Dwelling A 4) Dwelling B 5) Dwelling C	Residential facilities	End-user satisfaction			•	
Hassanain and Ifthikhar, 2015	Khobar, Eastern Province of Saudi Arabia 1) School building	Educational facility	End-user satisfaction		•		
Ilesanmi, 2010	Lagos, Nigeria 1) Housing Estate A 2) Housing Estate B 3) Housing Estate C	Residential facilities	End-user satisfaction			•	
Khajehzadeh and Vale, 2015	Yazad University, Iran 1) Dorm Number One	Educational/ Residential facility	End-user satisfaction	•			
Leung <i>et al</i> , 2014	Hong Kong 1) C&A home A 2) C&A home B 3) C&A home C 4) C&A home D 5) C&A home E 6) C&A home F 7) C&A home G	Residential facilities	End-user satisfaction			•	
Mumovic <i>et al</i> , 2009)	United Kingdom 1) School A 2) School B	Educational facilities	Building performance			•	
Mustafa, 2017	Salahaddin University-Erbil, Iraq	Educational facility	End-user satisfaction			•	

	1) Architecture and Software Engineering Departments						
Ning and Chen, 2016	United States 1) Indiana University China 2) Tsinghua University	Educational facilities	End-user satisfaction			•	
Patlakas <i>et al</i> , 2017	University College London, Britain 1) Bartlett School of Architecture Euston, Central London, Britain 2) Central House	Educational facilities	POE Visualisation			•	
Sawyer, de Wilde and Turpin-Brooks, 2008	Plymouth, United Kingdom 1) Building A Tunbridge Wells, United Kingdom 2) Building B	Municipal facilities	End-user satisfaction/ building performance				•
Strelets <i>et al</i> , 2016	Russia 1) Saint Petersburg Polytechnic University	Educational facility	End-user satisfaction		•		
Tookaloo and Smith, 2015	United States 1) University of Utah 2) The University of Wisconsin-Milwaukee 3) The University of Cincinnati 4) University of Washington - Centre for Architecture and Education 5) University of North Carolina - Charlotte 6) North Carolina State University 7) Georgia Institute of Technology 8) University of Minnesota	Educational facilities	End-user satisfaction				•
Turpin-Brooks and Vickers, 2006	United Kingdom Foundation building at the Eden Project	Conference facility	End-user satisfaction	•			
Wongbumru and Devancker, 2016	Residential projects, Bangkok, Thailand 1) Klong Chan Flat 2) Buengkhun Baan Eur Arthon	Residential facilities	End-user satisfaction	•			
Zhang and Barrett, 2010	Manchester, United Kingdom 1) School A 2) School B 3) School C	Educational facilities	End-user satisfaction			•	



2.6.8 Comparative Analysis

Comparative analysis is a study, utilising comparative materials, conducted to analyse ‘casual mechanisms across sets of comparable cases’, and construct ‘parallel demonstrations of theory’ (Skocpal and Somers, 1980; Ragin, 1989). Swanson, 1971, p.145) asserts:

“thinking without comparison is unthinkable. And, in the absence of comparison, so is all scientific thought and comparison.”

Comparative analysis provides an approach for evaluating and interpreting social research relative to ‘substantive and theoretical criteria’ (Ragin, 1989). Lieberman (1985, p. 44) states that social research:

“in one form or other, is comparative research.”

Comparative research often focuses interpretation, thus giving precedence to interpretation rather than causal analysis (Ragin, 1989). Researchers utilising a comparative approach look to account for significant historical outcomes or sets of comparable outcomes or processes by synthesising evidence in a manner sensitive to historical chronology, offering limited historical generalisations, sensitive to context (Ragin, 1989). Porter (1970) asserted that a rigorous methodology for comparative analysis has not emerged due to the difficulties it would impose. This is further elucidated upon by Smelser (1973) whom suggests, by definition, a rigorous comparative method is a contradiction in terms due to application of comparative analysis only being appropriate when the number of relevant cases is too small for the establishment of statistical control by the researcher over the causes and conditions of variation in social phenomena.

2.6.9 Thematic Analysis

Thematic analysis is a process synonymous with qualitative information. Thematic analysis utilises an explicit ‘code’, this may take the form of: i) a set of themes; ii) a complex model with themes; or iii) a combination of the two (Boyatzis, 1998). A theme, quite simply can be defined as a pattern amongst data, that at a superficial level describes and helps organise observations from a qualitative data set, at a more comprehensive level it can help interpret aspects of the phenomenon being studied (Saldaña, 2016; Willig and Rogers, 2017). Boyatzis, (1998, p.1) states:

“Thematic analysis is a way of seeing. Often, what one sees through thematic analysis does not appear to others, even if they are observing the same information, events, or situations. To others, if they agree with the insight, the insight appears almost magical. If they are empowered by the insight, it appears visionary. If they disagree with the insight, it appears delusional.”

The identification of a theme can take place at ‘manifest level’ - directly observable in the qualitative information, but also at a ‘latent level’ - underlying a phenomenon (Willig and Rogers, 2017). Thematic analysis is applicable to both inductive and deductive approaches. Themes can be generated inductively, emanating from the raw information, or alternatively, generated deductively utilising established theories or prior research (Boyatzis, 1998). The application of thematic analysis involves a number of prerequisite abilities or competencies, a prominent example being ‘pattern recognition’, the ability to see patterns in seemingly random information (Saldaña, 2016). Strauss and Corbin (1990) stated researchers require an openness and conceptual flexibility in order to perceive patterns emanating from the data. This openness must be ‘sustainable’, as typically, qualitative research often requires long hours of immersion in the information collection, and even longer hours in terms of information processing and analysis, before interpretations can be made (Boyatzis, 1998).

2.6.10 SWOT Analysis

A SWOT analysis allows a researcher to ascertain an organisations ‘strengths’ and ‘weaknesses’ relative to the organisations ‘opportunities’ and ‘threats’ (Boddy, 2014). A strength should be assigned when a point emanating from data set represents: *“something you can build upon”*, whereas, a weaknesses should be assigned to *“something that seriously needs to be corrected”* (Barrow *et al.*, 2001, p. 147). Similarly, ‘opportunities’ are assigned where something conceivably amplify beneficial outcomes, and ‘threats’ where current processes and practices could conceivably lead to negative outcomes for the organisation or institution (Boddy, 2014). Whilst SWOT analysis appears to be a rational method, it is in largely based in human interpretation and representation, researchers will assign differing weighting to differing factors, although debate on these differences can add to the research findings of this approach (Hodgkinson *et al.*, 2006; Boddy, 2014). SWOT analysis is often utilised to analyse a qualitative data set, assigning either a: i) strength; ii) weakness; iii) opportunity; or iv) threat; to corresponding points which arise in, for example, an interview or focus group. If utilised effectively, SWOT analysis is useful to business managers as well as built environment

practitioners because it allows the evaluation of strategic alternatives, centred on maximising internal strengths in conjunction with external opportunities (Boddy, 2014).

2.6.11 Word Frequency Analysis

Word frequency analysis allows researchers to analyse a digital text in terms of the frequency of the specific words utilised (Welsh, 2014). The open source software package Voyant-Tools is a software application which can calculate the frequencies of regularly used words within a text, but also visualise those findings in terms of: i) word frequency lists; ii) frequency distribution plots; and iii) key work in context (KWIC) displays (Voyant-Tools, 2019). The utilisation of word frequency analysis tools such as Voyant-Tools allows researchers, particularly those analysing qualitative data, to draw conclusions which would not necessarily be apparent utilising traditional coding research approaches.

2.7 RESEARCH DESIGN

An inductive methodological approach is adopted that seeks to develop new theory on contemporary POE practices and procedures, and specifically develop a new hybridized model for POE planning within HEI facilities. The research work is therefore deliberately applied in the context of HEIs and focuses on developing a product (i.e. hybrid system) that is impactful within practice but also scientifically robust. Within this overarching methodological approach, research methods adopted will be deployed within three iterative stages.

2.7.1 Stage One - A Synthesis/ Analysis of Relevant Academic Literature on POE Implementation.

Set within the broader context of digitizing the built environment, POE is said to provide a feedback loop and mechanism for soft landings (Way and Bordass, 2007) as well as an invaluable opportunity for designers and architects to learn from building performance (O'Neil and Duvall, 2005; Skills Funding Agency, 2014). Such lessons learnt provide tacit knowledge for practitioners (i.e. project team members gaining experience from POE implementation as opposed to the explicit knowledge available in academic and guidance literature) to learn how to improve the performance of current building developments but also the design of future/ similar buildings (Mustafa, 2017).

Against this background, a plethora of direct and indirect academic literature published provides a suitable discourse through which the present BOK can be contextualised. An inductive and interpretivist methodological approach was adopted in stage 1 that utilises a mixed methods systematic review of pertinent literature, the qualitative analysis of literature will be visualised using quantitative bibliographic software, to generate new theories on POE. Petticrew and Roberts (2008) and Oraee *et al.*, (2017) assert that a ‘mixed method systematic review’ is the most effective method for identifying gaps in a body of knowledge (BOK). A ‘mono-method manual systematic review’ utilises a single search parameter to identify the gaps in knowledge, whereas a mixed method systematic review requires the development of a protocol detailing multiple steps (Harden and Thomas, 2010). In contrast to a ‘mono-method manual systematic review’, this proposed approach is resistant to biases realised through subjective interpretation and judgement (He *et al.*, 2017). Within this overarching methodological framework, a two phase operational process was adopted.

In phase one, a detailed review of building performance measurement using POE was undertaken to contextualise POE research BOK and further delineate upon the specific areas of POE evaluation, process and benchmarking.

In phase two, bibliometric data was mapped to provide a systematic review of relevant extant literature. Hayvaert *et al.*, (2016) states that the amalgamation of both quantitative and qualitative methods requires the development of a protocol stating methods, processes and sampling strategies for both data collection and study objectives. With this in mind, an iterative search protocol was developed, utilising as a method three bibliometric data searches using the following pertinent terminologies: i) ‘POE’; ii) ‘POE’ and ‘process’; and iii) ‘POE’, ‘process’ and ‘benchmark’. The process of this enquiry utilised this data to produce bibliometric maps using ‘VOS Viewer’ and could be sourced from a number of electronic repositories, for example: Web of Science; ProQuest; Scopus. However, Web of Science was utilised because it claims to be the most accurate citation database available for bibliometric analysis (Clarivate Analytics, 2017). Each search utilised a sampling strategy which sought to capture literature that contained these terms in the abstract, title or keywords of published work. To avoid conflation with unrelated studies pertaining to alternative disciplines, the term ‘Poe’ was excluded to ensure the results related to the built environment.

The Web of Science repository allows for the tailoring of searches to meet specific needs such as the date of citation. No limit on the date of citation was implemented (1970-2018) to secure a more complete perspective on the entire POE BOK. The first two searches were conducted using the VOSviewer bibliometric analysis software to: construct bibliographic visualisations; and map the interconnections between authors researching the three topic areas. The Web of Science search functions were also utilised to discern key statistics (date of first citation and total number of research items) to critically compare similarly aligned disciplines pertaining to the design, construction and operational phases of a developments' lifecycle (i.e., BIM and FM). The unit of analysis for stage one of the study design utilises academic literature for the purposes of identifying: past technical applications of POE within literature; key authors and their respective country of origin; and ultimately a research gap that could be exploited to make a contribution to knowledge.

2.7.2 Stage Two – A Study of Pertinent Industry Guidance Documentation on POE Implementation.

The second stage of the methodological framework required an in-depth analysis of existing industry guidance documentation regarding POE implementation, processes and procedures. The concept of POE was first raised in the RIBA Handbook (1965), suggesting architects return to completed developments to learn from the outcomes. Since then, six main strategies have emerged in addition to the introduction of 'soft landings' through Publically Available Standards (PAS) 1192 in 2013 (c.f. Riley *et al.*, 2010). Of these six strategies, two specifically focus upon the POE of HEIs: i) the Higher Education Funding Council England (HEFCE) Guide to Post-occupancy Evaluation (2006); and ii) the Royal Institute of British Architects (RIBA) and Association of University Directors of Estates (AUDE) Higher Education Design Quality Forum (HEDQF) (2010). Whilst the HEDQF focuses upon elucidating the importance of communication throughout the development cycle and the impacts this can have on planning and implementation of POE, the 'HEFCE Guide to Post-occupancy Evaluation' offers a complete toolkit for the planning and implementation of a POE in a HEI. From a higher education perspective, POE implementation seeks to determine whether the institution's facilities management (FM) operations meet University objectives (Tookaloo and Smith, 2015). Conducting a POE in this context standardises best practice, increases the accountability of facility managers and ensures that HEIs realise the improvements identified by the POE in

future developments (Mustafa, 2017). HEFCE guidance is ostensibly designed to allow flexibility, stating that it is:

“prepared so colleagues can choose according to their needs and preferences, as few or as many of the areas identified in the report” (HEFCE, 2006, p.3).

The importance of POE in terms of development finance can also be ascertained from guidance documentation. The ‘HEFCE Guidance to Post-occupancy Evaluation’ (2006) refers to a “PFI [Private Finance Initiatives] /PPP [Public Private Partnerships] review to allow a length of experience of operating the building” (HEFCE, 2006, p13). PFI and PPP are funding mechanisms combining public finances with private capital and have been used widely throughout UK construction industry (Bing *et al.*, 2005). The ‘Skills Funding Agency (SFA) Post-occupancy Evaluation Guide’ (2014) (another strategy not specifically aimed at HEIs) offers a link to the Government’s “SFA capital funding: evaluation documents” online utility, similarly indicating financial diligence influenced governmental thinking in terms of promoting POE implementation on newly developed facilities (c.f. Skills Funding Agency, 2014). Despite UK Governmental interest in, and academic endorsement of POE, implementation within practice remains elusive (Alborz and Berardi, 2015).

Given myriad sources of POE guidance, this research implements a robust manual and observational comparative analysis between published HEI POE guidance (HEFCE Guide to Post-occupancy Evaluation) to identify commonalities and differences between these. A qualitative componential analysis is conducted to undertake this stage of research and is complemented with a detailed review of pertinent guidance documentation. The overarching ambition is to use this BOK as basis for further developing a hybrid POE that will be presented to industry practitioners as part of case study research. The unit of analysis for the second stage of the research design utilises personnel from BCU’s Estates department.

2.7.3 Stage Three - A Case Study of POE Implementation for Four educational Facilities within a Higher Education Institute (HEI) (Birmingham City University).

During stage three, a layer cake of applied, action and case study research (pertaining to the case study of four HEI facilities) was implemented to meticulously interrogate contemporary POE practices undertaken within a HEI. The objective being to observe and learn from these

practices and combine such with the findings from stages one and two prior to developing the hybrid model for POE planning – thus providing a triangulation of thematic knowledge sources (cumulatively accrued via each stage) (c.f. Edwards and Holt, 2010).

2.7.3.1 Applied and Action Research

Applied research is employed where a solution to a specific problem is required, and subsequently can aid a researcher's investigation or contribute solutions to problems faced by practitioners in industry (Neuman, 1999). This research is predicated upon developing a user friendly systematic approach to POE, this requirement has been identified in practice as well as being widely reported in associated academic literature.

2.7.3.2 Case Study Research

Case study research is the study of human activity embedded in the real world which can only be understood in context (Gillham, 2000). Consequently, for this research the findings of the previous two stages inform and shape the investigation undertaken during this case study as cumulatively, the work provides both background literature on POE but also delineates processes and procedures for POE implementation. As such, the research utilised both primary and secondary data in a synthesis between: i) academic literature (secondary data); ii) completed POE reports pertaining to BCU facilities' (secondary data); iii) interview and focus group data obtained from practitioners at BCU's Estates Department (primary data); and iv) industry standard guidance documents for the preparation and execution of a POE (secondary data) (c.f. HEFCE, 2006; Skills Funding Agency, 2014; RIBA, 2016; RIBA, 2017a; RIBA, 2017b).

This research utilises an inductive case study approach to investigate four of BCU's educational facilities in efforts to understand the POE processes implemented by the university. POE implementation collects large quantities of qualitative experiential data from building occupants to analyse their lived experiences of the built asset's performance in use. For the case study, POE's were accrued from four recently completed educational buildings: i) the City North Sports Centre (c.f. Figure 4); ii) the Mary Seacole Building (c.f. Figure 5); iii) the Parkside Building (c.f. Figure 6); and the Joseph Priestly building (c.f. Figure 7). These facilities have been selected due to their relatively recent handover dates (all handed over in the last fifteen years), and their presence within the same HEI estate. Utilising a comparative analysis, the selection of facilities comprising the same estate allows the researcher opportunity

to analyse differences in POE procedure and process from a single institution as it unfolded in each example.

Figure 4 - A photograph of the City North Sports Centre (former City North Campus)



Figure 5 - A photograph of the Mary Seacole Building (City South Campus)



Figure 6 - A photograph of the Parkside Building (City Centre Campus)



Figure 7 - A photograph of the Joseph Priestly Building (City Centre Campus)



The data (four completed POE reports) was attained through discussions with the university's Estates department (as per the ethics procedure adopted – delineated later in this report). This data consisted of: i) project team focus group feedback; and ii) end-user feedback found in each

of the reports. In some instances financial information is detailed in the final POE report, although not in every case. This data provided a window of opportunity through which to observe POE implementation in practice but also compare and contrast between any apparent deviations or differences in procedure and process for the University's newly developed facilities.

The data was analysed using a two stage process. Firstly, a process flow diagram (Lejk and Deeks, 2002) was developed utilising the HEFCE (2006) Guide to Post-occupancy Evaluation. Of the six main POE methods available to practitioners (c.f. Riley *et al.*, 2010), the HEFCE (2006) and HEDQF methods were initially selected as they refer specifically to HEIs. Whilst the HEDQF methodology pertains to HEIs, rather than offering a process that practitioners can follow, the guidance focuses on the accrual of qualitative data for use in the POE analysis. The POE process outlined in the HEFCE guidance document was delineated to form a process flow diagram (c.f. Lejk and Deeks, 2002), which in turn could be utilised as a comparison tool for recording and contrasting the differences in the process as it unfurled on each facility.

For the second stage, this newly developed flow diagram was utilised to compare and contrast the POE as implemented on the four facilities in question. Each POE report is deconstructed so to indicate the choices made by practitioners during the planning phase of the evaluation, and the subsequent time intervals in which these components of the evaluation would be conducted. Once the processes of each report have been identified, the delineated process of each report was plotted on the process flow diagram so to directly compare the POE process as it occurred on each facility.

2.7.3.3 Semi Structured Practitioner Focus Group

Semi-structured focus groups are a qualitative data collection technique (Matthews and Ross, 2010), and follow the semi-structured interview process (Morse and Richards, 2002; Marshall and Rossman, 2011). This technique requires a group leader (the researcher) to moderate the focus group whilst asking open ended questions pertaining to a specific topic (Matthews and Ross, 2010; Morse and Richards, 2002). The sample of Estates personnel to take part in the focus groups is relatively small, and includes i) Head of Estates; ii) Deputy Head of Estates; iii) the soft landings representative; iv) Environmental Officer; as well as v) individual building managers for differing facilities around BCU's City Centre campus. Whilst this sample of no

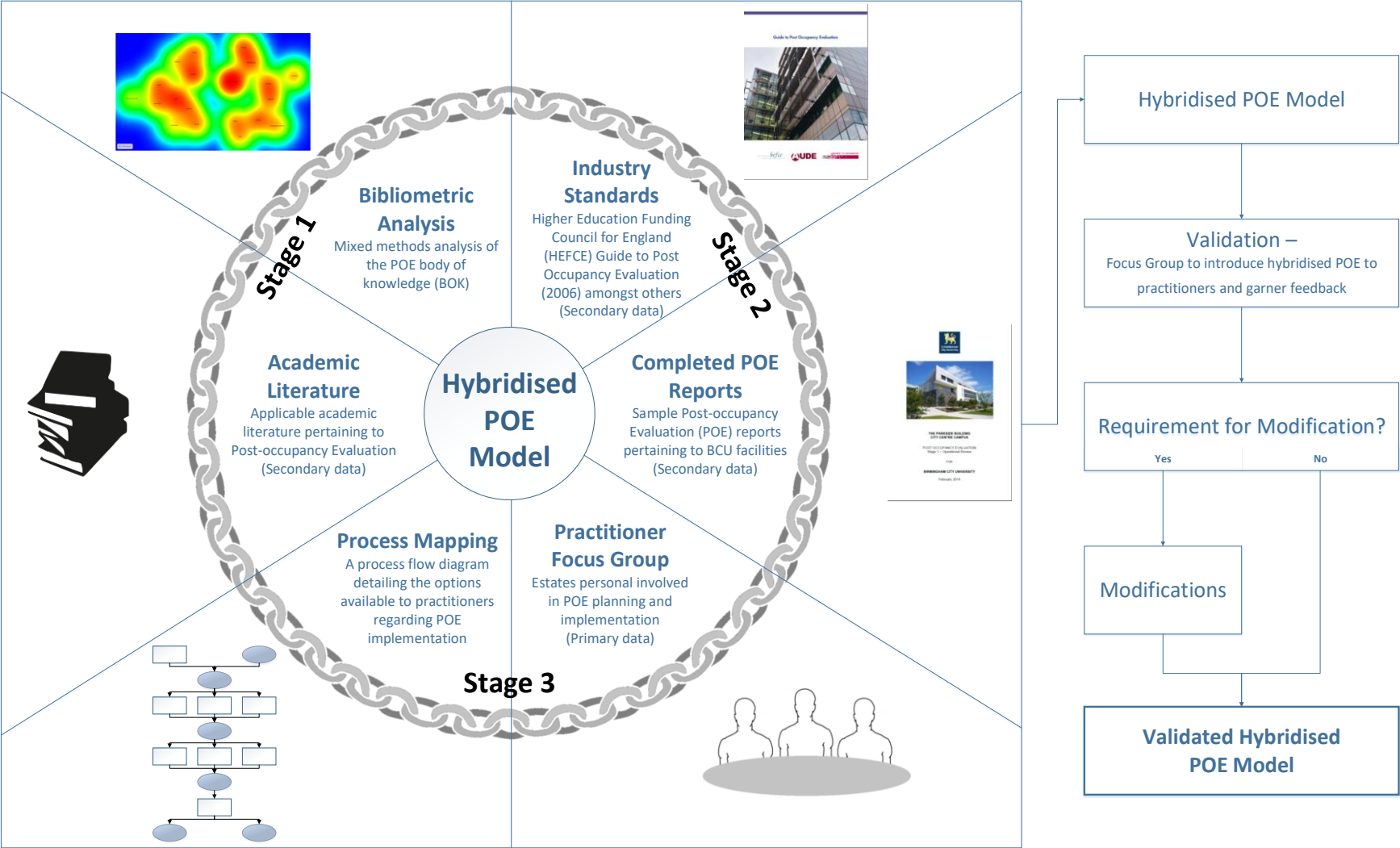
more than ten individuals, this represents one-hundred percent coverage of the personnel planning and conducting POE within the BCU Estates department.

The focus group focused solely on interrogating POE planning and implementation procedures utilised currently by the BCU's Estates Department. The objective of this focus group was to discern why procedures are implemented as they are, and where there is deviation from standard procedures, why this occurred. Furthermore, where differences in approach have been identified in the dissemination of previously undertaken POE reports, to identify the reasons why the different approaches have been taken. The responses from participating practitioners were recorded and transcribed, using both recording equipment (Dictaphone) and hand written notes, allowing analysis of the qualitative discourse emanating from the focus group, using a content analysis and subsequent SWOT analysis approach. At this point, the development of the hybridised POE process has built upon the requirements emanating from the three stages detailed within the methodology: i) the review of relevant academic literature; ii) the study of pertinent industry guidance documentation; and iii) the analysis of the case study incorporating four of BCU's educational facilities, in conjunction with the practitioner perspective garnered from the semi-structured focus group.

2.7.3.4 Development of the Hybrid POE Model

The development of the hybridised model for planning a POE in a HEI brings together the findings of all three stages (c.f. Figure 8). The combination of these findings to produce a newly hybridised process utilises, as previously stated, the 'chain of evidence' case study method proposed by both Yin (1994) and Gillham (2000). The final output of this research is a process map with accompanying white paper offering tangible industry guidance for Estates practitioners working within the higher education sector.

Figure 8 - A Visualisation of the Methodological Overview of the Study



The development of the hybridised POE process will be achieved using a number of qualitative analytical techniques. Firstly, a componential analysis of relevant literature is undertaken to identify the requirements emanating from said literature. Secondly, process mapping is utilised to map existing industry practice guidance, particularly focusing of the planning of POE in a HEI context. The hybridised process, was then presented to industry practitioners via interviews for validation.

2.8 VALIDATION

Validation should be considered as an ongoing dialogue on the topic of what makes interpretive research worthy of our trust (Creswell and Poth, 2018). Angen (2000, p.387) asserts that, validation within an interpretivist context is:

“a judgement of the trustworthiness or goodness of a piece of work.”

The focus of validation within an interpretivist approach is marked by i) a focus on the importance of the researcher; ii) a lack of truth in validation; iii) validation based on dialogue with participants; iv) interpretations which are temporal; and v) the potential for future reinterpretation (Creswell and Poth, 2018). Despite criticisms around validation not advancing knowledge or understanding (c.f. Wolcott, 1990; Wolcott, 1994), the validation stage of interpretivist research is crucial for ensuring that the research has ‘transformative value’ leading to ‘action and change’ (Creswell and Poth, 2018). The validation stage of interpretivist research, similar to Yin (1994) and Gilham’s (2000) suggestion of using a ‘chain of evidence’ when developing case studies, uses a ‘chain of interpretations’ which is documented, so that others will evaluate the trustworthiness and meanings arrived at in the conclusions of the research (Creswell and Poth, 2018). The validation stage of the research is undertaken in the form of semi-structured practitioner interviews, utilising the validation concept of dialogue with participants, in this case the practitioners directly involved with the planning and implementation of POE’s in HEIs, with experience of doing so at institutions other than BCU.

2.8.1 Semi-structured Practitioner Interviews

The series of five practitioner interviews introduced the newly hybridised POE model for the planning and implementation of POE in a HEI. The interviews are designed to capture data regarding the practical application of the model, from the perspective of practitioners whom

have contributed to the planning and implementation of POE's externally to BCU's own POE processes.

2.8.2 Interview Data and Analytical Techniques Utilised

The data obtained from the five interviews will be qualitative in nature. Questions will be deliberately open ended so to encourage participants to elucidate upon their direct experiences of POE in practice at BCU as well as requirements for improved processes for future POE's. The responses from participating practitioners will, again, be recorded and transcribed, using both recording equipment (Dictaphone) and hand written notes, allowing analysis of the qualitative discourse emanating from the focus groups. Analytical techniques including manual coding of responses will be utilised to study the responses.

2.8.3 Implementation of hybridised model in Practice

In recent years BCU has moved from its former suburban campus (Perry Barr) to a new campus located in Birmingham city centre, leading to the development of a number of bespoke HEI facilities in the last fifteen years. A number of facilities across the campus are undergoing POE's at present, with the 'operational review' having been completed, and planning at an advanced stage for the 'project review'. Whilst the POE strategy has been decided upon for these facilities currently under evaluation, the university has intentions to construct more facilities in the coming years, STEAMhouse Phase 2 being a prominent example. The construction of new facilities on BCU's City Centre campus may present opportunities to implement the newly developed POE model - however, testing the model in practice would require the implementation of the hybrid POE model on a newly developed BCU building, and would have to correspond with the agreed scheduling of the research project.

2.9 RESEARCH ETHICS

Given the confidential nature of this investigation, a strict rigorous two stage ethical process was adopted. During the first stage, the PhD researcher sought ethical approval from both supervisors at the host higher education institution before commencing any research. This involved completing an ethical pro-forma checklist approved by the Director of Studies and Second Supervisor. At this stage, a series of control measures were implemented to mitigate risks posed to both the PhD research and institution – these risk control measures included: i)

presenting the research to senior management within the Estates management team to secure their support for the ongoing programme of research; and ii) ensuring that any research papers [to be published] that used materials and documentation produced by Estates first sought written approval from senior members of the Estates management team. During the second stage (and prior to conducting the interviews), local ethics processes were followed as required by the Estates management team. Estates management granted consent provided the following conditions were met, namely that: the research findings would be shared with the Estates management team who could implement any recommendations emanating from the work; that members of the Estates management team are consulted with on any data utilised for the research; all participants were assured of strict anonymity and confidentiality; and they had the right to withdraw from the process at any stage (Wiles *et al.*, 2008). Finally, prior to commencing any interviews or focus groups, the participant's permission was requested to record the discussions held and reassurance given that the recording would not be disclosed, divulged or misused (deliberately or otherwise) in any way or form (Oliver, 2010).

CHAPTER 3

ADVANCEMENTS IN ASSET MANAGEMENT

3.1 INTRODUCTION

This chapter provides an essential background overview of contemporary asset management, particularly in terms of digitalisation of asset management. Building Information Modelling (BIM) is seen as a panacea within the built environment, potentially offering solutions to well-documented issues surrounding: i) stakeholder communication; ii) process efficiencies; and iii) built asset performance post-occupation. BIM, similar to POE, fall under the remit of Government Soft Landings, an initiative designed to smooth the handover of newly built assets in terms of digital systems as well as promoting an environment where a POE can be readily planned and implemented.

The content of this chapter has been partially externally validated, due to it having been through the peer review process for publication in a scientific journal. The research paper was entitled: ‘Digitalising Asset Management: Concomitant Benefits and Persistent Challenges’, published in the International Journal of Building Pathology and Adaptation in January 2018 (Roberts *et al.*, 2018).

3.2 CONTEMPORARY ASSET MANAGEMENT

AECO sector has traditionally been beset with issues surrounding stakeholder communication, process efficiencies and built asset performance during the operational phase of building occupancy (Arayici and Coates, 2012; Olatunji and Akanmu, 2014; Lindkvist, 2015; Pärn *et al.*, 2016). However, the advent of digital modelling in recent years has presented significant opportunities to improve upon these persistent issues. Increased efficiency and collaboration realised through the implementation of the disruptive technology BIM has led to governments mandating BIM as an industry standard – the UK Government being a prominent example (British Standard 1192, 2016; Race, 2013; Eadie *et al.*, 2014; Mehran, 2016). Consequently, the AECO sector has become increasingly digitalised, engendering concomitant benefits in terms of superior efficiencies and organisational collaboration over the whole lifecycle of development (Eadie *et al.*, 2013; Czmocho and Pekala, 2014; Yang, Shi and Wu, 2016). The increasing sophistication of digital technologies such as BIM (Eastman *et al.*, 2011; Race,

2013; Barnes and Davies, 2014; Kensek, 2014a), BIM tag technology (Motamedi *et al.*, 2011; Thomson and Boehm, 2015), environmental sensors (Kensek, 2014b) and laser scanning technology (Chan *et al.*, 2016; Yang, Shi and Wu, 2016) indicates that a larger “digital built environment” movement is underway (c.f. Bojanova, 2014; Brooke, 2016; Scholz, 2016; Pärn and Edwards, 2017).

Although the beneficial implications of digital modelling in the AECO sector are well espoused in academic literature, the main focus has been the design and construction phase of development. The building’s operational ‘in-use’ phase has received comparatively scant academic attention, yet is the chief contributor to the building’s whole lifecycle cost and performance (Bosch *et al.*, 2014; Kessem *et al.*, 2014; Liu and Issa, 2014; Lindkvist, 2015; Nical and Wodynski, 2016). Consequently, asset management is now progressively gaining considerable academic and practitioner interest particularly in terms of exploiting the beneficial implications of BIM implementation (Arayici and Coates, 2012; Olatunji and Akanmu, 2014; Lindkvist, 2015; Pärn *et al.*, 2016).

Pärn and Edwards (2017) and Dubé *et al.*, (2005) suggest that BIM is displacing traditional AECO practices and replacing them with virtual communities of practice. This is particularly relevant for asset management organisations that see technological development as a vehicle for delivering increased efficiency and value (Love *et al.*, 2014). Mohandes *et al.*, (2014) contend that the data management potential of BIM affords a panacea to asset management issues inherent within the ever increasing quantity and complexity of information gathered throughout a building’s lifecycle. BIM implementation can therefore support facility managers by complementing strategic and tactical skills requirements needed to manage an amorphous range of facilities management (FM) requirements (McGregor and Then, 1999; Atkin and Brooks, 2005; Azhar *et al.*, 2011).

Such implementation will require the resolution of persistent issues that cumulatively have prevented the wider adoption of digital technologies within asset management. This review brings together extant literature on digital modelling within the AECO sector, contemporary asset management and emergent digital asset management. A critical overview of digital modelling presents a succinct account of its beneficial implications when applied to asset management; and identifies factors currently hindering industry-wide implementation of digital asset management. In realising these aims, the objective is to garner a consensus from commentators participating in the digitalised AECO discourse regarding both the practical and

research-based requirements for increased digitalisation of the AECO sector. The research concludes by proposing: future developments of BIM in asset management; the need for greater inclusion of environmental sustainability issues; and the need to integrate sensor-based technologies to assist facility managers in optimising decisions for asset management.

3.3 COMPONENTIAL SYNTHESIS

The published materials contained within BCU's Summon, BCU Open Access Repository and Research Gate databases were comprehensively reviewed. Three lines of academic enquiry were pursued, namely, asset management literature, digital modelling literature and emergent digital asset management literature. This approach led organically to a structure comprising: the wider beneficial implications of a digitalised AECO sector, the implications of digitalised asset management and obstacles impeding widespread digital modelling implementation in practice.

The componential synthesis of published literature sought to thematically group the subject matter of papers published and ascertain the trajectory of future research into digital asset management (c.f. Figure 9). Thematic groupings were: BIM implementation; generative design; BIM data implications; BIM performance analysis; BIM for asset management; design for maintenance; and knowledge transfer and skill requirements. Where future research suggestions were offered, they were interpreted by the researcher and clustered into eight logical headings, namely, improvement to industry data interoperability; increased collaborative working at the organisational level; increased collaborative working at the individual/actor level; refinement of processes and management practices; resolution of implementation difficulties; increased performance measurement and analysis; increased industry skill levels; and increased environmental sustainability of development. Each heading represents an avenue for improving the functionality, performance and accessibility of digitalised asset management within the AECO sector. Collating and analysing the literature in this way allows a richer understanding of which journals focus on which issues.

Figure 9 - A Componential Synthesis of Future Research Suggestions pertaining to Digital Asset Management

AECO context	Future research suggestions								Academic citations
	i	ii	iii	iv	v	vi	vii	viii	
A	2	1	0	1	4	3	0	0	(29),(42),(43),(46),(48),(68),(73)
B	0	1	0	3	0	0	0	1	(1),(2),(4),(26)
C	3	3	1	0	0	0	1	0	(56),(58),(110),(118),(123)
D	0	0	0	1	0	3	1	6	(14),(16),(18),(24),(33),(40),(64),(94),(96),(119),(121)
E	5	2	1	3	3	5	0	1	(5),(15),(21),(52),(57),(60),(61),(66),(70),(77),(78),(84),(91)
F	0	0	0	0	1	0	0	0	(75)
G	1	3	0	0	0	1	4	0	(50),(59),(71),(74),(95),(97),(108),(113),(120)
Total suggestions	11	10	2	8	8	12	6	8	
Distribution amongst journal publications	AEI-9.09% AC-27.27% BEPAM-9.09% JFM-9.09% JITC-9.09% JME-18.18% MTA-9.09% SS-9.09%	AEI-10.00% AC-20.00% BEPAM-20.00% F-10.00% IJSPM-10.00% JFM-10.00% JITC-10.00% PE-10.00%	F-50.00% MTA-50.00%	AEI-12.50% BEPAM-25.00% BE-12.50% CI-12.50% F-12.50% PE-12.50% SS-12.50%	AC-12.50% BEPAM-12.50% CME-12.50% ECAM-12.50% F-12.50% JCEM-12.50% JME-12.50% RSER-12.50%	AC-33.33% BEPAM-8.33% BE-8.33% ECAM-8.33% F-16.67% IJMPB-8.33% JCEM-8.33% JEM-8.33%	BEPAM-16.67% CI-16.67% F-33.33% JME-16.67% LME-16.67%	AC-12.50% BS-12.50% IC-12.50% JCP-12.5% PE-25.00% RCR-12.50% SS-12.50%	

Suggested future research	
i	Improvement to Industry data Interoperability
ii	Increase collaborative working (organisational level)
iii	Increase collaborative working (individual/actor level)
iv	Refinement of processes and management practices
v	Resolution of implementation difficulties
vi	Increase performance measurement and analysis
vii	Increase to industry skill levels
viii	Increase environmental sustainability of development

Digital AECO context	
A	BIM implementation
B	Generative design
C	BIM data implications
D	BIM performance analysis
E	BIM for asset management
F	Design for maintenance
G	Knowledge transfer and skill requirements

Journal publications			
AEI	Advanced Engineering Informatics	JCP	Journal of Cleaner Production
AC	Automation in Construction	JCEM	Journal of Construction Engineering and Management
BEPAM	Built Environment Project and Asset Management	JFM	Journal of Facilities Management
BS	Building Simulation	JITC	Journal of Information Technology in Construction
BE	Building and Environment	JME	Journal of Management in Engineering
CI	Construction Innovation	LME	Leadership and Management in Engineering
CME	Construction Management and Economics	MTA	Multimedia Tools and Applications
ECAM	Engineering, Construction and Architectural Management	PE	Procedia Engineering
F	Facilities	RSER	Renewable and Sustainable Energy Reviews
IC	Informes de la Construcción	RCR	Resources, Conservation and Recycling
IJMPB	International Journal of Managing Projects in Business	SS	Structural Survey
IJSPM	International Journal of Strategic Property Management		

The three most frequently suggested research paths, in descending order were: increased performance measurement and analysis; improvement to industry data interoperability; and increased collaborative working at the organisational level (c.f. Figure 9). Whilst these issues have overarching implications for digital modelling implementation in general, they impact considerably upon implementation of digital modelling in asset management, but also on the aligned field of POE. Furthermore, the apparent academic significance placed upon these research requirements indicates that efforts to resolve them would bring immediate benefits to the AECO sector. Notably, the most frequently suggested research path regarding ‘increased performance measurement and analysis’ correlates with integrating technological developments such as BIM tag technology (Motamedi *et al.*, 2011; Thomson and Boehm, 2015), environmental sensors (Kensek, 2014b), laser scanning technology (Chan *et al.*, 2016; Yang, Shi and Wu, 2016) and utilisation of wireless networks (Riaz *et al.*, 2014). The incorporation of these technologies into BIM-enabled developments can greatly enhance the development process, particularly regarding asset management during the operational phase.

The next three research paths suggested within the synthesis, all with equal weighting, were: resolution of implementation difficulties; refinement of processes and management practices; and increased environmental sustainability of development. Whilst these implications received lower attention, they all have an important role to play in terms of increasing the AECO sector’s performance. The relatively low significance assigned to resolving implementation issues may be explained in terms of the three most prominent research paths all contributing to easing implementation difficulties.

3.4 DIGITALISING THE BUILT ENVIRONMENT

Traditionally, the design, construction and occupation phases of a development have operated in relative isolation to each other with architects producing designs, contractors delivering the development and facility managers operating and maintaining the building (Race, 2013; Garber, 2014; Liu and Issa, 2014; Motawa and Almarshad, 2015). Exchanging information between members of the project management team (PMT) using paper records and outputs from differing systems can introduce human error and data incompatibility, hindering the efficiency of a development (Martin, 2011; Kivits and Furneaux, 2013; Motawa and Almarshad, 2013; Pătrăucean *et al.*, 2015; Thomson and Boehm, 2015; Love *et al.*, 2016a; Yang, Shi and Wu, 2016). Diminished efficiency instigates spiralling costs and scaling back of

initial design objectives as well as more complex innovations, particularly regarding the environmental provisions within a development (Atkin and Brooks, 2005). Whilst lines of communication are clear, interaction between members of the PMT can foster adversarial relations when individuals seek to mitigate their liability (Khosrowshahi and Arayici, 2012; Jiao *et al.*, 2013; Barnes and Davies, 2014). In addition, facility managers are rarely consulted during the design or construction phases of a project's development and so the opportunity to maximise upon their tacit knowledge of data and information requirements for a building in-use is lost.

Application of advanced digital technologies (including BIM) to the design and construction phases of development has afforded extensive benefits. The ability to create a digital representation of a physical asset allows all development stakeholders to exchange knowledge, and coordinate the complex processes characteristic of development, using a single digital resource (Eastman *et al.*, 2011; Czmoach and Pekala, 2014; Garber, 2014). Digital design affords numerous improvements to traditional AECO design practices in terms of iterative design, parametrics and extensive prefabrication. Iterative design, for example, encompasses a cyclical process to facilitate constant testing, analysing and refining throughout the design phase of a development, a process which would require substantial time and resources if not undertaken digitally (Garber, 2014).

As digitisation has progressed at a rapid pace, conceptual designs are increasingly amalgamated with mathematical algorithms and parametric constraints expanding the remit of digital design into the realms of generative design (Abrishami *et al.*, 2014, 2015). Generative design facilitates consideration of the relationships between different components throughout the design process, as evidenced by BIM's ability to detect potential clashes between components (e.g. ductwork passing through structural steel) before commencement of construction (Garber, 2014; Abrishami *et al.*, 2015). The use of intelligent data, such as parametrics, requires dimensions to be assigned to generic form, and sets BIM apart from the two-dimension-based CAD systems from which it evolved (Barnes and Davies, 2014; Ghaffarianhoseini *et al.*, 2016). Consequently, BIM deals with both geometric and increasing quantities of non-geometric information (Brilakis *et al.*, 2010). This innovation allows design issues traditionally encountered during the construction phase of a development to be identified and amended before a development commences.

Race (2013) describes BIM as: incomplete in terms of its ability to amalgamate a combination of constituent components; and infinite in terms of its almost limitless potential for collection and inclusion of building data. Through BIM utilisation, development stakeholders can readily access and utilise a digital representation of both the physical and functional characteristics of an asset (Rahman *et al.*, 2016). AECO tasks are simplified, particularly at the design phase of development, thus optimising financial and time efficiency gains (Eadie *et al.*, 2013; Czmocho and Pekala, 2014; Yang, Shi and Wu, 2016). Consequently, BIM is considered to offer a potential remedy to the construction industry's susceptibility to economic recession, prompting the UK Government to commit to implementing BIM as a basic standard for all national infrastructure projects by 2016 (Race, 2013; BIM Task Group, 2013; Eadie *et al.*, 2014; Kessem *et al.*, 2014; Lindkvist, 2015; Mehran, 2016). This is especially pertinent considering that the sector has undergone a period of introspection regarding performance and productivity levels in recent decades (Babič *et al.*, 2010; Underwood and Isikdag, 2011; Li *et al.*, 2013; Love *et al.*, 2013; Fox, 2014; Lu *et al.*, 2015; Rogers *et al.*, 2015).

Digital modelling facilitates greater continuity between the various systems and actors throughout the built environment lifecycle (Bosch *et al.*, 2014; Olatunji and Akanmu, 2014; Lindkvist, 2015; Pătrăucean *et al.*, 2015). Palpable benefits afforded by a BIM model include: accurate costing information throughout the development (Azhar *et al.*, 2011; Barnes and Davies, 2014); opportunities to capitalise upon off-site prefabrication thus aiding in the delivery of an efficient and cost effective development (Azhar *et al.*, 2011; Eastman *et al.*, 2011; Race, 2013); and availability of data from a development for the purposes of informing future developments, representing a significant opportunity to improve knowledge transfer between different AECO projects (Kensek and Noble, 2014; Göçer *et al.*, 2015; Grover and Froese, 2016). Furthermore, the increasing sophistication of digital modelling technologies (cf. Eastman *et al.*, 2011; Race, 2013; Barnes and Davies, 2014; Kensek, 2014a) presents a wealth of opportunities to increase the quantity and quality of information gathered regarding a BIM-enabled built environment asset. Technological developments such as BIM tag technology (Motamedi *et al.*, 2011; Thomson and Boehm, 2015), environmental sensors (Kensek, 2014b) and laser scanning technology (Chan *et al.*, 2016; Yang, Shi and Wu, 2016) can rapidly generate building data to inform both the construction and operation phases of development, as well as increasing opportunities to inform future developments. Wireless networks (cf. Riaz *et al.*, 2014) offer a means of utilising and integrating any information generated from these technological advancements for use in a built asset digital model.

The innate data storage capabilities of digital modelling have also had a major impact upon the AECO sector. Within BIM, entire planes through a design are subdivided into individual graphic tablets and arranged in a grid format, each tablet containing all applicable information for that specific section of the development. The larger the development the more tablets a plane may contain, with the only real restriction being the computing power of the system operating the virtual model (Race, 2013). This also has beneficial implications of embedding product and asset information into a 3D model (Succar, 2009), highlighting the development of a dual approach for both storing and exchanging information through BIM. However, stringent quality control protocols are required which do not impede the speed and frequency of updates when either incorporating new, or updating existing, information on tablets (Race, 2013). Process data streams (or building information) are dynamic, allowing for data sharing as well as constant transformations; conversely, archival repositories or record BIM is a means of storing data in their contractual state (Kensek, 2014a).

3.4.1 Cloud Computing and Standards

The advent of advanced cloud technology has had significant implications for the development of digital modelling and its potential applications in practice. Cloud computing technology facilitates the delivery of information technology services retrieved from the internet using web-based tools and applications vis-à-vis direct connection to a server (Race, 2013). Benefits accrued include: augmented business agility; improved capital and revenue expenditure; business scalability and agility; faster development and deployment of software applications; and importantly a managed but outsourced IT capability (Redmond *et al.*, 2012; Jardim-Goncalves and Grilo, 2010; Chen *et al.*, 2016). There are three levels at which clouds operate:

- 1) Infrastructure as a Service (IaaS) – the base level of cloud function, which incorporates server space, data storage, networking facilities and the capacity to operate a number of systems such as Linux, Windows and Solaris (Race, 2013).
- 2) Platform as a Service (PaaS) – incorporates the same functionality as IaaS but with the addition of software tools which allow bespoke applications to be created within the context of an organisation's objectives, customisations of Gmail, Google Calendar and Google Docs (Chen *et al.*, 2016).
- 3) Software as a Service (SaaS) – incorporates all the functions of IaaS and PaaS, but with greater focus upon facilitating specific needs of business users (Chen

et al., 2016). Accounting software, for instance, can be prohibitively expensive for many organisations; SaaS can provide generalised accounting software for individual cloud users (Race, 2013).

Many organisations agree that collaborative cloud options available through an integrated BIM platform are advantageous, particularly regarding the potential to benchmark asset performance, an issue particularly relevant to POE in FM (Du *et al.*, 2014). Traditional rudimentary evaluation tools currently available (including the BIM Maturity Matrix, BIM Excellence and the Interactive Capacity Maturity Model) do not facilitate the same levels of competitive analysis of BIM performance across industry peers (c.f. Succar, 2009; Succar *et al.*, 2012; Du *et al.*, 2014). BIM data and information in a multidisciplinary collaborative environment require stringent control and are currently governed by three overriding standards:

- 1) CI/SfB (1962) – predominantly aimed at classifying and structuring information for use in construction projects. Information is categorised by: physical environment; elements; construction forms; materials; and finally, activities and requirements. Although antiquated, it remains a relevant standard.
- 2) Uniclass (1997) – a similar system to CI/SfB but it provides a greater range of classifications. It is based upon the more recent (but now obsolete) ISO TR 14177.
- 3) BS 1192 (2007) – seeks to aid the production of information specifically in the architectural sector. This standard offers guidance on the construction of a communal pool of information and provides facilities to interact with both private and public repositories of data (cf. Race, 2013; Xue *et al.*, 2015).

3.5 DIGITAL ASSET MANAGEMENT

To optimise the business and working environment, an organisation's facilities must be managed effectively to avoid severe business performance reductions (Atkin and Brooks, 2005). Asset management, in context to its role within the larger field of FM, supports core business objectives of an organisation regarding the functionality of its buildings and infrastructure (Lehtonen and Salonen, 2005; Jensen *et al.*, 2012; Steenhuizen *et al.*, 2014; Nical and Wodynski, 2016). Although asset management is traditionally viewed as simply maintenance, cleaning and general caretaking (Meng, 2014), it incorporates a variety of interrelated multidisciplinary functions and disparate management systems, which must

operate in an integrative manner (Waheed and Fernie, 2009; Barrett and Finch, 2014; Kessem *et al.*, 2014; Mohandes *et al.*, 2014; Ilter and Ergen, 2015; Cao *et al.*, 2016; Nical and Wodynski, 2016). Many organisations are appreciating the benefits of an efficient and crucially innovative asset management operation in a constant striving towards achieving ‘best value’ (Scupola, 2012; c.f. Kashiwagi and Savicky, 2003; Atkin and Brooks, 2005; Jensen *et al.*, 2014). A holistic approach to asset management is therefore required that accounts for interdependent factors supporting business growth, prosperity and best value such as financial efficiency (‘sweating’ physical assets), allowances for future changes in the provision of space, and providing the best possible environment for the organisation’s core business and workforce (Atkin and Brooks, 2005; Barrett and Finch, 2014). Whilst the integration of BIM with FM and asset management is currently less established than the design and construction aspects of development, the potential to extract and analyse information stored in BIM to improve FM delivery is undeniable (Bosch *et al.*, 2014; Kessem *et al.*, 2014; Love *et al.*, 2014).

Deployment of digital modelling in asset management can greatly improve the quality of data transfers between development stakeholders (Jiao *et al.*, 2013; Lindkvist, 2015; Khaddaj and Srour, 2016). Traditional, manual handover of data often leads to inaccuracies (or worse, loss of data), diminishing the operational information held on a building during its lifecycle (Lindkvist, 2015; Motawa and Almarshad, 2015; Love *et al.*, 2016a). Studies have shown that facility owners regularly encounter incomplete as-built data documentation, fostering dissatisfaction, particularly where transferred operations and maintenance (O&M) data prove wholly unsuitable for asset management (Mayo and Issa, 2016). The management of information remains a vexatious and complicated issue within the AECO sector as significant effort is invested into replicating resources and unintentionally supporting inefficient workflows (Jiao *et al.*, 2013; Kessem *et al.*, 2014).

To address these issues, attempts have been made to utilise the inherent capabilities of digital modelling to coordinate consistent and computable building data throughout a building’s whole lifecycle (Underwood and Isikdag, 2011; Becerik-Gerber *et al.*, 2012; Gheisari and Irizarry, 2014; Love *et al.*, 2014). Chong *et al.*, (2016) suggest that BIM provides a vehicle for improving data reliability and quality while other researchers suggest that BIM implementation in asset management provides the efficient capture of building information (i.e. systems, spaces and finishes) in a digital format (Ilter and Ergen, 2015; Kessem *et al.*, 2014). Asset information replication can be minimised through the storage of manufacturers’ product data within 3D

parametric objects (Kessem *et al.*, 2014). A BIM-compliant database assists facility managers in various duties such as commissioning and closeout, energy management, maintenance and repair, quality control and assurance as well as space management (Becerik-Gerber *et al.*, 2012). However, at this juncture it has not been extended for use in POE implementation despite obvious connections between BIM and POE. Efforts to create an integrated data sharing platform utilising BIM have resulted in the development of software applications such as project lifecycle information modelling (PLIM) (Race, 2013). Data utilised in the construction phase of development are often revised before completion of the construction process. Use of a specially designed BIM for asset management application, such as PLIM, can aid in managing and storing these revised data for FM purposes (Jiao *et al.*, 2013). Furthermore, widespread collection of building asset data facilitated through BIM adoption will increase performance comparison and benchmarking, ensuring continuous performance improvement in the future (Giel and Issa, 2016).

Some estimates place 85 per cent of the total lifecycle cost of a development occurring during the operational phase, highlighting the potential of BIM-driven asset management to improve upon built asset performance, particularly regarding cost efficiencies over the course of a building's lifecycle (Korpela *et al.*, 2015). This has led some clients and building operators to require increases in a development's economic and environmental efficiencies (Kessem *et al.*, 2014). Despite this compelling statistic, BIM developments have mainly focussed upon new buildings, which make up between 1 and 2 per cent of the total building stock annually (Volk *et al.*, 2013; Kessem *et al.*, 2014; Diaz-Vilariño *et al.*, 2015). To date, the opportunity to optimise lifecycle cost management of built assets has largely been missed.

3.6 ENVIRONMENTAL SUSTAINABILITY

Digital modelling has significant potential to improve the AECO sector's environmental performance. Sustainability is defined by the World Commission on Environment and Development (1987) as: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Practitioners and clients within the AECO sector are under increasing pressure to provide value for money throughout the development process but in a sustainable manner (Arayici *et al.*, 2011; Welle *et al.*, 2011; Boyes, 2015; Göçer *et al.*, 2015; Nardelli *et al.*, 2015; Araszkievicz, 2016). Similarly, facility managers are increasingly aware of the benefits of effectively executed

maintenance management and efficient energy consumption (Liu and Issa, 2014). In total, 40 per cent of global primary energy and more than 30 per cent of total global CO₂ emissions are directly linked to building lifecycles, placing the annual emissions higher than those of either the transport or industrial sectors (Costa *et al.*, 2013; Yung and Wang, 2014; Min *et al.*, 2016; Mousa *et al.*, 2016).

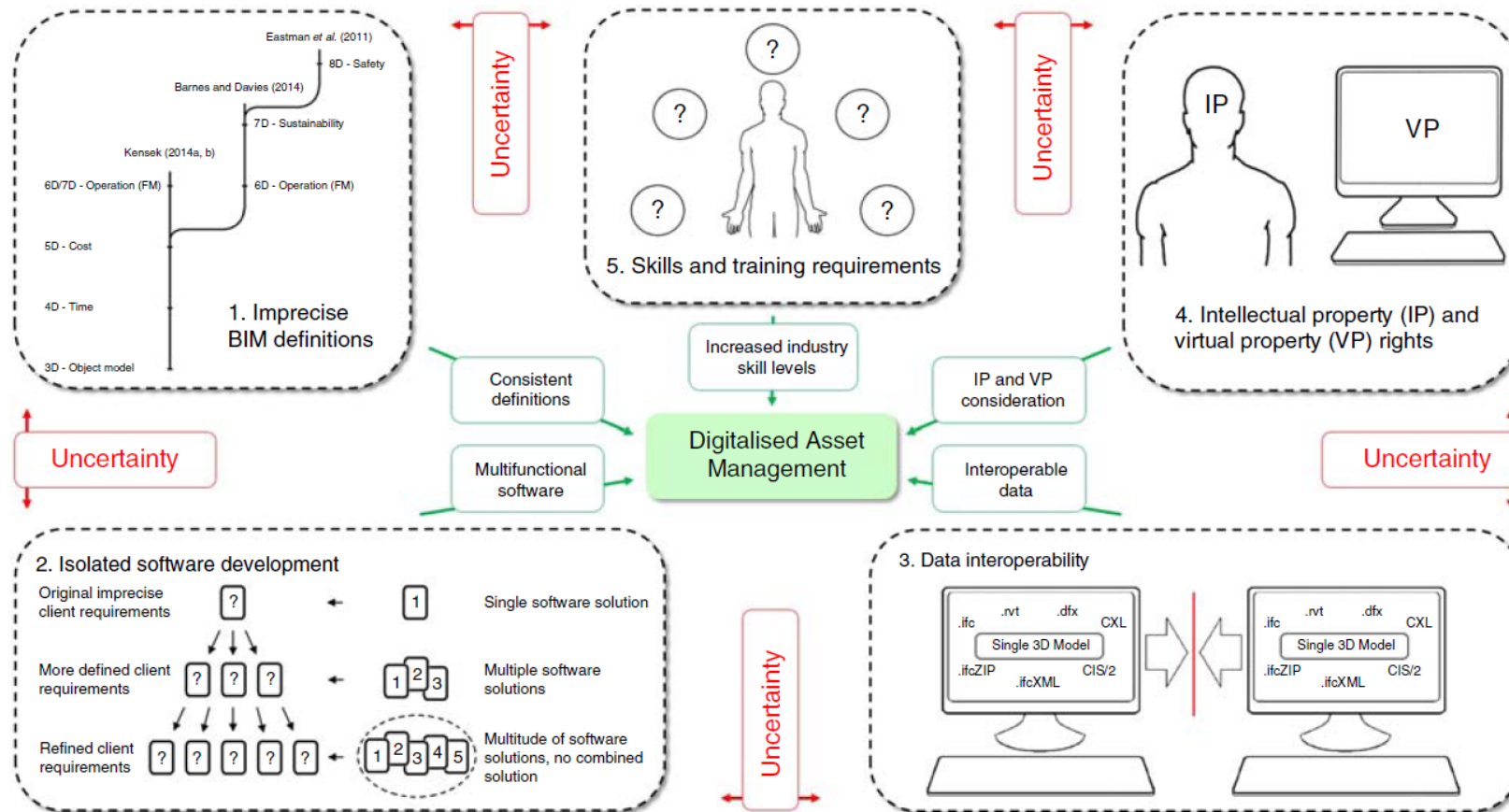
To achieve sustainability, an organisation must manage the three aspects of social, financial and environmental performance (Yung and Wang, 2014; Chong *et al.*, 2016). While much attention regarding digital asset management is focussed upon efficiency, cost savings and collaboration, there is considerably less discussion regarding the environmental aspect of sustainability, such as deconstruction emissions and recycling rates (Volk *et al.*, 2013). This where integration with POE would be advantageous in measuring building performance during use from the occupants perspective. Nevertheless, BIM adoption may offer vital aid in meeting perennial challenges regarding quality, efficiency, productivity and sustainable development (Arayici *et al.*, 2011; Kivits and Furneaux, 2013; Li *et al.*, 2013; Rogers *et al.*, 2015). Many practices currently employed by the AECO sector are unnecessarily inefficient, presenting significant opportunities to generate major savings, particularly regarding O&M activities (Liu and Issa, 2014). Exemplars such as the Sydney Opera House illustrate that building sustainability ratings may be improved through BIM-compliant asset management (Ballesty *et al.*, 2007; Baharum and Pitt, 2009; Volk *et al.*, 2013). Through the utilisation of retrospective BIM, benefits ordinarily attributed to contemporary BIM developments (such as integrated building, maintenance and management data storage and retrieval) can be leveraged to improve both data integrity and productivity (Ballesty *et al.*, 2007; Love *et al.*, 2016b).

3.7 OBSTACLES TO THE IMPLEMENTATION OF DIGITAL ASSET MANAGEMENT

Despite the plethora of beneficial implications attained through digitalised AECO practice, a number of recurring issues can hinder whole-scale implementation in practice, namely, imprecise BIM compliance definitions (Barlish and Sullivan, 2012; Succar *et al.*, 2012; Alwan and Gledson, 2014; Smith, 2014); isolated software development (Eastman *et al.*, 2011; Race, 2013); data interoperability (Becerik-Gerber *et al.*, 2012; Ilter and Ergen, 2015); intellectual property (IP) and virtual property (VP) rights (Olatunji and Akanmu, 2014); and increased industry skill and training requirements (Atkin and Brooks, 2005; Arayici and Coates, 2012;

Garber, 2014; Abrishami *et al.*, 2015; Rahman *et al.*, 2016). Notwithstanding the increasing prominence of BIM in academic literature, implementation in industry continues to prove a challenging endeavour (refer to Figure 10).

Figure 10 - A Visualisation of the Contributory Factors Inhibiting Digitalisation of Asset Management



i. Imprecise BIM compliance definitions - Variability in BIM compliance definitions beyond 5D may be adversely affecting outcomes at the higher levels of compliance. This also engenders uncertainty regarding skill requirements and software development, in terms of unclear objectives

ii. Isolated software development - 3D modelling software is often developed in isolation. This may affect both efforts to establish consistent industry wide definitions and resolve data interoperability issues

iii. Data interoperability - Despite efforts to simplify data and file format variability, data interoperability issues persist in practice. Continuing data interoperability may impact upon both software development and hamper efficient handling of IP and VP

iv. IP and VP rights - A digitalised AECO sector makes use of large quantities of data owned by various stakeholders. Inappropriate handling of such data may exacerbate interoperability issues whilst increasing skill and training requirements

v. Skills and training requirements - Contemporary software and workflows create new skill requirements. Failure to meet these requirements can fundamentally affect an organisation's ability to capitalise on the concomitant benefits of digitalised AECO practice

3.7.1 *Imprecise BIM Compliance Definitions*

There are various levels of BIM compliance, where each new level incorporates all the functions of the previous levels but then adds an additional layer of information (cf. Barnes and Davies, 2014; Kensek, 2014a). The level at which an organisation aligns its BIM compliance directly affects the potential benefits it may expect to receive. However, definitions used to describe BIM compliance levels are varied and often contradictory which has prompted calls to develop a more complete, comprehensive and consistent industry-wide set of standard definitions to improve clarity in practice (Barlish and Sullivan, 2012; Succar *et al.*, 2012; Alwan and Gledson, 2014; Smith, 2014). Imprecise definitions may adversely affect wider implementation of BIM compliance; Table 6 highlights the differences and omissions in BIM compliance definitions between a selection of different commentators. 3D BIM through to 5D BIM share universally accepted definitions, with the exception of a few minor differences. From 6D BIM onwards, definitions diverge significantly (Yung and Wang, 2014; Nical and Wodynski, 2016). The UK Government has committed to BIM compliance for nationally driven developments and infrastructure, seeking to mitigate the sector's susceptibility to economic downturn whilst simultaneously driving the UK's ailing productivity levels through promotion of innovative new systems and working practices (Li *et al.*, 2013; Race, 2013; Kessem *et al.*, 2014). Whilst this commitment may engender appreciable benefits for practitioners, if compliance is aligned at a lower level, then benefits associated with higher compliance levels may be missed (such as integrated asset management and environmental sustainability through BIM). 9D would integrate POE as a brand new dimension that has hitherto not been included and yet is a major factor that must be considered when measuring the buildings performance in use during the FM period of a buildings whole lifecycle.

Table 6 - A Comparison of BIM Compliance Definitions

BIM compliance/ maturity definitions	Author(s)							
	Eastman <i>et al.</i> , 2011	Redmond <i>et al.</i> , 2012	Volk <i>et al.</i> , 2013	Barnes and Davies, 2014	Kensek, 2014	Yung and Wang, 2014	Nical and Wodynski, 2016	Proposed
3D - Object model	•	•	•	•	•	•	•	
4D – Time	•	•	•	•	•	•	•	
5D – Cost	•	•	•	•	•	•	•	
6D – Operation	•			•			•	
6D – Operation and Sustainability					•			
6D – Sustainability		•				•		
7D – Sustainability	•			•				
8D – Safety	•							
9D - POE								•

3.7.2 Isolated Software Development

The software development process may also adversely impact upon the widespread implementation of digital modelling. As BIM has evolved, software applications have been developed almost in tandem (Race, 2013). This is due to industry demand for readily available solutions which, in turn, stimulates software proliferation to fulfil that need (Chen *et al.*, 2016). When this software is subsequently implemented, new requirements may arise which were not initially apparent and further software applications are developed. This recurrent process continues unabated until multiple software solutions exist to meet industry requirements, each individually developed, funded and owned. There are numerous BIM software applications which perform various different functions (refer to Table 7). As a consequence, difficulties arise when attempting to combine and share the functionality of the individual software applications across multiple software platforms causing this functionality to become fragmented (Eastman *et al.*, 2011). Software isolation is a prominent issue when implementing BIM during the design and construction phases of development and implementation of digital modelling in asset management will be similarly affected by the same issue (Kessem *et al.*, 2014; Xu *et al.*, 2016). The absence of multi-functional software solutions also has negative implications for BIM in asset management development and implementation because the cost of acquiring multiple software packages, particularly within the context of small to medium enterprises, can be prohibitive (cf. Dainty *et al.*, 2017). A number of leading software developers purport to have developed a complete BIM system, offering the data management

requirements crucial to a BIM data repository (Chen *et al.*, 2016). However, to have developed such a system at this early stage of BIM development suggests an evolution of pre-existing CAD data management components (Race, 2013).

Table 7 - An Overview of BIM Software

Software Function	Software package	Overview
Conceptual Design	Rhino	3D modelling software not exclusive designed for architectural design. Purportedly no upper limit on potential complexity of generated model (Rhinoceros, 2017).
	SketchUp	3D modelling software utilised by architects, designers, builders, makers and engineers. Software is focused upon simplifying technical user requirements in order to aid the creation of innovative 3D designs (SketchUp, 2017).
Design and Analysis	Catia	3D modelling software developed in context to the simulated real-life performance of the generated 3D product. Multi-purpose, utilised in various industries (Dassault Systmems, 2017).
	MicroStation	3D modelling software with advanced parametric modelling capabilities focusing on multidisciplinary project delivery. Focused toward BIM and the built environment as opposed to cross-industry application (Bentley, 2017).
	MagiCAD	Mechanical, electrical and piping design modelling for the AECO sector. Focused upon the integration of an extensive BIM library containing parametric data (MagiCAD, 2017).
	Revit	Software developed specifically for BIM. Developed to offer multidisciplinary and collaborative design environment (Autodesk, 2017a).
	Trimble (formerly Tekla)	Software offering intelligent 3D modelling specifically for the construction sector. Particular focus upon collaboration and efficiency (Trimble, 2017).
	Ecotect	A constituent of Autodesk. 3D modelling software focused upon the design and performance of green buildings. Discontinued due to intention to incorporate features into Autodesk. Notably no replacement to date (Autodesk, 2014; Autodesk, 2016).
Fabrication and Construction	Navisworks	A constituent of Autodesk. Allows architecture, engineering and construction professionals a holistic view of multiple integrated models. Focused on delivering greater control of project outcomes to development stakeholders (Autodesk, 2017b).
Operation and Maintenance	EcoDomus	A real-time 3D facilities software package offering a user friendly interface for facility managers. A single-source database is utilised to collect all relevant information in one location for use over a buildings entire life-cycle (ecodomus, 2015).
	ArchiFM	3D modelling software focused upon an entire life-cycle view of development. Utilised by architects, designer's engineers and builders within the AECO sector. Particularly focused on utilising BIM (Graphisoft, 2017).

3.7.3 Data Interoperability

The issues related to the software development process highlight the requirement for an industry-wide data standard, ensuring interoperability between systems and facilitating collaboration between development stakeholders (Linderoth, 2009; Singh *et al.*, 2010). However, academic discourse points towards a disconnect in interoperability related to BIM format data across asset information systems including: computerised maintenance systems, energy management systems, electronic document management systems and building automation systems (Becerik-Gerber *et al.*, 2012; Ilter and Ergen, 2015). The primary objective of any data management activity is to enable increased data interoperability, essentially allowing data generated by one party to be easily accessible for all participants (Jiao *et al.*, 2013; Lindkvist, 2015; Khaddaj and Srour, 2016). In practice, and despite the desire for sharing capabilities amongst asset management applications, many existing systems support the individual asset management function for which they were designed, but leave the overall interoperability with other systems in a fragmented state – often requiring manual input to facilitate any form of exchange (Becerik-Gerber *et al.*, 2012; Counsell, 2012; Xu *et al.*, 2016). Kessem *et al.*, (2014) suggests that there is a lack of an industry-wide process for updating a designed model with as-built information. Much of the data generated and stored in BIM over the course of a development are in a process of moving from an active to a non-active state (Jiao *et al.*, 2013). To address these concerns and issues, new information standards may be required (Hooper, 2015) and further research is needed to develop a system to integrate and automate information in a cost, time and resource efficient manner (Brilakis *et al.*, 2010; Akinade *et al.*, 2015).

3.7.4 IP and VP Rights

In relation to the interoperability of data, consideration of the implications of IP rights and VP rights is crucial. IP and VP rights recognise the defence of rights afforded to the author or owner of an intellectual or virtual asset, as well as the duration and scope of those rights (Olatunji and Akanmu, 2014). Asset management data can be owned by one of a multitude of different organisations, enterprises and government agencies; these data require the same treatment, respecting the IP or VP rights of the owner or author (Jiao *et al.*, 2013). However, property rights are an obstacle to the collaborative environment BIM promotes, particularly at the design phase of development (Olatunji and Akanmu, 2014). BIM in asset management can

expect to encounter similar issues, for many organisations sharing IP and VP rights can seem counterintuitive in the context of protecting an organisation's product and operational data, despite the benefits of collaborative working processes. Furthermore, the question is raised as to which is the most appropriate development stakeholder in an AECO project to be made custodian of such information and control the data contributed by multiple disciplines simultaneously (Jiao *et al.*, 2013; Olatunji and Akanmu, 2014). The contemporary trend for 'proptertisation' of intellectual rights has asserted the importance of this issue from a legal perspective and the legal ramifications of IP and VP rights, within an increasingly collaborative and open AECO environment, require significant academic and practitioner attention (Carrier, 2004; Posner, 2005; Olatunji and Akanmu, 2014). Extant research has questioned the wisdom, in economic terms, of exclusive ownership and rights to an intellectual artefact, asking whether exclusive ownership promotes creativity and innovation, or stifles it through weakened competition and democracy (Olatunji and Akanmu, 2014). For many organisations, there are tangible benefits to controlling all their own project data, but this can be problematic in current practice (Jiao *et al.*, 2013).

3.7.5 Industry Skills and Training Requirements

The abundance of new functions and possibilities facilitated by digital modelling has advanced more rapidly than the required skills and understanding to fabricate the results; an issue not confined to the AECO sector (Garber, 2014). The consequence of rapidly advancing technological capabilities is that a fresh injection of suitably skilled professionals is required to deal with the myriad of prerequisite skills and competencies needed to effectively operate within interdisciplinary teams (Arayici and Coates, 2012; Abrishami *et al.*, 2015; Rahman *et al.*, 2016). Furthermore, as with the embracing of all new innovations, there will be a transitional period which demands an increased requirement for these new skills and the associated training (Atkin and Brooks, 2005). This can often be a discouraging implication for organisations when considering implementing digitalised systems, so the beneficial implications of adopting such technology must be emphasised and made clear to practitioners (Rahman *et al.*, 2016).

3.8 CONCLUSIONS

The increasing digitalisation of the AECO sector has engendered many key benefits, including: cooperative working practices, democratised data, built asset performance analysis and process

management. Many of these advantages provide tangible solutions to persistent problems plaguing the sector. However, as is often the case, the resolution of one issue can lead to numerous further unforeseen issues. The implementation of digital modelling in asset management is no different. Significant variations are encountered in asset management software, particularly in terms of file formats; intended lifecycles of systems and data; and functionality of the software. To accomplish universal industry-wide adoption of digital asset management, major efforts will be required to bridge the considerable gaps which at present prevent the wholesale integration of technologies such as BIM, PLIM and CAFM.

In addition to specific digital asset management implementation difficulties, a number of overarching issues persist. To realise the advantageous implications of digital asset management, ongoing issues regarding data interoperability; software isolation; skills and training; IP and VP considerations as well as consistent digital modelling definitions must be resolved, or more precisely considering the scale of the task, not have effort to resolve them diminished. These problems are prominent in digital modelling literature regarding the design phase of development, but play just as important a role in the successful implementation of digital modelling in asset management. It is here, and at this juncture that POE could be integrated as a new 9D level of BIM implementation. Specifically, to measure the performance of a building in-use at the FM phase in a buildings whole lifecycle.

Some commentators (cf. Arayici *et al.*, 2011; Welle *et al.*, 2011; Costa *et al.*, 2013; Casas *et al.*, 2014; Yung and Wang, 2014; Boyes, 2015; Bu *et al.*, 2015; Göçer *et al.*, 2015; Nardelli *et al.*, 2015; Araszkievicz, 2016; Ahuja *et al.*, 2016; Mousa *et al.*, 2016) argue that the real potential of BIM in asset management lies in its innate potential to help in delivering superior environmental sustainability value, as opposed to purely financial sustainability. The operational phase of a building lifecycle consumes the majority of natural resources, so this implication demands attention, particularly given the current introspection within the AECO sector regarding its vast environmental footprint. The alarming statistics regarding energy consumption of built environment assets over the course of their expected lifespans have engendered interest, both in academia and in practice, in increasing sustainability values through digitalised asset management, extending the functionality of BIM right through a building's complete lifecycle (Motawa and Carter, 2013; Shoubi *et al.*, 2014; Liu *et al.*, 2015; Guo and Wei, 2016; Yang, Ghahramani and Becerik-Gerber, 2016). Improvements to the design and construction phase of development, collaborative working practices and data

management applications, for instance, could stimulate similar increases to asset management efficiency and concomitant reductions in O&M costs (Martin, 2011; Kivits and Furneaux, 2013; Motawa and Almarshad, 2013; Pătrăucean *et al.*, 2015; Thomson and Boehm, 2015; Love *et al.*, 2016a; Yang, Shi and Wu, 2016).

Despite the well-documented difficulties of implementing new systems and working processes, the beneficial implications of pursuing digital modelling adoption in practice far outweigh avoiding innate implementation issues. When considered as part of a wider digital movement, digital modelling is having significant desirable impacts upon various other sectors, most notably the automotive and shipbuilding sectors. Furthermore, advancements in sensor technologies and wireless networks are steadily increasing the quantity and quality of information generated from BIM-enabled developments, information which can be utilised in the operational phase of a development and inform future developments. In consideration of the plethora of desirable implications realised through the implementation of digital modelling, failure to realise this potential would represent a missed opportunity to impact upon many of the persistent issues which plague the AECO sector. To achieve these ambitions would require transformation of a manual POE into a digital process. More importantly and before such a development, a consistent and robust hybrid POE requires development. Hence justifying the rationale for this current research study.

CHAPTER 4

POST-OCCUPANCY EVALUATION: A REVIEW OF LITERATURE

4.1 INTRODUCTION

This chapter offers a critical review of POE academic literature. Within the chapter, topics such as: i) the level of POE implementation in practice; ii) inhibitors of implementation in practice; iii) a review of POE processes; and iv) the academic objectives of ‘iterative improvement’ and ‘facility benchmarking’ are investigated. A bibliometric analysis is then undertaken utilising a three stage protocol, each stage of the protocol adding an additional search parameter further focusing the study and identifying key researchers working on the topic. Finally, the discussion elucidates on the links between POE and the wider digital movement within the built environment, but in particular facilities and asset management.

The chapter formed the basis of a research paper entitled: ‘Post-occupancy Evaluation: A Review of Literature’, published in the ‘International Journal of Engineering, Construction, and Architectural Management’ in January 2019 (Roberts *et al.*, 2019). The content of this chapter has therefore been partially externally validated, due to it having been through a robust peer review process.

4.2 POST-OCCUPANCY EVALUATION

The AECO sector is responsible for creating and managing the built environment (both buildings and infrastructure) to facilitate human activities (i.e., work, leisure and housing) over time. Creating this man-made environment directly impacts upon the people who inhabit or use buildings and infrastructure but also the surrounding environment. For example, buildings: are major consumers of environmentally polluting natural resources (Milutienė *et al.*, 2012); are essential to socio-economic development (Acharya and Sadath, 2019); and can impact upon occupants’ health and well-being (Al horr *et al.*, 2016). Within the whole life cycle of a built asset’s life, conspicuous academic attention is paid to the design and construction phases (Kessem *et al.*, 2014; Roberts *et al.*, 2018). However, it is the operational phase of building occupancy and use that is the chief contributor to pollution, whole life cycle costs and performance metrics (c.f. Bosch *et al.*, 2014; Liu and Issa, 2014; Lindkvist, 2015; Nical and Wodynski, 2016). For this reason, far greater attention is needed to review and evaluate building performance in-use.

To measure a building's operations and performance, a POE is typically utilised to determine whether decisions made by the design, construction and facilities management professionals have met the envisaged requirements of end-users and the development's commissioners (Adeyeye *et al.*, 2013; Skills Funding Agency, 2014). Such work has significant implications in the area of soft landings (within a building delivery process) by ensuring that future decisions made about similar buildings designs are based upon lessons learnt from an existing building's operational performance and the fulfilment of client and user requirements (Gana *et al.*, 2018). POE considers a broad range of diverse performance metrics including: building use, energy consumption, maintenance costs and user satisfaction (c.f. RIBA, 2016; RIBA, 2017a; RIBA, 2017b). A building's operational performance is measured using: i) project team feedback that recounts the commissioning and construction phases; ii) end-user feedback on finishes and functional performance; iii) technical performance feedback from a building's systems; and iv) a strategic overview incorporating the data from each of the aforementioned evaluation stages (c.f. HEFCE, 2006; RIBA, 2016; RIBA, 2017a; RIBA, 2017b).

The widely espoused beneficial implications of POE implementation include: i) transference of operations knowledge accrued in order to inform future building designs (Cooper, 2001); ii) iterative improvement of an existing facility's performance (Göçer *et al.* 2015); and iii) the ability to benchmark building performance between facilities, particularly within the same estate (Preiser and Vischer, 2005; Olivia and Christopher, 2014). However, practitioners have hitherto either failed to adopt a POE or lacked consistency in approach to its implementation (Alborz and Berardi, 2015). Part of the lack of consistency issue can be attributed to the various POE implementation strategies found within literature and practice (cf. Riley *et al.*, 2010). Consequently, the opportunity to reduce excessive energy usage, reliance on resources and material wastage is squandered, whilst financial returns on investment and occupant satisfaction are simultaneously reduced (Ahuja *et al.*, 2016). Research suggests that the accrual of value and passive attitudes toward sustainable solutions represent major stumbling blocks that discourage sector stakeholders (i.e. designers, contractors and clients) from completing a POE (Wong and Kuan, 2014). Increased societal and political demands for 'greener buildings' may aid in dispelling these unduly negative attitudes (Miller *et al.*, 2012).

Against this contextual backdrop, this chapter seeks to: analyse extant literature on POE of a building's operations and performance as a means of mapping the existing body of knowledge (BoK); identify impediments preventing its wide scale adoption throughout practice; and develop

new theory that would seek to integrate digital technologies within facilities management (FM) via a POE feedback mechanism. Both industry guidance and academic literature are reviewed to: construct an overview of the differing POE strategies available to building commissioners and developers; and identify the interconnectedness of key authors undertaking contemporary POE research. Cumulatively, this accrued BOK is then utilised to determine the extent to which POE interrelates with other fields of study. These other fields include: digital technologies such as sensor based networks and building information modelling (BIM) which are increasingly being used to tailor a building's performance to individual occupant needs; and facilities management (FM) where FM teams are the custodians of buildings and utilise POE findings to modify buildings in-use (cf. Parn *et al.*, 2017). Concomitant research objectives are to: provide insightful guidance on POE implementation throughout a building's whole life cycle; generate new theories on POE usage within practice; and propose future avenues of investigative research that will augment current and future building design, construction and performance.

4.3 THE POE BODY OF KNOWLEDGE

Interpretation of academic and professional practice literature enables the development of new theories using inductive reasoning; where the latter represents the first step towards developing a much clearer ontological perspective of the POE phenomena under investigation (Suddaby *et al.*, 2015). Petticrew and Roberts (2008) and Oraee *et al.*, (2017) assert that a 'mixed methods systematic review' is the most effective method for identifying gaps in a BOK. In contrast to a 'mono-method manual systematic review', it is resistant to biases realised through subjective interpretation and judgement (He *et al.*, 2017). Within this overarching methodological framework, a two stage operational process was adopted. In stage one, a detailed review of building performance measurement using POE was undertaken to contextualise the research and further delineate the specific areas of POE evaluation, process and benchmarking.

In stage two, bibliometric data was mapped to provide a systematic review of relevant extant literature. Hayvaert *et al.*, (2016) state that the amalgamation of quantitative and qualitative methods requires the development of a protocol stating methods, processes and sampling strategies for both data collection and study objectives. With this in mind, an iterative search protocol was developed which utilised three bibliometric data searches incorporating the following pertinent terminologies: i) 'POE'; ii) 'POE' and 'process'; and iii) 'POE', 'process' and 'benchmark'. Data utilised to produce the bibliometric map could be sourced from a number of electronic repositories,

for example: Web of Science, ProQuest and Scopus. However, Web of Science was utilised because it claims to be the most accurate citation database available for bibliometric analysis (Clarivate Analytics, 2017). Each search sought to capture literature that contained the selected terms in the abstract, title or keywords of published work. To avoid conflation with unrelated studies pertaining to alternative disciplines, the term 'Poe' was excluded to ensure the results related to the built environment and not to other disciplines.

The Web of Science repository allows for the tailoring of searches to meet specific needs, such as the date of citation. No limit on the date of citation was implemented (1970-2018) to secure a more complete perspective on the entire POE BOK. The first two searches were conducted using the VOSviewer bibliometric analysis software in order to construct bibliographic visualisations and map the interconnections between authors researching the three topic areas. The bibliometric data sourced from the Web of Science was organised using the repository's 'analyse' function to indicate the top 25 academic journals publishing POE research. A third stage of analysis was conducted manually and was not restricted to the top 25 academic journals as the search generated only seven results. The Web of Science search functions were also utilised to discern key statistics (date of first citation and total number of research items) with which to critically compare similarly aligned disciplines pertaining to the design, construction and operational phases of a development's life cycle (i.e. BIM and FM).

4.4 BUILDING PERFORMANCE AND MEASUREMENT

Each year, buildings produced and operated by the AECO sector consume 40 per cent of global anthropogenic material and energy flows, 25 per cent of total timber harvested and 16 per cent of freshwater (Milutienė *et al.*, 2012). These unsustainable rates of consumption mean that the sector consequently engenders monumental environmental impact, for example, per annum the sector contributes: 24 per cent of India's CO₂ emissions; 33 per cent of Canada's energy production; and 42 per cent of Australia's normalised solid waste (El shenawy and Zmeureanu, 2013). Globally, buildings' life cycles account for 40 per cent of energy requirements and carbon dioxide emissions and 70 per cent of total greenhouse gas emissions (Motawa and Carter, 2013; Lui *et al.*, 2015). Against this statistical backdrop, Cooper (2001) and Riley *et al.*, (2010) assert that buildings constructed using contemporary design and construction innovations, without process feedback on performance, effectively remain an unproven prototype. Yet the majority of a building's environmental impact occurs during the operational phase, which may last several decades (Guo

and Wei, 2016). To further exacerbate matters, occupants spend more time indoors - within the United States for example, people spend up to 90 per cent of their time within buildings that constitute a 120 million real estate stock and account for 40 per cent of the nation's total annual energy requirements (Shoubi *et al.*, 2014). Consequently, the AECO sector's unsustainable record of poor environmental performance during a building's construction and operation phases renders a *laissez-faire* 'business as usual' attitude untenable (Ahuja *et al.*, 2016). During these phases buildings require expert management of budgets, schedules and environmental impact to enhance returns on investment, mitigate wastage/environmental impact and augment occupancy satisfaction (Ahuja *et al.*, 2016). Herein resides the inherent importance of a POE and its innate ability to provide invaluable reflection upon a building's performance.

4.4.1 *Post-occupancy Evaluation (POE) Implementation*

POE encompasses an expansive range of processes and activities that systematically evaluate a building's performance subsequent to its handover (Ilesanmi, 2010; Tookaloo and Smith, 2015). Traditionally, building performance knowledge was passed down through generations of construction specialists who possessed exhaustive tacit knowledge of a client's cultural, social, operational, technical and economic parameters (McGrath and Horton, 2011). The Royal Institute of British Architect (RIBA) report "Plan of Work for Design Team" (1965) first introduced the concept of an architect returning to a completed development to assess its success and/or identify areas for improvement (RIBA, 1965). However, despite fifty years of subsequent development, the vast majority of discourse on POE planning and implementation is generated via real estate departments of higher education institutions and is not routinely applied throughout the wider AECO sector (Leaman, 2004; Hadjri and Crozier, 2008; Zhang and Barrett, 2010).

When implemented for a newly developed facility, POE can accrue various benefits in terms of: maximising space utilisation, reducing operational costs and optimising maintenance costs (c.f. Shohet *et al.*, 2003; RIBA, 2016; RIBA, 2017a; RIBA, 2017b). However, the roles, responsibilities, perspectives and expectations of both industry practitioners and built asset end-users differ significantly (Rebaño-Edwards, 2007). For instance, whilst developers are primarily concerned with efficiency and cost (Gervásio *et al.*, 2013), end-users focus more upon the quality of the building's finishes, its environmental performance and services (Turpin-Brooks and Viccars, 2006; Hassanain and Mudhei, 2006; Riley *et al.*, 2010; Choi *et al.*, 2012; Hussanain and Iftikar, 2015). Regardless of perspective, prudent business decision making for buildings requires the

efficient management of data and information (García-Peñalvo and Conde, 2013; Gong *et al.*, 2018). Undertaking a POE presents a significant opportunity to garner insightful feedback on the design, construction and management decisions taken during the building's whole life cycle (O'Neil and Duvall, 2005; Skills Funding Agency, 2014). POE reports can contain invaluable data regarding: i) end-user feedback of facility performance; ii) project team feedback regarding the design and construction phases; iii) technical data from the facility's building management system; and iv) strategic data from an organisation's Estates management perspective (HEFCE, 2006; RIBA, 2016; RIBA, 2017a; RIBA, 2017b). Garbowski and Mathiassen (2013) assert that sound real estate decision-making is crucial to ensuring an organisation's financial and strategic success. Additionally, García-Peñalvo and Conde (2013) proffer that the more useful the available information, the more efficient and considered the decision-making process will be. However, despite voluminous 'big data' available, significant gaps are apparent between a building's predicted and actual performance (de Wilde, 2014; Brown, 2015).

4.4.2 Barriers to POE Implementation

Curiously, the implementation of POE is inconsistent internationally and prevailing practice within the United States is far more advanced than international counterparts (Adewunmi *et al.*, 2010). Within the UK, two prominent guidance documents offer insight into the financial importance of a POE. The Higher Education Funding Council England (HEFCE) Guidance to Post-occupancy Evaluation (2006) refers to a "*PFI [Private Finance Initiatives] /PPP[Public Private Partnerships] review to allow a length of experience of operating the building*" (HEFCE, 2006, p13). PFI and PPP are funding mechanisms combining public finances with private capital and have been used widely throughout UK construction industry (Bing *et al.*, 2005). The Skills Funding Agency (SFA) Post-occupancy Evaluation Guide (2014) offers a link to the Government's "*SFA capital funding: evaluation documents*" online utility, similarly indicating financial diligence influenced governmental thinking (c.f. Skills Funding Agency, 2014). Despite UK Governmental interest in, and academic endorsement of, POE its implementation within practice remains elusive partial due to this lack of a singular guidance source (Alborz and Berardi, 2015). Other reasons for this are varied but centre upon three key inhibiting sets of factors (refer to Table 8):

Table 8 - An Overview of Factors Preventing POE Implementation

Inhibitor of POE	Description
Ownership.	Ownership of the POE process within a collaborative team of developers is often a stumbling block to its execution (Riley <i>et al.</i> , 2010). Mitigation of liability is a significant driving factor for individual built environment professionals within the team (Khosrowshahi and Arayici, 2012; Jiao <i>et al.</i> , 2013). This is further exacerbated by a culture of fear, blame and conflict which is synonymous with the building sector (Jauzens <i>et al.</i> , 2003).
Cost, procurement and incentives.	Riley <i>et al.</i> (2010) assert two prominent questions when considering the POE process: i) which party is responsible for commissioning and funding the evaluation? and ii) which party is professionally responsible for carrying it out? When examining this dilemma from a client perspective, the client often believes the ‘testing’ phase of the building life cycle has already been paid for (Riley <i>et al.</i> , 2010). Consequently, the factors of cost, failure to agree on POE measures and disjointed incentives to implement POE, represent significant barriers (c.f. Zimmerman and Martin, 2001; Vischer, 2001).
Education and culture.	Within the AECO sector, many designers, builders and project managers believe that they are in possession of in-depth knowledge of building performance, when often such knowledge extends only to the experience required to create and adjust buildings (Bordass and Leaman, 2005). Furthermore, there remains a notable absence of any obligation or payment to undertake a POE and POE implementation does not feature in contemporary architectural courses (Cooper, 2001).

- i) *ownership* – a prevailing culture of litigation and blame present major stumbling blocks to POE implementation – an issue further exacerbated by blurred lines of responsibility for such (Riley *et al.*, 2010; Jiao *et al.*, 2013);
- ii) *cost, procurement and incentives* – the cost of, and value perceived from conducting a POE create significant barriers to POE adoption (c.f. Zimmerman and Martin, 2001; Vischer, 2001). Contractual clauses within a chosen procurement path could alleviate this issue but at the conception stage, anecdotal evidence (sourced from the authors’ own industrial experiences as a practitioner and informal conversations held practitioner colleagues) suggests that a POE is hardly considered. Financial and non-financial incentives could also be employed but at present these are not well defined or utilised; and
- iii) *education and culture* – architects and designers are at the forefront of the client interface during project inception and yet, POE and its implementation rarely feature in architectural courses awarded (Cooper, 2001). When a POE is used the process adopted is often subject to variability and personal choice (of the person(s) implementing the POE) thus making direct comparisons between buildings difficult. This knowledge void further compounds the problem of POE adoption.

4.4.3 The POE Process

The POE process is steered by research pertaining to human requirements, built asset performance and FM (Riley *et al.*, 2010). It consists of two prominent lines of investigation, namely: i) *technical performance*; and ii) *functional performance* (Hassanian *et al.*, 2017). *Technical performance* measurement represents an assessment of the background environment provided by a building for conducting its intended activities (Preiser *et al.*, 1988). Technical performance considerations evaluate: thermal comfort; acoustical performance; visual comfort; indoor air quality; and fire safety (McGrath and Horton, 2011; Hassanian *et al.*, 2017). In contrast, *functional performance* measurement evaluates whether a building is fit for purpose when considering user activities. Functional performance considerations evaluate: space management; interior and exterior finishes; proximity to other facilities; and human factors (Zhang and Barrett, 2010). Although various strategies for conducting a POE exist, it is these two lines of investigation (functional and technical performance measurement) that predominate (refer to Table 9).

Table 9 - An Overview of POE Strategies

POE Strategy		Description
PROBE		PROBE is designed to utilise both quantitative and qualitative data regarding: energy consumption; occupant surveys and interviews; observational walkthroughs; and technical reviews (Riley <i>et al.</i> , 2010).
BUS	Occupant Survey	The Building Use Studies (BUS) occupant survey utilises questionnaires to gather end-user feedback on considerations such as: thermal comfort; ventilation; lighting and noise; personal control; space; design; and image (BUS Methodology, 2017). The BUS occupant survey uses key performance indicators to benchmark against other facilities held on the company's databases (Riley <i>et al.</i> , 2010).
CIC DQI		Construction Industry Council (CIC) Design Quality Indicators (DQI) utilises a questionnaire specifically designed to capture feedback from any individual (from the project team to neighbours) over the course of the building's life cycle (CIC, 2003).
OLS		Overall Liking Score (OLS) analyses three aspects of sustainability, namely: i) economic; ii) social; and iii) environmental (c.f. WCED, 1987). The OLS is predicated on an end-user questionnaire designed to capture opinions on successes and potential improvements (Riley <i>et al.</i> , 2010).
HEDQF Forum Methodology	POE	The Higher Education Design Quality Forum (HEDQF) Post-occupancy Evaluation Forum Methodology utilises facilitated seminars organised approximately a year after the handover of the facility (RIBA, 2010). Unlike the other strategies, this method can be executed as part of the HEFCE Guidance to Post-occupancy Evaluation, as opposed to simply being a stand-alone strategy (HEFCE, 2006; RIBA, 2010).
Soft Landings		Soft Landings considers the whole life cycle of the building, committing resources into consideration of: i) briefing; ii) pre-handover; and iii) the long term operation of the facility (Sustainable Cities, 2009). Soft Landings creates an environment and ethos suitable for the undertaking of a POE (Riley <i>et al.</i> , 2010).
HEFCE Guidance		The HEFCE Guide to POE is the preeminent document used in the higher education sector (Riley <i>et al.</i> , 2010). It was developed with the intention of increasing the preciseness of: benchmarking; management; and operation of educational buildings. The HEFCE Guidance advises collection of data at specific intervals after handover of a facility to maximise its usefulness: i) practitioner team feedback data collected between 3 to 6 months after handover before the project team move on to future projects; ii) end-user feedback data collected 9 to 18 months after handover when building users have settled in; and iii) technical data from an asset Building Management System, for instance after the initial snagging period (c.f. HEFCE, 2006).

From a higher education perspective, POE implementation seeks to determine whether the institution's FM operations meet University objectives (Tookaloo and Smith, 2015). Conducting a POE in this context standardises best practice, increases the accountability of facility managers and ensures that HEIs realise the improvements identified by the POE in future developments (Mustafa, 2017). The primary guidance document informing POE in English Higher Education is HEFCE's Guidance to Post-occupancy Evaluation which offers a toolkit for planning and implementation (HEFCE, 2006). HEFCE guidance is ostensibly designed to allow flexibility, stating that it is: "*prepared so colleagues can choose according to their needs and preferences, as few or as many of the areas identified in the report*" (HEFCE, 2006, p.3).

4.4.4 POE Benchmarking

POE findings provide benchmark criteria for comparing one facility's quality of finish, services and performance against another's (Wauters, 2005; Hassanain *et al.*, 2016) and offer guidance to improve future developments (Tookaloo and Smith, 2015). However, benchmarking facility performance via POE is problematic due to industry reservations that any value accrued is largely beneficial to industry competitors vis-à-vis the developer commissioning the evaluation (Olivia and Christopher, 2014). Zeisel (1981) states that the built environment design process should be cyclical, rather than being initiated and concluded in accord with the specific building's design and construction phases. This is further reinforced by Zimmerman and Martin (2001) who propose that POE forms a 'logical final step' to the cyclical process, providing a basis of 'lessons learned' which are fed forward into future developments. Similarly, Leaman and Bordass (2001) introduce the concept of 'virtuous circles of improvement' where POE is implemented as a benchmarking strategy throughout the design phase. This approach fosters a dynamic, continually evolving BOK to engender continuous improvement throughout the design and construction phases as opposed to final feedback at the handover (c.f. Leaman and Bordass, 2001, p.151). However, despite a variety of POE benchmarking strategies, Green and Moss (1998) suggest that organisations must implement knowledge cycles based upon their facility's bespoke management requirements (Hadjri and Crozier, 2008).

4.5 BIBLIOMETRIC ANALYSIS

Bibliometric analysis has been developed and utilised across multiple disciplines due to its ability to visually represent a large body of literature (van Eck and Waltman, 2010). In contrast to manual analysis, bibliometric analytical software such as Gephi (Bastian *et al.*, 2009) or VOSviewer (van Eck and Waltman, 2010) avoids introducing researcher bias and removes time and resource limitations relating to the practical number of studies selected (He *et al.*, 2017). Visual representation of bibliometric data also allows an academic topic to be expediently and comprehensively investigated (Cobo *et al.*, 2011). VOSviewer constructs distance-orientated network maps where each node/cluster represents the occurrence of a term or author, dependent upon the map generated. Nodes/clusters can also be assigned different colours within a visualisation, differentiating them from other nodes/clusters. VOSviewer's clustering function represents an advancement on previous mapping techniques, allowing deeper observations of connectedness than were previously possible using alternative software such as Statistical Package

for the Social Sciences (SPSS) and Pajek (c.f. van Eck and Waltman, 2010). The distance between nodes/clusters gives a better indication of the strength of relationship between these items when compared to graph-based maps (Waltman *et al.*, 2010). The analysis of direct citations can also pinpoint the most influential studies within a specific field under investigation.

To produce citation visualisations for POE, the minimum number of papers published by an academic was arbitrarily set at two and the minimum number of citations was also set at two. These minimum values were selected to reflect the POE BOK which in comparison to alternative areas of built environment research, returns a relatively small sample size of applicable published research. For example, a Web of Science search on the term ‘Building Information Modelling’ returns 51,937 results (May, 2018) compared with 516 results for the term ‘Post-occupancy Evaluation’ (May, 2018) – hence, POE represents a mere 0.98% of the available BIM BOK. Three varieties of visualisation were produced: i) co-authorship visualisation; ii) term density visualisation; and iii) a term date visualisation for the whole POE BOK. To maintain a systematic approach, the same specifications and settings were applied throughout the analysis to ensure consistency and for each visualisation fractional counting was utilised. van Eck and Waltman (2014) recommend using fractional counting when producing visualisations. Both full counting and fractional counting utilise the number of documents co-authored by two authors when formulating connections, however fractional counting also takes into account the total number of authors of each of the co-authored documents (*ibid*).

When producing the term density visualisations, a number of specifications and filtering methods were applied. First, the minimum number of occurrences of a term for it to be considered significant was set at 12 following trial and error experimentation – too low a number and less significant terms could complicate the final visualisation but too high a number and significant terms would be omitted. Second, VOSviewer provides options to manually remove irrelevant terminology not pertaining to the visualisation; in this instance common research terms such as ‘introduction’ and ‘conclusion’ were removed because whilst important to research *per se*, they do not contribute to the theoretical lens of POE. The term date visualisation generated for this study utilised the same data and specifications used to analyse term density, but the ‘date overlay’ function within VOSviewer was applied as opposed to the ‘density overlay’. This was done to ascertain the chronological development of various components of a POE emanating from academic literature pertaining to the POE BOK. The final stage of analysis examined the interconnectedness of publications discussing ‘Post-occupancy Evaluation’, ‘Process’ and

‘Benchmarking’. This focused search returned only seven research papers. Each paper was manually examined to ascertain: i) date of publication; ii) publishing journal; iii) total number of citations per research item; iv) average number of citations; and v) the total number citations combined. These metrics offered insight into the interconnections between research into this specific topic within the larger POE BOK and the chronological development of POE, process and benchmarking research.

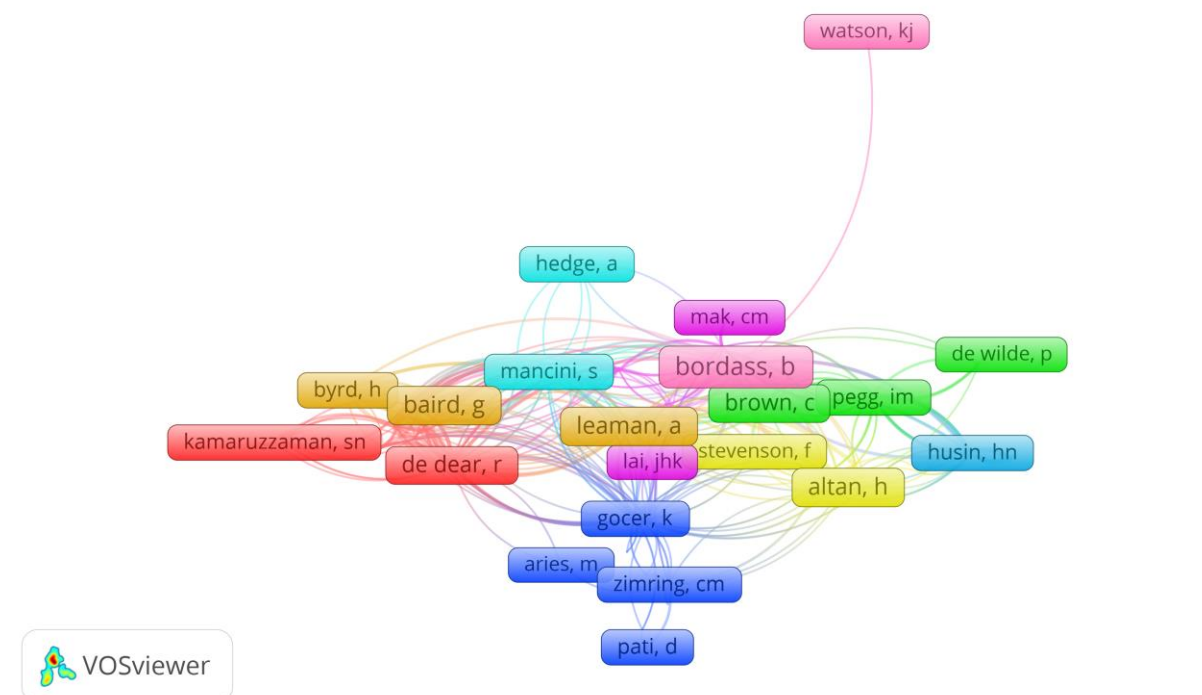
4.6 FINDINGS

The research findings for the bibliometric analysis are reported upon within the three iterative and thematic groups analysed in the visualisations, namely: POE literature; POE literature with a focus upon process; and qualitative analysis of literature pertaining to POE, POE process and facility benchmarking.

4.6.1 POE Literature

Figure 11 depicts a citation visualisation for the POE BOK indicating the strength of connections between authors who have published POE research. Of the 1,122 individual authors who have cumulatively published 516 papers, only 119 authors remained once the filtering specifications were applied (i.e. two papers and two citations). Although VOSviewer’s program functionality permits selection of authors who are linked through co-authorship (thus removing the nodes which share no direct link), for this visualisation unconnected nodes were included to expose the 39 authors working in isolation, with no co-authorship links with any other researchers within the POE BOK. The unconnected authors displayed can be observed as being equidistant from the central linked cluster, or as having a weak relationship with the centrally located connected academic material. Figure 11 reveals eight distinct clusters where co-authorship between authors is indicated by representation of the same colour. The notably small distances separating independent clusters indicates strong connectedness in terms of citations between each cluster and its corresponding author(s). This indicates that the community of researchers working on POE represented in the central cluster are closely linked. Prominent authors noted include: Bordass and Leaman (2005) who reviewed a portfolio of POE feedback techniques; Baird (2010) who examined the relationship between POE and post occupancy review of buildings and their engineering (PROBE); and Husin *et al.*, (2012) who attempted to link POE to safety for low cost housing in Malaysia.

Figure 11 - A Bibliometric Citation Visualisation of Researchers Contributing to the POE BOK



Clusters: from left to right

Red	Watson, K.J	Loftness, V.	Green
Salleh, N.M.	Cyan	Aziz, A.	Brown, C.
Kamaruzzaman, S.N	Vietch, J.A.	Lai, J.H.K	Gorgolewski, M.
Zawawi, E.M.A.	Mancini, S.	Sanni-Anibire, M.O	Wheeler, A.
Zagreus, L.	Soebarto, V.	Hassanain, M.A.	Pegg, I.M.
Arens, E.	Dorsey, J.A.	Hwang, T.	Allan, N.
Zhang, H.	Hedge, A.	Kim, J.T.	Sodegar, B.
Candido, C.	Birt, B.J.	Mak, C.M.	Goodhew, S.
Schiavon, S.	Blue	Xue, P.	de Wilde, P.
Thomas, L.E	Aries, M.	Yellow	Jones, R.V.
Williams, M.	Shepley, M.M.	Stevenson, F.	Turquoise
Kim, J.	Göçer, K.	Raslan, R.	Nawawi, A.H
de Dear, R.	Preiser, W.F.E.	Altamirano-Medina, H.	Ismail, F.
Beige	Newton, C.	Guptar, R.	Husin, H.N.
Lenoir, A.	Pati, D.	Chandiwalla, S.	Khalil, N.
Garde, F.	Kantrowitz, M.	Nicol, F.	Labaki, L.C.
Rasheed, E.O.	Hua, Y.	Altan, H.	Kowaltowski, D.C.C.K.
Byrd, H.	Zimring, C.M.	Patlakis, P.	Pina, S.A.M.G.
Baird, G.	Yaldiz, E.	Santacruz, H.B.	Ruschel, R.C.
Leaman, A.	Purple	Oreszczyn, T.	
Bordass, B.	Choi, J.H.	Mumovic, D	

Figure 12 presents a density visualisation of key terms and phrases emanating from the POE BOK. The overlay colour(s) presented on the visualisation are predicated by the number of items which

appear within *the neighbourhood* – where the latter refers to the items populating a point/area within a visualisation which share common properties. The higher the density of items within the neighbourhood, the warmer the colour produced, where blue represents no connection and red represents the strongest connection (van Eck and Waltman, 2014). Two distinct density clusters can immediately be observed, with a further seven sub-clusters present within each. The first density cluster, located to the left hand side of the visualisation, has the term ‘process’ at its centre. Moving out from this centre point are the terms: framework; design process; interview; occupancy; nature; effectiveness; architecture; staff; facility; student; school; and university. The visualisation suggests that all of these terms share a strong relationship which centres upon the fulcrum of the process of conducting a POE - hence, this cluster can be conveniently assigned the nomenclature ‘*POE process implementation*’. This cluster supports the earlier work of Göçer *et al.*, (2015) who sought to develop a collaborative effort of continuous building performance improvement by using the results of POE implementation embedded into BIM. The second density cluster has no defined centre but rather consists of four sub-clusters: system; occupant; comfort; and satisfaction. The fulcrum of these sub-clusters orientates around occupant/ building user feedback and consequently the cluster is assigned the nomenclature ‘*POE building user feedback*’. This cluster supports Preiser’s (1995) ground breaking work that sought highlight the importance of POE to facility managers in terms providing a tool with which to systematically identify and evaluate critical aspects of building performance.

Figure 12 - A Density Visualisation of Key Terms and Phrases within the POE BOK

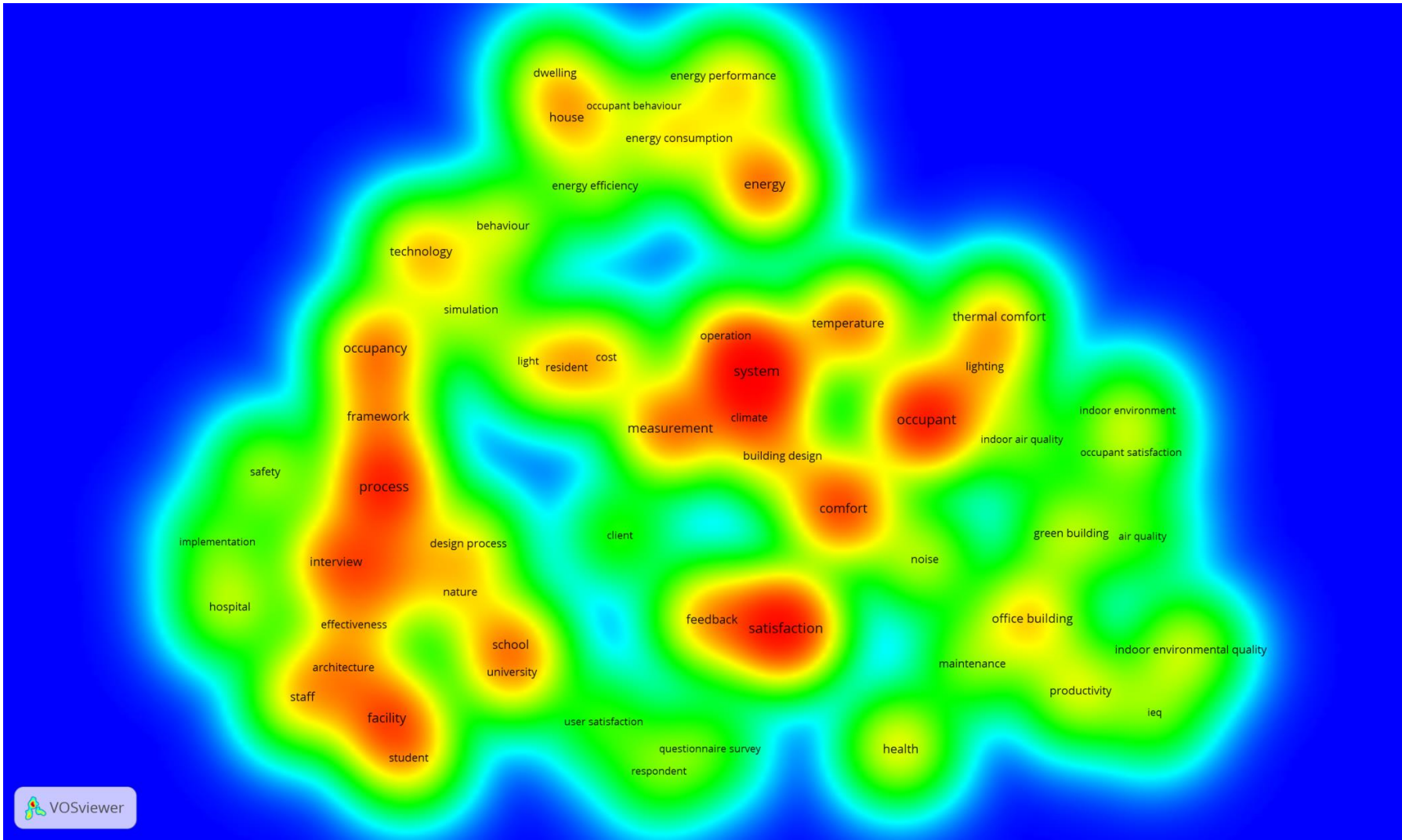
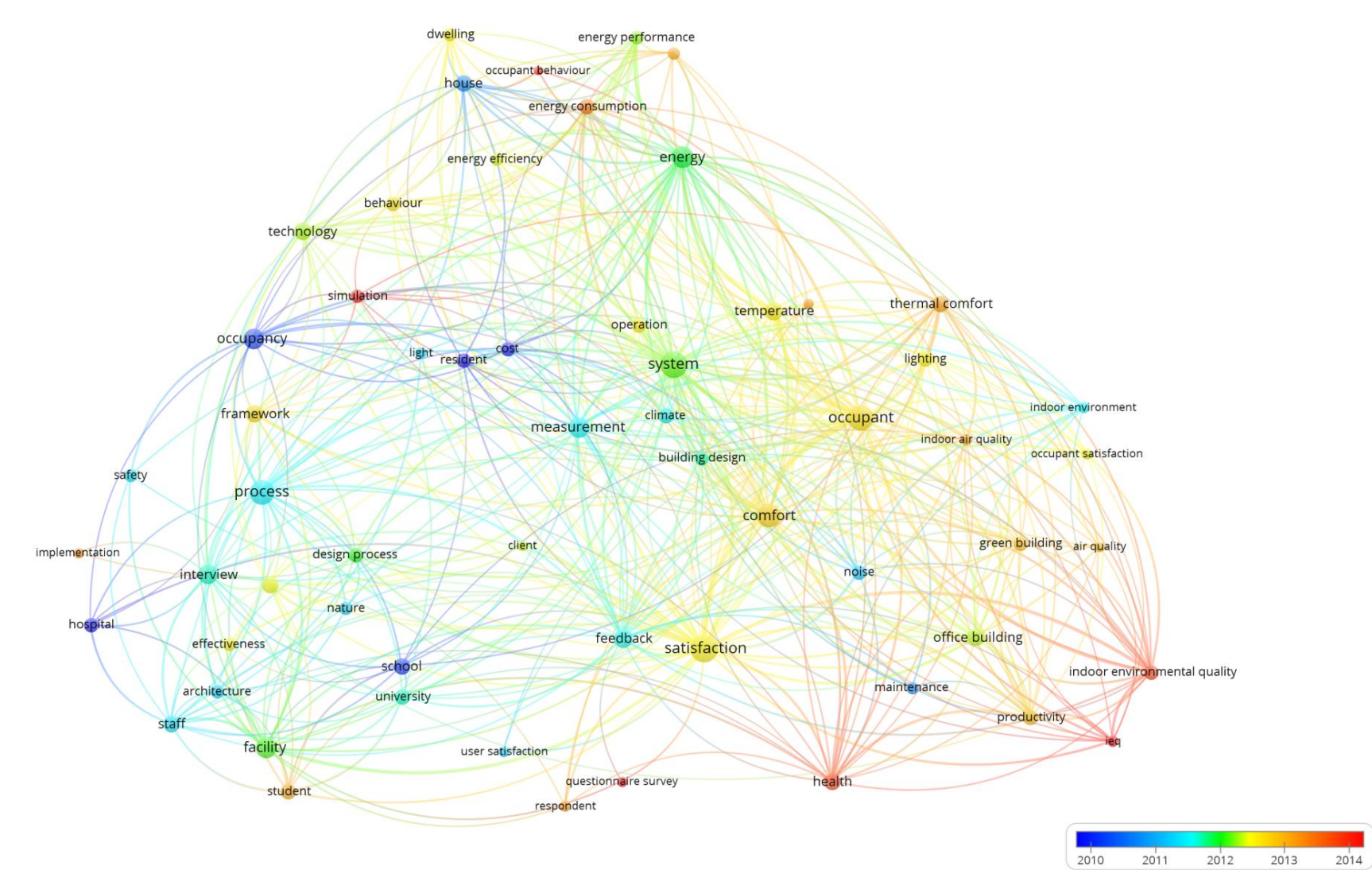


Figure 13 represents the previous density visualisation with the citation date overlay applied to illustrate when specific topics under the larger POE umbrella received specific academic attention (c.f. van Eck and Waltman, 2010). The figure illustrates that ‘occupancy’ (particularly regarding hospitals, schools, universities and residential property) was at the forefront of academic attention from 2010 to 2012, whilst between 2011 and 2012 the focus was upon: ‘processes’, ‘measurement’, ‘feedback’ and ‘climate’. Between 2012 and 2013, ‘systems’, ‘energy’, and ‘satisfaction’ (comfort, lighting and temperature) received prominent academic attention. During 2014 ‘indoor environmental quality’, ‘health’ and ‘occupant behaviour’ received the most academic attention whilst ‘simulation’ appears from 2014 onwards. The body of research on POE for passive buildings revealed problems with indoor air quality and comfort due to ‘building tightness’; where the latter refers to virtually hermetically sealed buildings and environmental efficient building - this research could explain the higher number of citations concerning health and indoor air quality as reported in Figure 13.

Figure 13 - A Density Visualisation of the POE BOK with the Citation Date Overlay

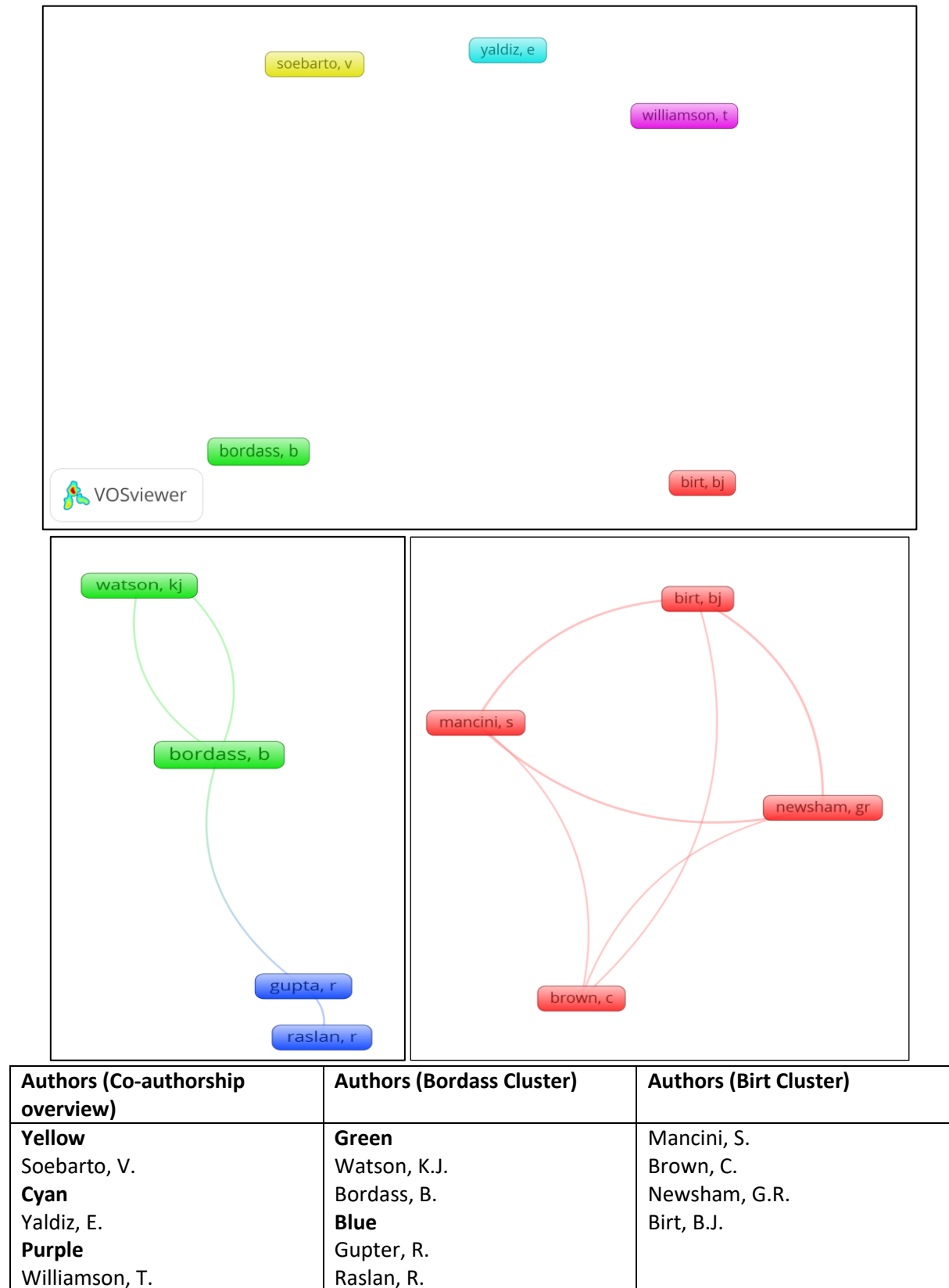


A breakdown of the POE BOK organised by journal publication was also analysed. The journals most frequently publishing POE were: Building Research and Information (frequency (f) = 42); Building and Environment (f = 35); and Energy and Buildings (f = 23). Within the remaining journals publishing POE, publication frequency fell from Journal of Architecture and Planning Research (f = 19) down to multiple journals publishing four items or less.

4.6.2 Process Focus within POE Literature

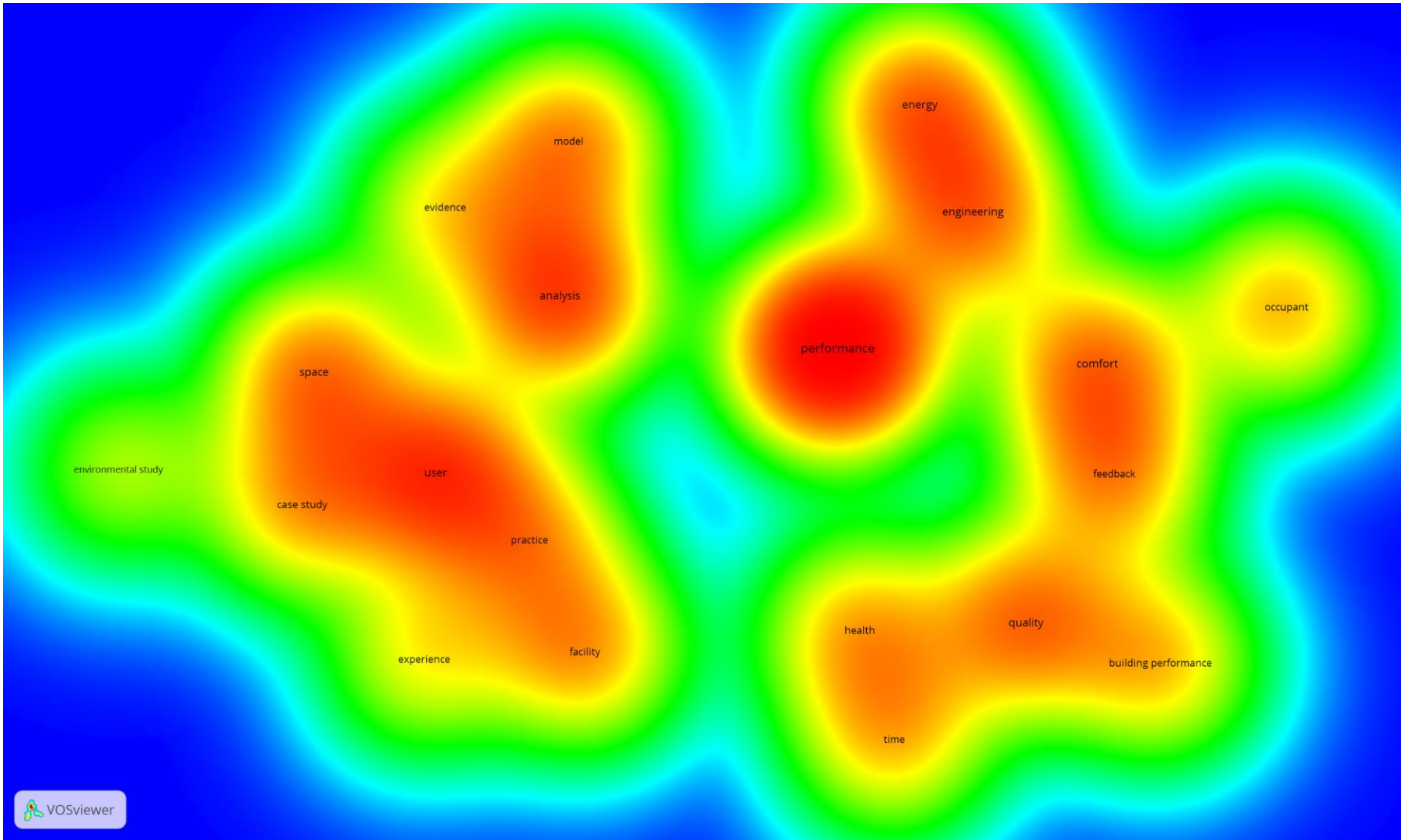
Figure 14 depicts a co-authorship visualisation of 'POE' and 'process' literature. Of the 292 authors who published 111 research items, only 12 remain after applying filtering specifications. Nodes which share no connections with any other items within the visualisation are again included to offer an insight into the overall connectedness of literature. Of the 12 authors who met the threshold, only five are connected through co-authorship. The observable significant spacing between each node and differing cluster colour indicates that said authors listed in this visualisation are not linked by co-authorship and work in relative isolation. Of the 292 authors who have published research on the topic of 'POE' and 'process', only five (1.71%) were linked through co-authorship. This lack of interconnections could possibly explain why standardised POE implementation strategies in practice remain elusive. Interestingly, the total number of citations pertaining to POE and process have grown exponentially since 2010 - indeed, as of May 2018, the number of citations has already surpassed the total annual citations recorded in 2013. Hence, although interest in the area remains relatively small, research undertaken is rapidly increasing in volume.

Figure 14 - A bibliographic Visualisation of Researchers Contributing to POE and Process Literature



A term density map of 'POE' and 'process' bibliometric data is presented in Figure 15. There is a notably significantly smaller set of terms arising from this visualisation with four distinct clusters being identified, namely: analysis; user; performance; and quality. These clusters offer an insight into the research currently being undertaken regarding POE and processes and represent the four key areas of research within this niche. The Web of Science bibliometric data regarding 'POE' and 'process' was also organised to indicate the top 25 academic journals under which the research has been published. Journals with the highest frequency of publication were: Building Research and Information ($f = 16$); and Herd Health Environments Research Design Journal ($f = 10$). Within the remaining journals, publication frequency fell from that of Energy and Buildings ($f = 4$) to multiple conferences with one publication each.

Figure 15 - A Term Density Map of POE and Process Bibliometric Data

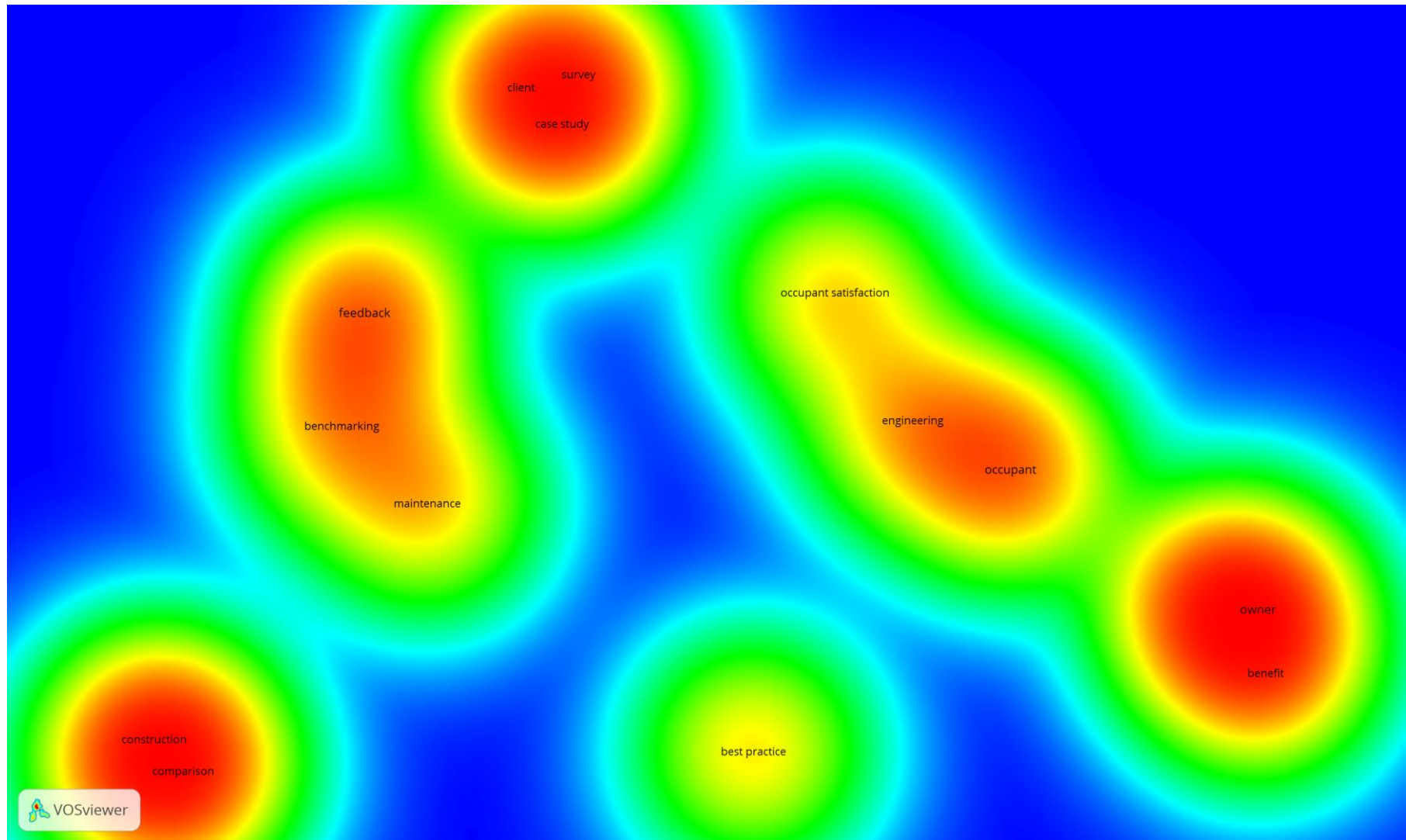


4.6.3 Analysis of Literature Pertaining to POE, POE Process and Facility Benchmarking

A synthesis of literature pertaining to the search terms ‘POE’, ‘process’ and ‘benchmark’ identified only seven research items, of which six have been cited since publication (c.f. Zagreus *et al.*, 2002 [88 citations]; Zimmerman and Martin, 2001 [77 citations]; Bordass and Leaman, 2005 [33 citations]; Curwell *et al.*, 1999 [14 citations]; Elijah-Barnwell and Friedow, 2014 [2 citations]; Gorgolewski *et al.*, 2016 [1 citation]; and Kujawski, 2013 [0 citations]). Of these six items, four papers published between 1999 and 2005 dominate the citation ranking, making up 98.60% of the total citations emanating from this group. The two later items (published 2014 and 2016) contributed three citations between them.

Figure 16 shows a density visualisation map of key term occurrences using the search results for ‘POE’, ‘process’ and ‘benchmark’ terms. As before, the number of occurrences required for a term to be considered significant was set at 12. Five distinct clusters can be observed: i) construction and comparison; ii) benchmarking, maintenance and feedback; iii) client, survey and case study; iv) engineering, occupant satisfaction and occupant; and v) owner and benefit. Of these five clusters, three exhibit a stronger concentration, namely cluster i, cluster iii and cluster v. A sixth cluster regarding ‘best practice’ can be observed within the visualisation located equidistant from the other five clusters, which suggests that the concept of best practice is crucial as it arises in all of the other clusters. Bibliographic search results for this stage of the analysis were broken down to examine pertinent journals publishing on this topic. These journals were: i) Building Research and Information ($f = 3$); ii) Herd Health and Environment Research Design Journal ($f = 1$); iii) Indoor Air ($f = 1$); iv) Journal of Green Building ($f = 1$); and v) Sustainable Building and Refurbishment for Next Generations ($f = 1$).

Figure 16 - A Term Density Map for POE, Process and Benchmark



4.7 DISCUSSION

The analysis presented highlights that a small number of POE researchers are working in relative isolation; this finding generates new theory that suggests that a prevailing lack of a cohesive ‘community of practice’ (CoP) in this important area should be resolved by the creation of a cross industry-academic body to promote, regulate and govern POE implementation. Interestingly, ‘POE process implementation’ and ‘POE building user feedback’ were identified as significant clusters of academic enquiry to underscore their importance in terms of ensuring a consistent POE approach adopted and securing subjective feedback from building users. These conclusions have largely stemmed from studies conducted on HEIs vis-à-vis the wider built environment (c.f. Garbowski and Mathiassen 2013; García-Peñalvo and Conde 2013) – this is most likely because researchers have readily available access to buildings within their own host institution that support POE implementation. However, researchers have hitherto failed to influence built environment practitioners’ adoption of POE in practice (c.f. Bordass and Leaman, 2005; Alborz and Berardi, 2015). In addition to a CoP body being developed, a plethora of potential financial and non-financial incentives are apparent and gravitate around building benchmarking. For example, environmental based legislative instruments could be used to set a minimum level of building performance to be expected to support existing rating schemes such as Leadership in Energy and Environmental Design (LEED) (cf. Ofori-Boadu *et al.*, 2012; Martek *et al.*, 2019). At present, such schemes are supported by government for government buildings but are not mandatory for non-government buildings (Ofori-Boadu *et al.*, 2012). Alternatively, building performance could be used to set the level of financial revenue streams accrued from building users, i.e. higher performing buildings recover higher rental rates or purchase values. Incentives could also present an opportunity to remove overriding fears of practitioners regarding the value within POE implementation and how competitors could benefit from such (c.f. Preiser and Vischer, 2005; Olivia and Christopher, 2014).

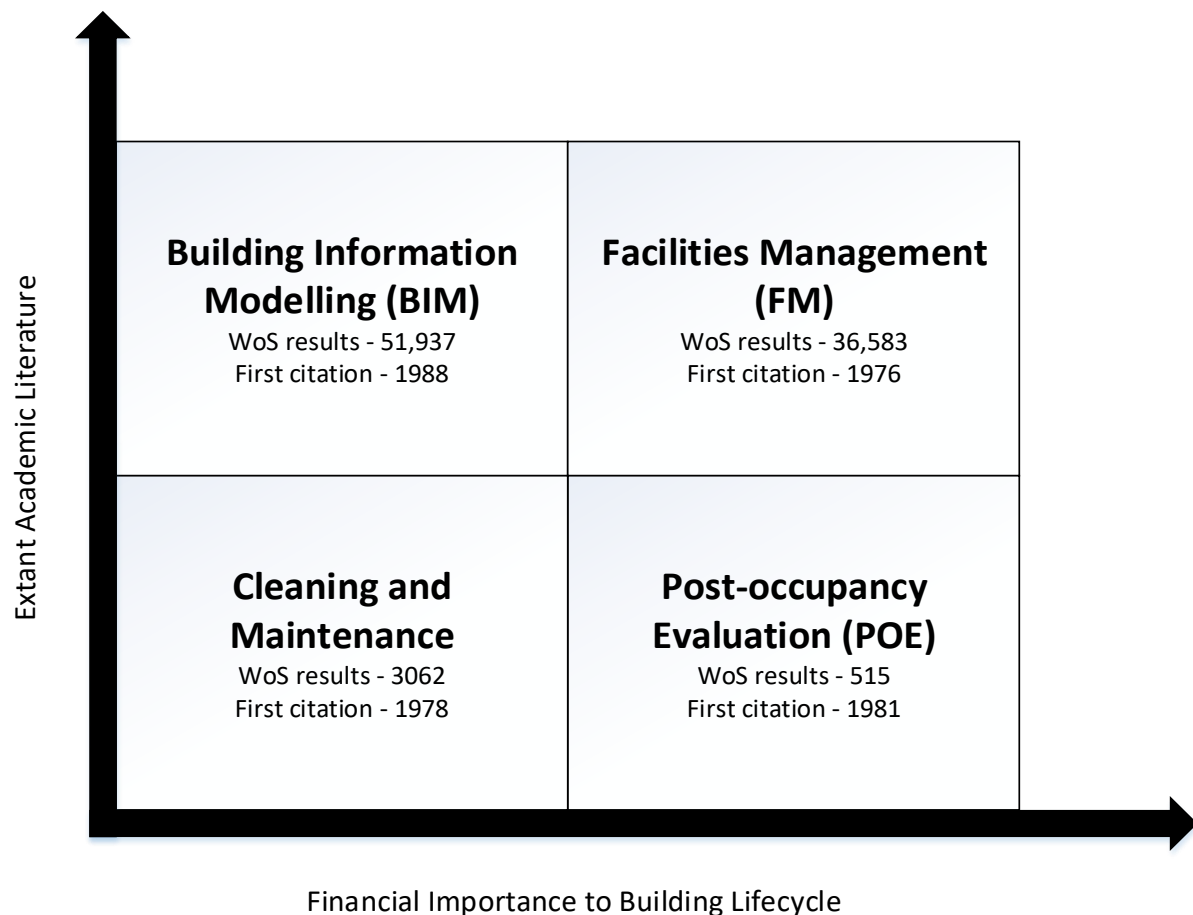
Ultimately market forces are required to create demand for POE’s and that may require further education and marketing to the general public (Martek *et al.*, 2019) – perhaps under the guises of finance savings, environmental performance and user comfort. Whatever the solution to the POE uptake problem domain, it is apparent that a notable lack of a CoP within academia and practice has hitherto failed to embed POE as an integral part of a building’s life cycle. Moreover, other initiatives (e.g. BIM, digitizing the built environment, industry 4.0 or environmental legislation)

are conspicuous by their absence in literature reviewed – yet, POE arguably represents the best means of measuring the success of these initiatives within the built environment.

4.7.1 Theory Development

Using knowledge accrued from this research, Figure 17 was constructed depicting a theoretical 2 x 2 matrix for digitalising the built environment which incorporates similarly aligned fields of built environment research. The x-axis represents the financial importance of a particular established field of study to a development's life cycle. The y-axis indicates the frequency of academic literature produced on particular areas of built environment research. Cleaning and maintenance ($f = 3,062$ with the first citation in 1978), whilst critical to the operation of a built asset, has largely been amalgamated into the larger Facilities Management (FM) field of research ($f = 36,583$ with the first citation in 1976). BIM ($f = 51,937$ with the first citation in 1988) has a limited impact upon the operational phase of built assets' life cycles at present, although the emergent fields of 'BIM in FM' and 'Digital Asset Management' ($f = 613$ with the first citation in 1992 and $f = 527$ research items with first citation in 2000 respectively) indicate significant research efforts to amend this. POE ($f = 515$ with the first citation in 1981) can be adjudged to have had a far greater impact upon the financial performance of a development's life cycle, yet has received substantially less academic attention. Future work is however required to empirically test this emergent theory.

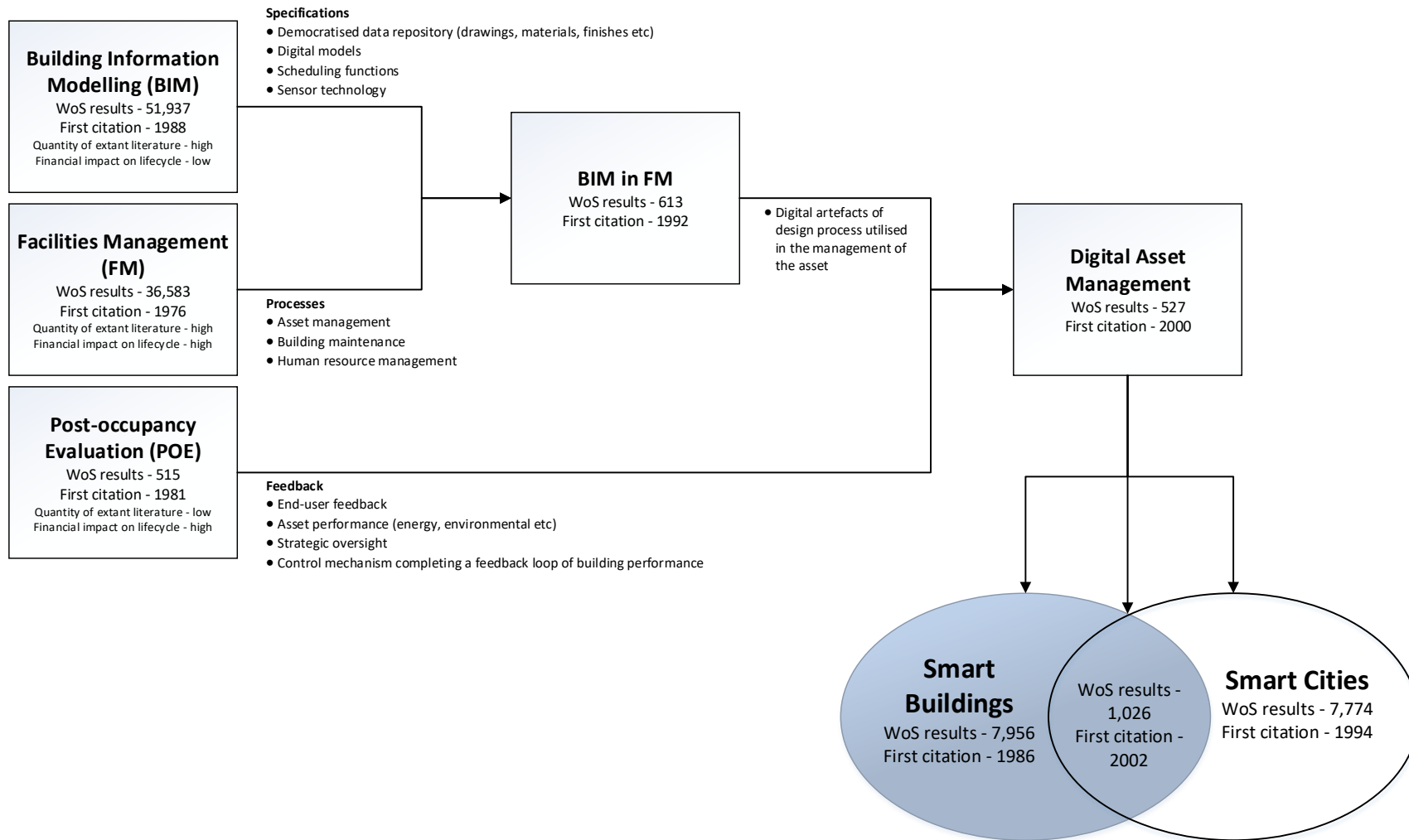
Figure 17 - A Theoretical Matrix for Digitalising the Built Environment



Disruptive technologies such as BIM drive innovation and offer digital solutions for well documented and persistent issues within the built environment (c.f. Eastman *et al.*, 2011; Motamedi *et al.*, 2011; Race, 2013; Kensek, 2014a; Kensek, 2014b; Thomson and Boehm, 2015 Chan *et al.*, 2016). However, whilst increasing the application of disruptive innovations generates voluminous data/information on buildings *per se*, such does not automatically translate into knowledge or wisdom. If practitioners were to utilise POE to evaluate user feedback and learn from the building's functionality and performance during its in-use phase, then the design feedback loop originally envisaged by Pärn *et al.* (2017) could readily be realised. At present, POE has largely utilised manual paper-based feedback mechanisms and has been perceived to create problems, including: i) inadequate funding to conduct a POE (Vischer, 2001; Zimmerman and Martin, 2001; Riley *et al.*, 2010); ii) lack of clarity on who is responsible for the evaluation (Bordass and Leaman, 2005; Riley *et al.*, 2010); and iii) the mitigation of liability of the project stakeholders regarding any issues highlighted by the POE (Zimmerman and Martin, 2001; Jauzens *et al.*, 2003; Khosrowshahi and Arayici, 2012; Jiao *et al.*, 2013). Consequently, the literature

(augmented by anecdotal evidence from industry) suggests that POE is either not used or that the data generated is not exploited to its fully inherent capacity. There appears to be an ominous disconnect between building users and designers and perhaps a ‘building handover’ is symbolic of designer abdication of performance liability? Building upon these theoretical ideas, Figure 18 presents a triumvirate of BIM, FM and POE. The figure illustrates that the integration of BIM in FM has many palpable benefits that could be realised via a POE feedback mechanism (cf. Pärn *et al.*, 2017). The application of this ‘missing link’ within the digital development process could contribute to accelerating the development of smart buildings and cities. Again, future work is required to test this theory and measure the impact that POE could have upon expediting smart buildings and cities development.

Figure 18 - Future Trends in Smart Building/Smart City Development



4.8 CONCLUSIONS

Whilst related research published has focused on specific aspects of conducting a POE (i.e. human comfort or energy consumption), this research presented represents the first detailed ‘holistic examination’ of extant literature of POE. Findings highlight that a significant dearth of relevant research is apparent and moreover, that a CoP in this field of study is needed to widen practitioner participation and their consistent implementation of POE. This finding is somewhat enigmatic given that POE is fundamental to measuring the technical and functional performance of current buildings and improving the designs of future buildings developed. Moreover, consistency of POE implementation is essential particularly when comparing between buildings. Without reliable data and information, this research posits that important knowledge and wisdom required to enable smart building and smart city developments will be significantly hampered. Specifically, architects, designers and contractors should work with facilities management teams post building occupation to undertake POE’s (that measure building performance across all pertinent benchmarking criteria (energy consumption, lighting and heating control etc.)) to ensure that future designs perform as they were envisaged at conception. At present, prominent members of the design and construction team rarely contribute to the POE process and so the opportunity to learn from mistakes or develop improvements is largely lost. Such a recommendation may require changes in procurement processes to ensure that all project stakeholders involved throughout the building’s whole life cycle are involved in POE.

A number of practitioner barriers to POE implementation were also observed and reported upon but prominent issues related to: scarce POE funding; unclear lines of responsibility for conducting POE; and liability mitigation for any issues highlighted by the POE. These barriers perhaps explain why the subject area fails to attract research funding and wider research activity – as evidenced by the small pool of fragmented research being conducted in the field. To overcome these barriers, future work is required to expand the current research study and engender wider practitioner and academic debate. Such work may include: i) reporting upon case studies of POE implementation within wider industry (vis-à-vis higher education institutions) to report upon examples of practice and provide tangible evidence of benefits to be accrued. Such work could be used as the basis for changing attitudes towards POE and educate future generations of practitioners; ii) working with professional bodies and higher education institutions to ensure that pertinent under- and postgraduate awards (or continual professional development programmes) give sufficient

coverage on how to conduct a POE and the benefits that such yields for business and society. To change the prevailing culture within the AECO sector will require a cohesive effort to bridge the divide between academia and practice using factual evidence accrued from case studies; iii) developing a standardised approach to conducting a POE that would facilitate direct comparison between POE's conducted for various building developments - such work would enable the creation of a wider community of practice and knowledge bank that would feed into taught curricular and industry practice. Present variations between competing POE processes further exacerbate barriers reported upon and thus prevent wider POE implementation; and iv) empirically testing or refining the theories and interpretations emanating from this inductive research (for example, the theoretical matrix for digitalising the built environment). Deductive research is now required to either prove or disprove the work presented as a means of advancing research knowledge and practitioner attitudes.

CHAPTER 5

DELINEATION OF THE POE PROCESS

5.1 INTRODUCTION

The implementation of a POE on a newly developed facility offers a significant opportunity to benchmark facility performance and iteratively improve future developments utilising the findings of the evaluation (c.f. Wauters, 2005; Hassanain *et al.*, 2016; Göçer *et al.*, 2015; Candido *et al.*, 2016). However, the ability to benchmark evaluation findings requires common points of analysis and comparison within the POE process, subsequently ensuring common metrics for evaluation can be compared from one facility to another. Furthermore, utilising common elements of the evaluation to directly compare differing facilities facilitates iterative improvement of HEI facilities moving forward. As such, current POE processes are delineated in this chapter in efforts to better understand POE processes being implemented in practice at present, and specifically to identify the factor inhibiting the aforementioned common points of analysis facilitating ‘benchmarking’ and subsequent ‘iterative improvement’.

5.2 DELINEATION OF THE POE PROCESS IN A HEI

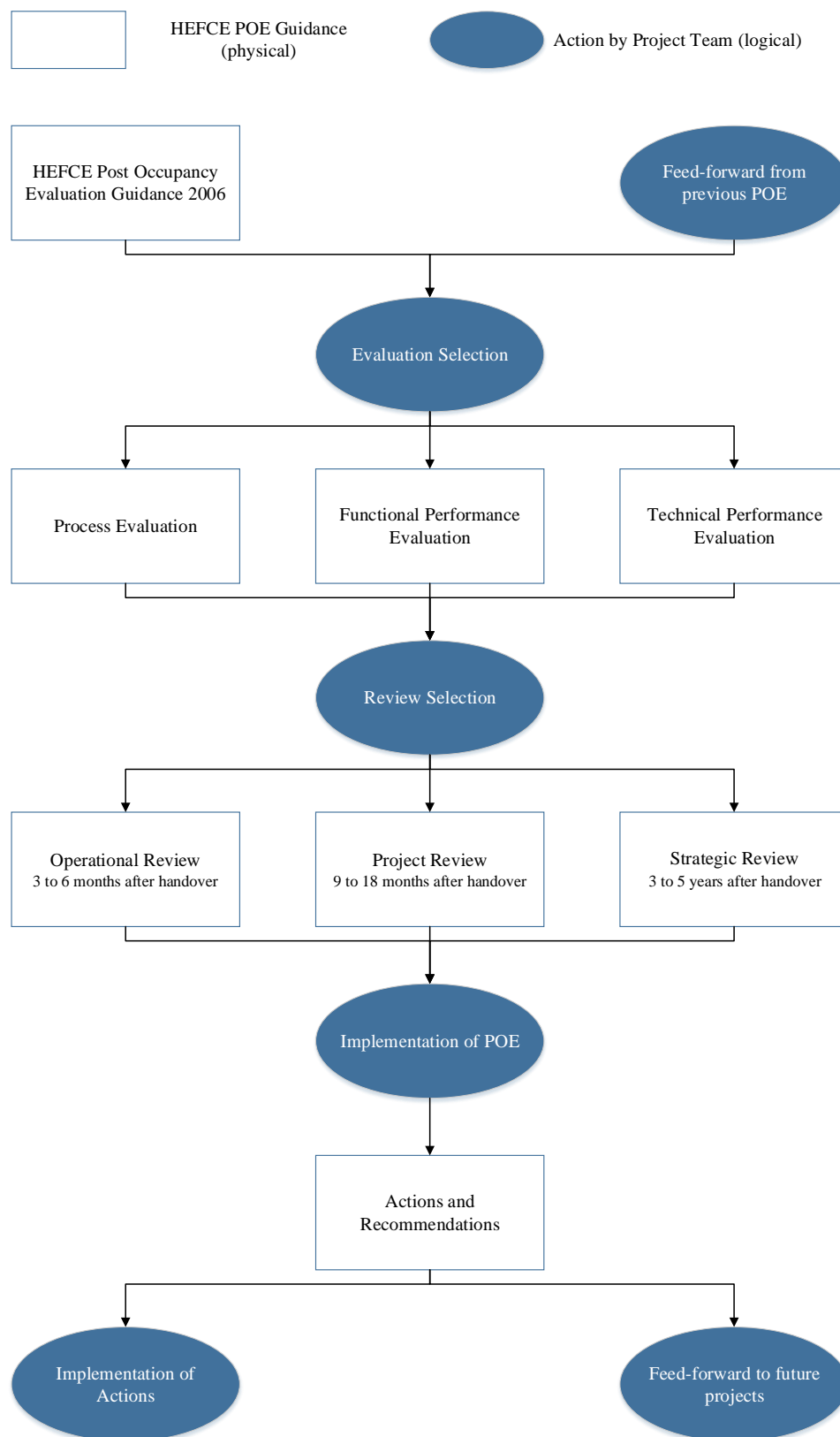
The first stage of the delineation process required the mapping POE process in terms of its essential stages, namely: i) evaluation selection; and ii) review selection (HEFCE, 2006). The evaluation selection denotes what aspect of the development is to be evaluated, these fall under three categories: i) process evaluation; ii) functional performance evaluation; and iii) technical performance evaluation (HEFCE, 2006). Likewise, the review selection also utilises three categories, namely: i) operational review; ii) project review; and iii) strategic review. Unlike the evaluation selection which focuses on what elements of the development are to be analysed, the review selection also offers guidance on when to schedule elements of the review.

Once these essential stages were identified, a data flow diagram was developed utilising the identified key stages as a basis for developing a delineated process map. Data flow diagrams allow the investigation of a circumstance from a physical and logical perspective which can then be combined in a diagrammatical form (Lejk and Deeks, 2002). For this research, provisions detailed in the HEFCE (2006) POE guidance represent the physical component (or framework of the POE), whereas the choices the case study participants (the project team) were

required to make regarding POE execution represent the logical component (the choices within the framework) (c.f. Lijks and Deeks, 2002). Utilising a delineated process map in the form of a data flow diagram allows for direct comparison of the procedures and processes undertaken in each report, allowing the identification of inconsistencies in process between the four facilities under investigation.

Figure 19 shows the delineated POE process data flow diagram based upon: the HEFCE's Guide to Post Occupancy Evaluation (2006); and ii) the completed POE reports pertaining to BCU educational facilities. The initial starting point is represented by two nodes: the first representing the provisions set out in the guidance documentation and represents a physical component. The second, representing a logical component, represents feed-forward of findings (lessons learned) from previously undertaken POE reports (c.f. Zimmerman and Martin 2001; Ponterosso *et al.*, 2018). The HEFCE guidance offers a complete toolkit from which practitioners can select templates pertaining to differing strategies and techniques listed within the guidance. Therefore this documentation represents a key starting point for practitioners intending to undertake a POE in the context of a Higher Education Institution.

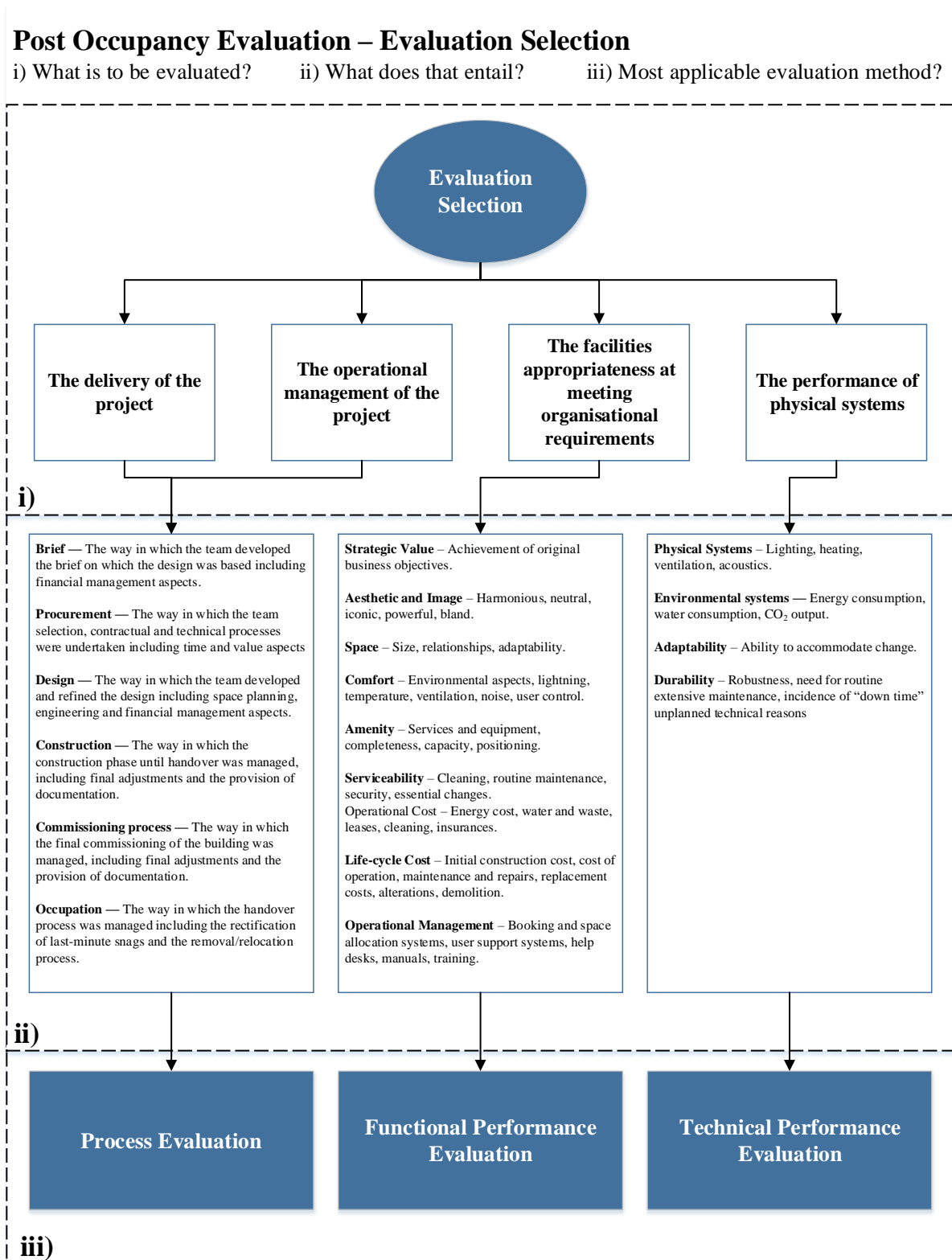
Figure 19 - Delineated POE Process for HEI's



The next node is a logical component, representing the essential stage ‘evaluation selection’. Originating from this node, three options (physical components) may be selected: i) ‘process

evaluation'; ii) 'functional performance evaluation'; and iii) 'technical performance evaluation'. Despite there being three selectable options at the evaluation selection stage, four avenues of investigation are listed within the HEFCE guidance: i) 'the delivery of the project'; ii) 'the operational management of the project'; iii) 'the facilities appropriateness at meeting organisational requirements'; and iv) 'the performance of physical systems' (HEFCE, 2006). Of these four avenues for evaluation, the first two: i) 'the delivery of the project'; and ii) the 'operational management of the project'; both focus upon the same evaluation metrics. These metrics are as follows: i) the 'brief'; ii) 'procurement'; iii) 'design'; iv) 'construction'; v) the 'commissioning process'; and vi) 'occupation'. Selection of either of these two avenues for investigation will lead the practitioner to selecting a 'process evaluation'. The third avenue of investigation, 'the facilities appropriateness at meeting organisational requirements' utilises different metrics to the first two, namely: i) 'strategic value'; ii) 'aesthetic value'; iii) 'space'; iv) 'comfort'; v) 'amenity'; vi) 'serviceability'; vii) 'life-cycle cost'; and viii) 'operational management'. Selection of this avenue of investigation will lead the practitioner to select a 'functional performance evaluation'. The final avenue of investigation available to practitioners focuses upon 'the performance of physical systems', and utilises: i) 'physical systems'; ii) 'environmental systems'; iii) 'adaptability'; and iv) 'durability'; as its metrics for evaluation, and leads the practitioner to selecting the 'technical performance evaluation' (c.f. Figure 20).

Figure 20 - Evaluation Selection Rationale



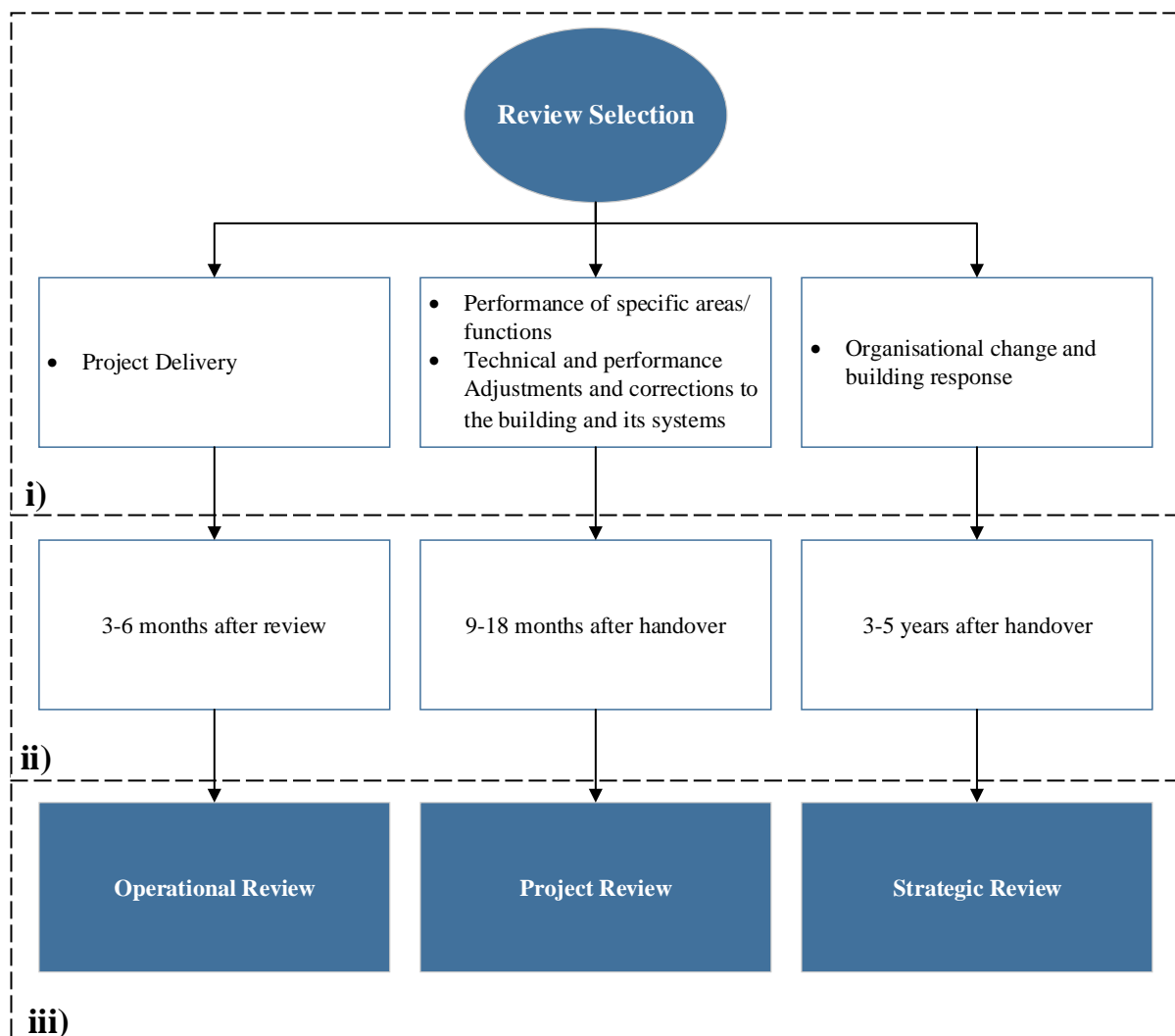
The second essential stage, ‘review selection’, is represented in the next series of nodes (c.f. Figure 21). Similarly to the ‘evaluation selection’, practitioner are required to selecting from three options, namely: i) ‘operational review’; ii) ‘project review’; and iii) ‘strategic review’.

The ‘review selection’ introduces timescales for the implementation of differing elements of the evaluation: i) ‘operational review’ is advised at three to six months after handover; ii) ‘project review’ is advised at nine to eighteen months after handover; and iii) ‘strategic review’ is advised three to five years after handover. The ‘review selection’, similar to the ‘evaluation selection’, also offers metrics on which the facility is to be reviewed (c.f. Figure 19). The ‘operational review’ focuses on the ‘delivery of the project’. The ‘project review’ focuses upon: i) ‘performance of specific areas/functions’; ii) ‘technical and functional performance’; iii) ‘adjustments and corrections to the building and its systems’; and iv) the operational cost. Finally, the ‘strategic review’ focuses on organisational change and building response.

Figure 21 - Review Selection Rationale

Post Occupancy Evaluation – Review Selection

i) What is to be reviewed? ii) Applicable timescale iii) Most applicable review method?

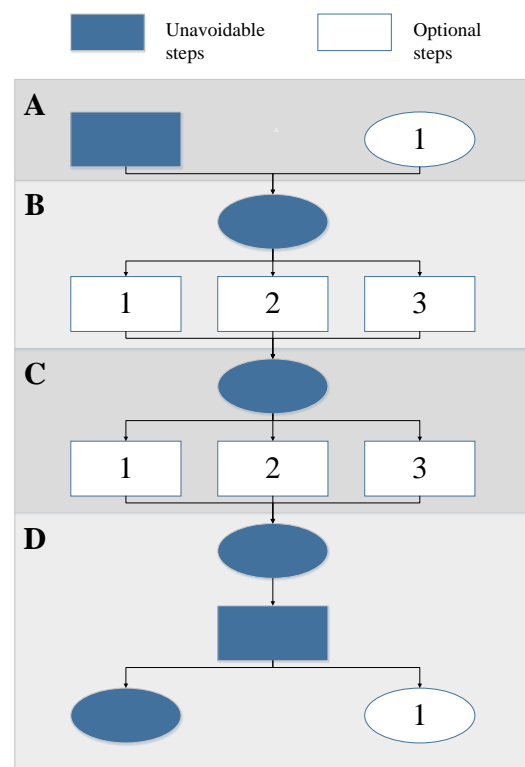


The final phase of the POE process pertains to implementing the POE (logical component) as planned through the previous stages. The following node after this point (a physical component) details the actions and recommendations subsequent to the evaluation. Following this node, two (logical) nodes are present: i) ‘implementation of actions and recommendations’; and ii) ‘feed-forward (of findings/lessons learned) to future projects’. These two nodes are central to the POE process as they influence the operation of the facility in question, as well as, when implemented, can influence future developments.

5.2.1 Process Permutations

Utilising a comparative analysis, in conjunction with the delineated process maps, the number of permutations possible for each process map can be established. Figure 22 highlights the four key decision making points (A-D), at each of these points the practitioner is required to select, or omit a particular component of the HEFCE outlined POE process. For instance, the decision to be made at the point marked ‘A’, requires the practitioner to either utilise feed-forward emanating from previously undertaken POE’s, or to omit them. Within each decision point A-D can be found the options available for selection by practitioners, numerically labelled based upon the number of choices available.

Figure 22 - The Delineated Process Map Indicating Key Decision Points



When planning a POE, each level of POE component selection can have a different number of selectable options. At point 'A', the practitioner has two options to choose from as detailed above. At point 'B', the 'evaluation selection', the practitioner has three options to choose from. Similarly, at point 'C', the 'review selection', the practitioner again has three options to choose from. At point 'D', two selections are available to practitioners, one representing implementation of actions resultant of the POE, and the other regards feed-forward of 'lessons learned' to future developments.

In order to calculate the number of possible permutations emanating from this process map, the following formula was utilised (r = number of decisions; n = total number variables)

$$\textit{The total number of permutations} = n^r$$

Using this formula, 36 different permutations were found to be possible for practitioners to select. Despite benchmarking (c.f. Wauters, 2005; Hassanain *et al.*, 2016) and iterative improvement (c.f. Göçer *et al.*, 2015) being prominent objectives emanating from academic literature pertaining to POE, a process offering so many options and potential outcomes may preclude the ability to regularly compare, contrast and learn from previous development's POE reports.

5.3 PUBLICALLY AVAILABLE HEI POE REPORTS

A major finding of the PROBE case studies (1995-2002) (c.f. Bordass *et al.*, 2001; Cohen *et al.*, 2001; Bordass and Leaman, 2007) regarded the requirement for POE findings to be published and made public, engendering benefits for the wider AECO sector in terms of readily available building performance and benchmark data (c.f. Cohen *et al.*, 2001). Bordass *et al.*, (2001, p.154) states that 'few architectural or engineering design practices consistently collect information on whether or not their buildings work, and none make the information available in the public domain.' Focusing on Higher Education (HE) POE reports, eighteen reports (detailing the evaluations of twenty one HE facilities) have been made publically available online since the conclusion of the PROBE case studies, these have originated from two institutions: i) the University of Nottingham; and ii) the University of Sheffield. Of these eighteen published reports, seventeen originate from the University of Nottingham, of which one report contains details on three separate facilities (N5a, N5b and N5c), and one report pertaining to the University of Sheffield.

Table 10 gives an overview of the publically available POE reports pertaining to the UK HE sector with regard to: i) the institution which commissioned the evaluation; ii) the facility which was subject of the POE; and iii) the consultants whom facilitated the POE in each instance. Notably, although both HEIs utilised external consultants for the planning and implementation of their POE's, the University of Sheffield differed from the University of Nottingham, having prepared the final POE report internally as opposed to the consultant preparing the report.

Table 10 - An Overview of Publically Available POE Reports from the UK HE Sector

Publically Available HEI POE Reports			
No.	Institution	Facility	Consultant
S1	University of Sheffield	Sheffield International College	✓ *BRE
N1	University of Nottingham	Centre for Biomolecular Sciences	✓ QTC Projects
N2	University of Nottingham	School of Veterinary Medicine and Science	✓ QTC Projects
N3	University of Nottingham	Jubilee Campus Sports Centre	✓ QTC Projects
N4	University of Nottingham	Sutton Bonington Sports Centre	✓ QTC Projects
N5a	University of Nottingham	Amenities Building	✓ QTC Projects
N5b	University of Nottingham	International House	✓ QTC Projects
N5c	University of Nottingham	Sir Colin Campbell Building	✓ QTC Projects
N6	University of Nottingham	Nottingham Geospatial Building	✓ QTC Projects
N7	University of Nottingham	Vaughan Parry Williams Pavilion	✓ QTC Projects
N8	University of Nottingham	Humanities Building	✓ QTC Projects
N9	University of Nottingham	Engineering and Science Learning Centre	✓ QTC Projects
N10	University of Nottingham	Bioenergy and Brewing Science Building	✓ QTC Projects
N11	University of Nottingham	Gateway Building	✓ QTC Projects
N12	University of Nottingham	Highfield House	✓ QTC Projects
N13	University of Nottingham	Si Yuan Centre of Contemporary Chinese Studies	✓ QTC Projects
N14	University of Nottingham	Institute of Mental Health Building	✓ QTC Projects
N15	University of Nottingham	Energy Technologies Building	✓ QTC Projects
N16	University of Nottingham	Aerospace Technology Centre	✓ QTC Projects
N17	University of Nottingham	Orchard Hotel	✓ QTC Projects
N18	University of Nottingham	Romax Technology Centre	✓ QTC Projects
*POE report prepared by the HEI, not the consultant			

Figure 23 - The Delineated Processes for Publically Available HEI POE Reports

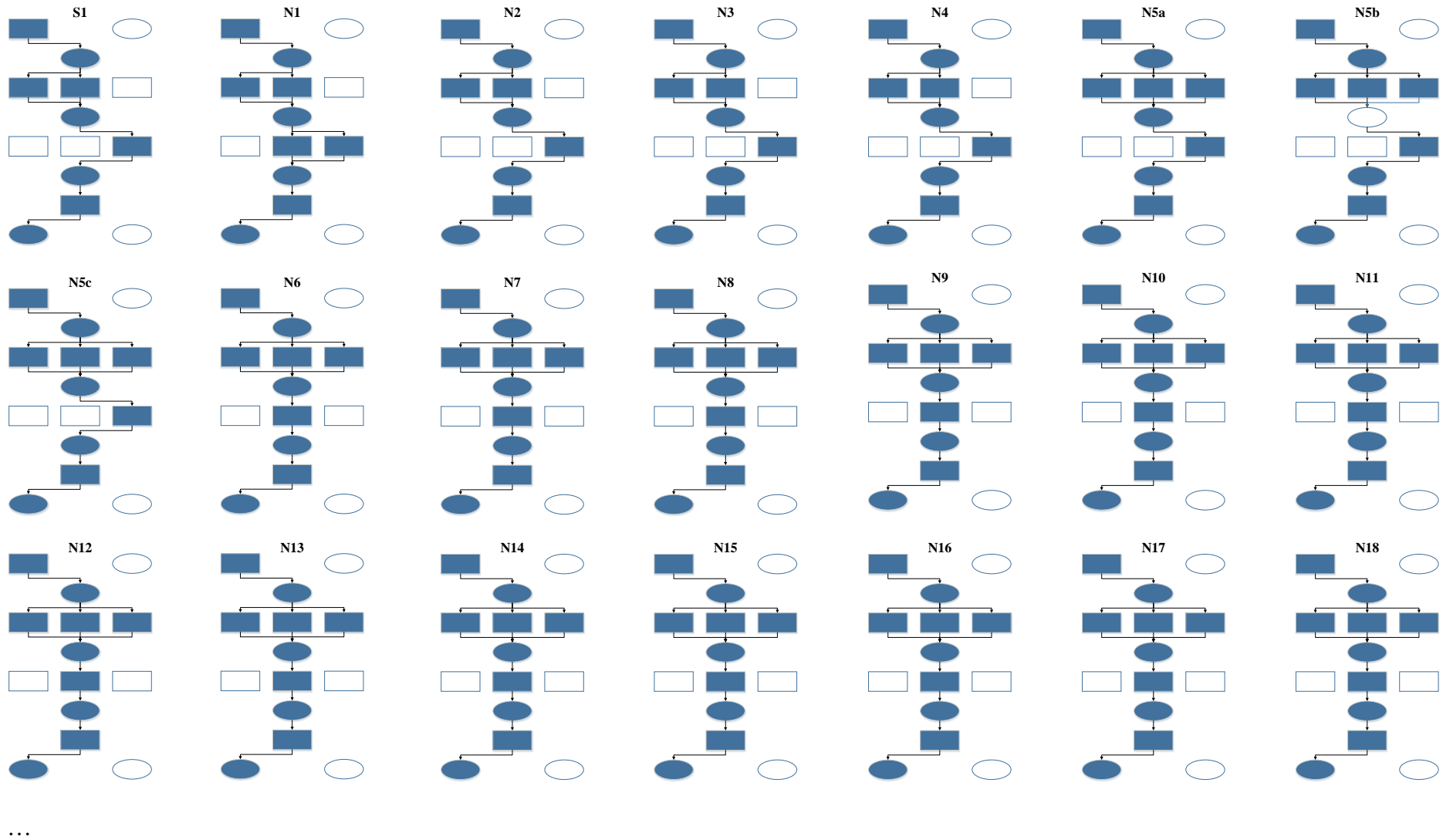


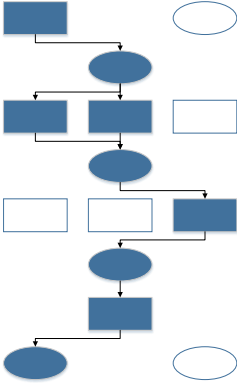
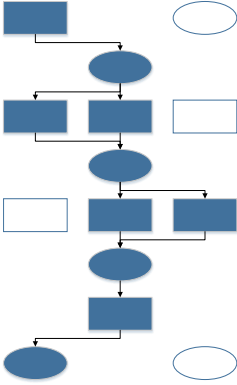
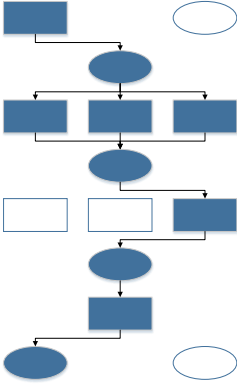
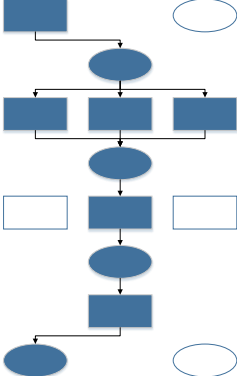
Figure 23 details the delineated POE processes in each of the publically available POE reports pertaining to UK HEIs. All of the POE investigations listed in this visualisation occurred between December 2008 (Sheffield International College) and December 2015 (Romax Technology Centre), and as such all refer to the HEFCE Guide to Post-occupancy Evaluation (2006), the prime guidance document for the planning and implementation of POE in the UK HE sector. It can be observed in Figure 23 that none of the POE processes emanating from publically available HEI POE's utilise either: i) historic POE report findings at the design phase; or ii) prepare findings to be fed-forward to future HE developments.

The concept of a cyclical approach to development has been comprehensively discussed in academic literature, particularly in the context of POE research (c.f. Ziesel, 1981; Zimmerman and Martin, 2001; Leaman and Bordass, 2001). However, the observation that no publically available HEI POE's are utilising historic building performance data, or subsequently preparing findings for use at the design phase of future developments, suggest this recognised objective is not being realised in practice. Cooper (2001) and Riley *et al.*, (2010) assert that buildings constructed using contemporary design and construction innovations without process feedback on performance, effectively remain unproven prototypes.

The analysis of the publically available HEI POE reports highlighted four permutations of the POE process which all of the POE reports can be assigned to. Table 11 details: i) the four permutations; ii) the specific pathway each follows; and iii) the frequency of each permutation. Common features can be identified from each of the four permutations, all permutations utilise: i) a 'process evaluation'; and ii) a 'functional performance evaluation'. Similarly, all permutations omit the use of an 'operational review (3-6 months)'.

The 'review selection' choices made by practitioners diverge significantly, two permutations (no.2 and no.4) utilise a 'project review (9-18 months)', whilst three permutations (no.1, no.2 and no.3) utilise a 'strategic review (3-5 years)'. Only POE permutation no.2 utilises more than one review selection - a 'project review (9-18 months)' in conjunction with a 'strategic review (3-5 years)'. Notably, the permutation that does utilise multiple review selection periods (no.2) has a frequency of one, making it the least utilised permutation of all of those observed.

Table 11 - The POE Permutation Pathways Emanating from Publically Available HEI POE Reports

No.	POE Permutation	POE Pathway Details	Frequency (f)
1		Evaluation Selection ✓ Process Evaluation ✓ Functional Performance Evaluation ✗ Technical Performance Evaluation Review Selection ✗ Operational Review (3-6 months) ✗ Project Review (9-18 months) ✓ Strategic Review (3-5 years)	$f=4$
2		Evaluation Selection ✓ Process Evaluation ✓ Functional Performance Evaluation ✗ Technical Performance Evaluation Review Selection ✗ Operational Review (3-6 months) ✓ Project Review (9-18 months) ✓ Strategic Review (3-5 years)	$f=1$
3		Evaluation Selection ✓ Process Evaluation ✓ Functional Performance Evaluation ✓ Technical Performance Evaluation Review Selection ✗ Operational Review (3-6 months) ✗ Project Review (9-18 months) ✓ Strategic Review (3-5 years)	$f=3$
4		Evaluation Selection ✓ Process Evaluation ✓ Functional Performance Evaluation ✓ Technical Performance Evaluation Review Selection ✗ Operational Review (3-6 months) ✓ Project Review (9-18 months) ✗ Strategic Review (3-5 years)	$f=13$

The evaluation selections chosen by practitioners in all four permutations showed less variation, permutations no.3 and no.4 utilise the full range of evaluation options: i) a 'process evaluation'; ii) a 'functional performance evaluation'; and iii) a 'technical performance evaluation'. Whilst permutations no.1 and no.2 utilise: i) a 'process evaluation' and ii) a 'functional performance evaluation'; and omit the 'technical performance evaluation'.

Of the four permutations observed from the sample of twenty one HEI facilities, permutation no.4 is utilised more frequently than the other permutations identified ($f=13$). Permutation no.4 utilises the full spectrum of evaluation metrics suggested in the HEFCE Guide to Post-occupancy Evaluation (2006), in conjunction with the 'project review (9-18 months)' review selection. Whilst the selection of a 'project review (9-18 months)' for the implementation of all metrics at the 'evaluation selection' phase is not suggested in the guidance documentation, permutation no.4 offers the most systematic pathway of all permutations identified in terms of the breadth of analysis and the ease of replication of the process on future facilities. Permutation no.3 similarly utilises all of the metrics available for selection at the evaluation selection stage, but utilises the 'strategic review (3-5 years)', effectively requiring the practitioners to reflect on a construction process which took place between three and five years earlier. Permutations no.1, no.2 and no.3 record a far lower frequency scores ($f = 1-4$) than no.4, having only been implemented on a small number of occasions in each case before the process was improved.

Table 12 - The Publically Available POE Reports Organised into Chronological Order

POE code	POE Completion Date	Permutation no.
S1	December 2008	1
N1	May 2009	2
N2	May 2009	1
N3	June 2009	1
N4	May 2010	1
N5a	March 2011	3
N5b	March 2011	3
N5c	March 2011	3
N6	March 2012	4
N7	April 2012	4
N8	May 2013	4
N9	July 2013	4
N10	February 2014	4
N11	February 2014	4
N12	June 2014	4
N13	June 2014	4
N14	October 2014	4
N15	December 2014	4
N16	March 2015	4
N17	July 2015	4
N18	December 2015	4

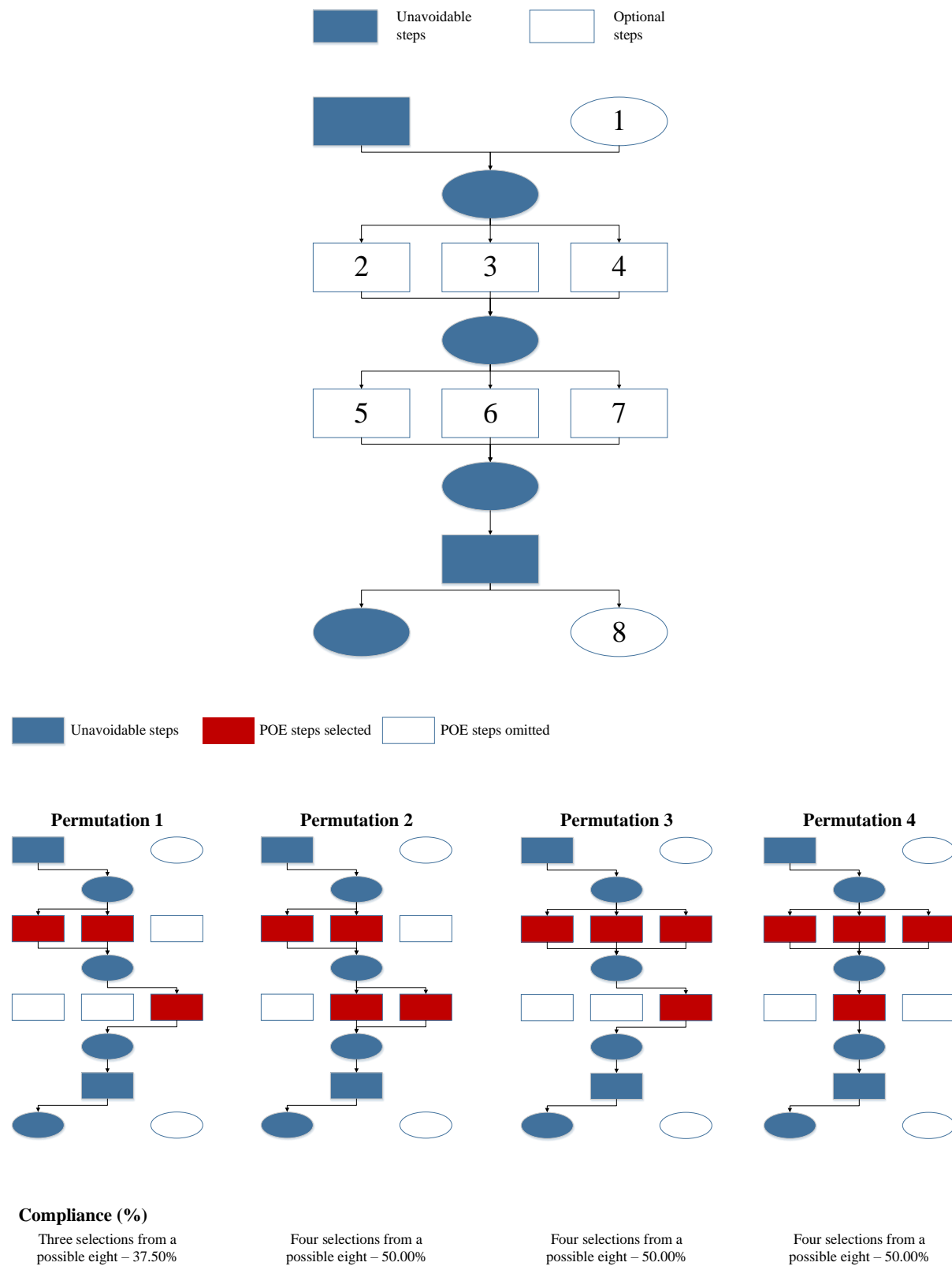
Table 12 lists: i) the publically available HEI POE reports; ii) the date the POE was completed; and iii) the permutation the POE followed. Organising the POE reports chronologically reveals a trend with regard to the permutation each report belongs to. From December 2008 through to May 2010, permutation no.1 is utilised by both the University of Nottingham and the University of Sheffield. The only exception being the use of permutation no.2 at the University of Nottingham on its first POE report (N1), although this permutation was only utilised once ($f = 1$) and was not observed again. March 2011 saw three POE reports (N5a, N5b, and N5c) completed for the University of Nottingham, all following permutation no.3. The three facilities evaluated using this permutation (no.3) were reported back in a single POE report, unlike any of the other reports in the sample. Permutation no.3 was also not utilised again after its application in N5a, N5b, and N5c. From March 2012 through to the final POE report (December 2015), permutation no.4 was utilised in all instances ($f = 13$). The changes observed in the POE process permutations suggest a process of refinement, the POE process itself being iteratively improved as the practitioners involved with the evaluation gain experience of planning and implementing a POE in practice.

5.4 HEI POE COMPLIANCE

The HEFCE guidance is ostensibly designed to allow flexibility, stating that it is: “*prepared so colleagues can choose according to their needs and preferences, as few or as many of the areas identified in the report*” (HEFCE, 2006, p.3). The diverse set of selectable options made available by the HEFCE Guidance, allow practitioners to select anything between cursory evaluation of the facility, to an evaluation incorporating all of the selectable options and thus taking into account every possible metric suggested in the guidance. Figure 24 shows the compliance with the maximum possible evaluation and review selections of the four POE permutations identified within publically available HE POE reports.

Figure 24 also offers a visualisation of the compliance of each of the four permutations identified from the publically available POE reports. Three permutations (no.2, no.3 and no.4) show the same level of compliance having selected four of a possible eight selections (50% compliance), while the other permutation (no.1) selects three of a possible eight selections (37.50% compliance). When POE compliance is organised by selection stage (‘evaluation selection’ and ‘review selection’), differences can be identified between the three permutations with the same compliance score. Permutations no.3 and no.4 have 100% compliance (three out of three selections) at the evaluation selection stage, whilst only having a 33.33% compliance (one of three selections) at the review selection stage. Permutation no.2 has a 66.67% compliance (two of three possible selections) at the evaluation stage, and 66.67% compliance (two of a possible three selections) at the review selection stage. Permutation no.1 has a compliance score of 66.67% at the evaluation selection stage, and 33.33% at the review selection stage, placing it at the minimum level of compliance at each stage found in the other three permutations.

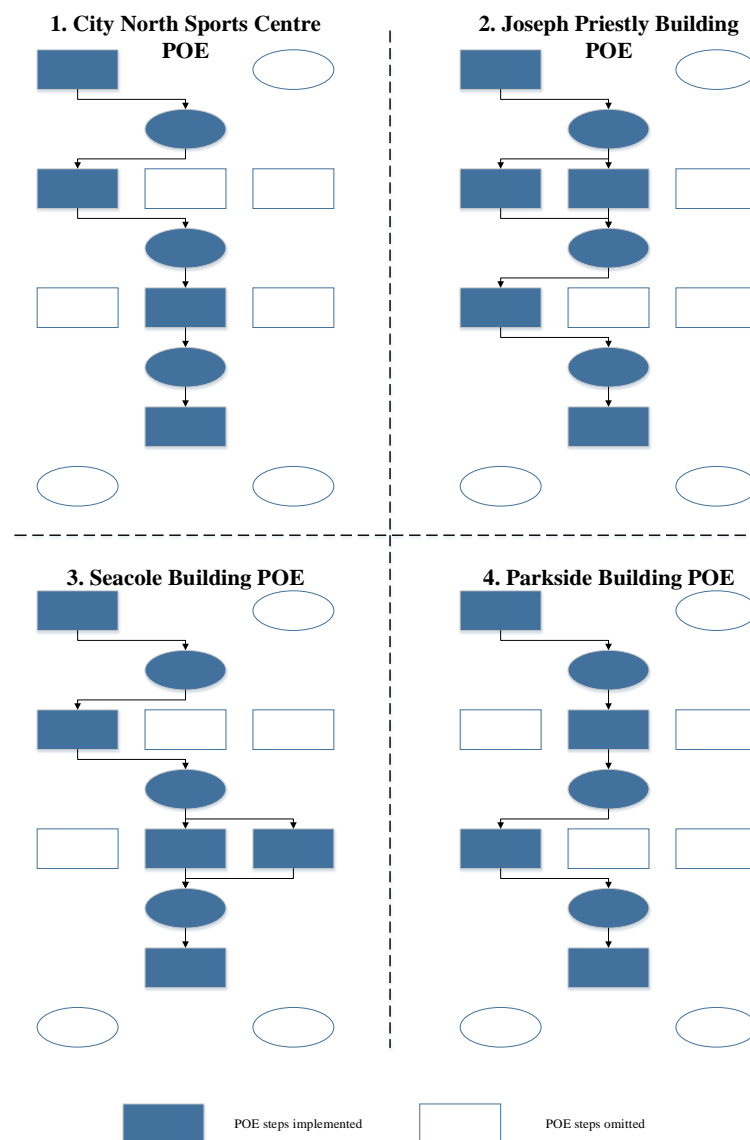
Figure 24 - Compliance of Each HEI POE Permutation in Comparison to the Maximum Analysis Suggested in Guidance Documentation



5.4.1 Birmingham City University POE Reports

Figure 25 shows the POE process as it was planned and implemented by BCU on four of its HE facilities. A number of initial observations can be made, firstly no two POE were conducted using the same components upon which the facility was evaluated. Similarly, there is no indication that the feed-forward from previously undertaken POE's was used on any of the completed POE reports analysed in this study. Furthermore, none of the POE reports appear to feed-forward findings, or prepare findings in the form of an executive summary for the purposes of informing future developments.

Figure 25 - A Comparison of the process (independent) of four POE's conducted on BCU educational facilities

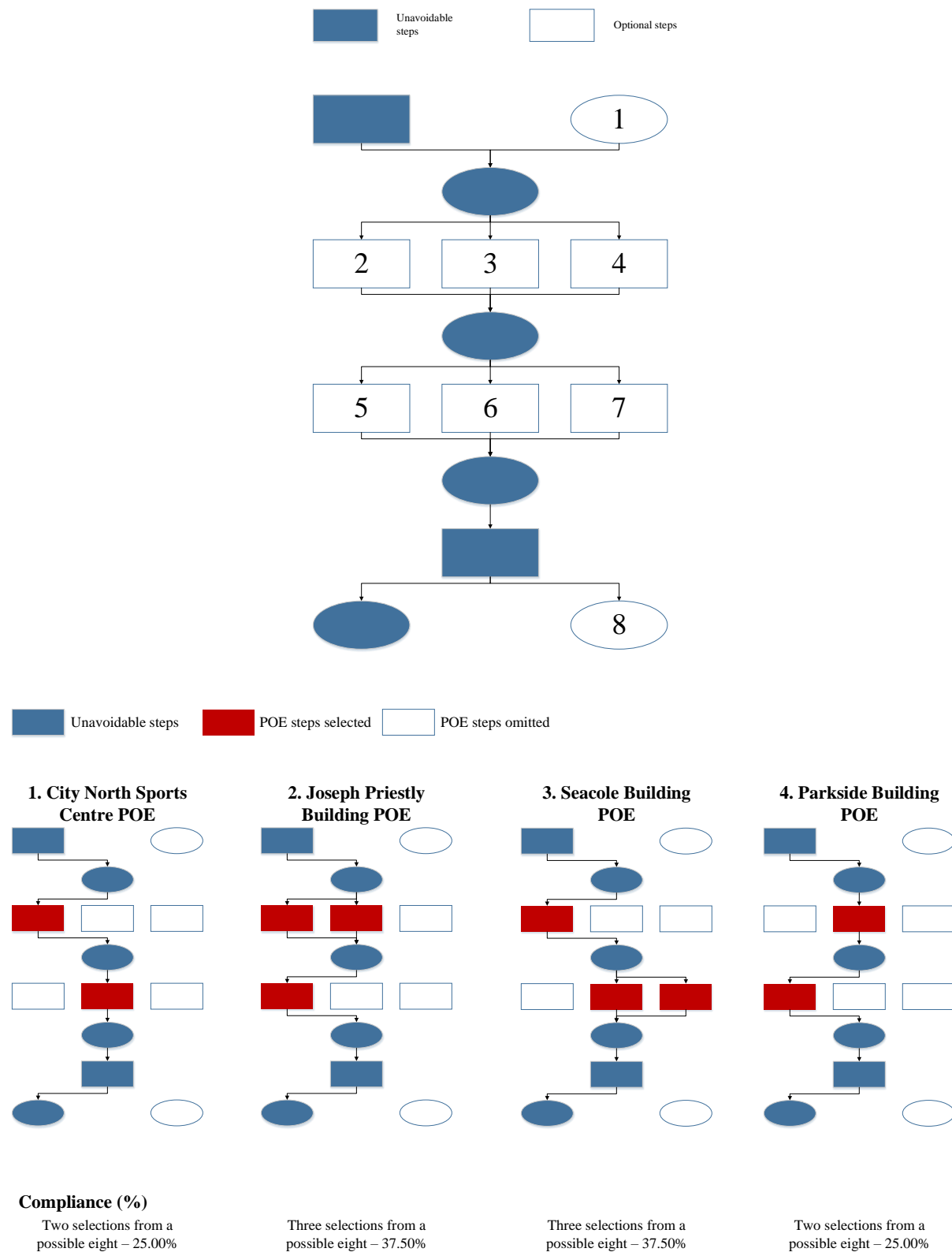


A number of observations can be made regarding the elements selected and utilised for the planning and implementation of POE at BCU. The Joseph Priestly (JP) building, in contrast to the other POE's in this study, utilised more than one evaluation strategy, namely: i) a 'process evaluation'; and ii) a 'functional performance evaluation'. The use of both of these evaluation strategies in combination, an overview of the development process as well as the performance of the completed asset, suggests a more rigorous evaluation has been undertaken on this particular asset when compared to other HEI facilities in this study. Notably, the JP building is the only facility in this study which whilst being HEI facility, has no student facing activities. Similarly, the Seacole building on BCU's City South Campus utilises aspects of a 'strategic review' (taken strategic financial information) in conjunction with the more regularly utilised 'operational review' and 'project review' (c.f. Figure 25).

5.4.2 BCU POE Compliance

The compliance of BCU's POE reports are evaluated, allowing a direct comparison between BCU's POE process and the sample of publically available HEI POE reports (c.f. Figure 26).

Figure 26 - The Compliance of Each BCU POE Report in Comparison to the Maximum Analysis Suggested in Guidance Documentation



The most compliant POE reports within this study were found to have a compliance of 37.50% (the Joseph Priestly Building and the Seacole Building), both having selected three components

from a possible eight. The other two POE reports were found to have a compliance of 25.00% (the City North Sports Centre and the Parkside building), having selected two components from a maximum of eight. Despite obvious similarities in compliance levels (two at 25.00% and two at 37.50%), each of the POE reports in this study uses a different combination of evaluation and review components. This may further preclude the ability of practitioners to reliably benchmark, and iteratively improve HEI facilities (c.f. Preiser and Vischer, 2005; Olivia and Christopher, 2014).

Comparison of the compliance scores of the publically available HE POE reports with the BCU POE reports highlights a distinct difference in compliance scores. The highest score identified within the BCU sample scored 37.50% (2 out of 4 reports), whilst the lowest score identified within the publically available POE reports also scored 37.50% (permutation 1). Two BCU POE reports scored 25.00% compliance, a lower compliance score than any identified within the publically available sample.

5.5 DISCUSSION

POE is recognised as an essential feedback mechanism for the built environment (Göçer *et al.*, 2015; Ponterosso *et al.*, 2018). Since its formal inception whilst investigating ‘sick building syndrome’ in the 1960s (c.f. Collinge, 2014), various attempts by both practitioners and academics alike to implement POE as an industry best practice standard (c.f. Mustafa, 2017). This objective remains elusive despite a wealth of literature espousing the organisational and practical advantages to undertaking such an evaluation (Alborz and Berardi, 2015). Analysis of the four POE reports pertaining to four of BCU’s recently developed educational facilities highlighted a number of contributory factor which may be influencing not only the wide scale utilisation of POE in practice, but also the ability to achieve objectives outlined within contemporary academic literature such as: i) benchmarking (c.f. Wauters, 2005; Hassanain *et al.*, 2016); and ii) iterative improvement of facilities (c.f. Göçer *et al.*, 2015; Ponterosso *et al.*, 2018).

A significant number of different potential permutations are possible emanating from the POE practice guidance documentation. Upon analysis, 36 different permutations are possible emanating from the HEFCE Guide to Post-occupancy Evaluation (2006). For effective facility performance benchmarking, common points within the POE process are required where performance metrics can be directly compared in differing facilities (c.f. Wauters, 2005;

HEFCE, 2006; Hassanain *et al.*, 2016). Whilst all of the BCU POE's followed different POE process pathways, the sample of 21 publically available POE reports could all be organised into 4 permutations. Furthermore, the permutations observed from the publically available POE reports, suggest a trend of increasing refinement occurring within a series of POE reports. Without this innate process of refinement, the potential of 36 different permutations emanating from the HEI POE process offers an insight in to the difficulties practitioners face regarding generation of directly comparable findings.

In consideration of multiple potential permutations emanating from the delineated POE process, a compliance score can be assigned to each of the POE reports analysed in this study. The maximum analysis which could potentially be undertaken would involve selecting every option available at each of the two essential selection stages (evaluation and review selection) and would represent a 100% compliance score. Conversely, the minimum analysis which could be undertaken would be represented by a single selection at each key selection stage. Of the four BCU POE reports analysed in this study, two reports scored 37.50% compliance, and two scored 25.00% compliance. In comparison, the permutations observed when the publically available POE were analysed scored considerably higher compliance scores, one report with 37.5% compliance and three reports with 50% compliance. BCU's POE reports at present show more variability of approach than the publically available sample, whilst also taking less building performance metrics into account than the industry sample. Furthermore, where compliance scores were found to be similar within BCU reports, this did not mean the same analysis components had been selected, merely that the same number of selections had been made. The relatively low compliance scores found on all four BCU reports in conjunction with few common points of analysis further precludes practitioners' ability to benchmark POE findings from one facility to another.

Finally, the ability to iteratively improve HEI facilities utilising the findings of a POE is dependent on findings from previous POE investigations being used as a starting point when planning future POE's. None of the four POE reports analysed in this study utilised previous findings as a starting point, and by extension none of the reports prepare findings for feeding forward to future POE's. This apparent isolation in which each POE is planned and implemented may detrimentally affect practitioners' ability to iteratively improve facility performance (c.f. Göçer *et al.*, 2015; Ponterosso *et al.*, 2018).

5.6 CONCLUSIONS

Preiser (2002) states “POE is the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied.” The terms ‘systematic’ and ‘rigorous’ are key to developing an implementable POE which can be cross-referenced with other POE reports pertaining to other facilities. Academic literature regarding POE, identifies the need for facility benchmarking (c.f. Wauters, 2005; Hassanain *et al.*, 2016), and iterative improvement of built environment assets (c.f. Göçer *et al.*, 2015; Ponterosso *et al.*, 2018). POE’s in the context of HEIs largely utilise the HEFCE Guide to Post-occupancy Evaluation (2006) as a basis for planning and implementing POE. This guidance is “prepared so colleagues can choose according to their needs and preferences, as few or as many of the areas identified in the report” (HEFCE, 2006, p.3). This emphasis upon practitioners choosing the analytical metrics which they perceive as best meeting the objectives set out by the institution they represent, may negatively impact upon the ‘systematic’ and ‘rigorous’ POE process outlined by Preiser (2002).

CHAPTER 6

FOCUS GROUP TRANSCRIPT DATA ANALYSIS

6.1 INTRODUCTION

Chapter 6 details the: i) planning and implementation; and ii) analysis of the focus group. The focus group was comprised of a selection of personnel from across multiple departments within BCU, all of whom are linked to the POE process either through involvement at the planning phase, or will be in receipt of the findings after the process is complete. Provided within this chapter is an overview of focus group participants' experience of both working with Estates departments as well as direct experience of the POE process. A thematic analysis is utilised to develop themes emanating from the transcript, and a SWOT analysis subsequently utilised to contextualise the developed themes, and then to decipher in temporal terms, exactly where attention is required regarding the POE process currently employed in HEIs.

6.2 FOCUS GROUP PLANNING

The practitioner focus group approach was selected to unpick the findings of the delineated POE process utilised as a comparative tool to investigate the case study of four of BCU's HEI assets. The practitioners selected had direct experiences of BCU's POE processes, either as contributors to the process, or recipients of the findings. These individuals included: i) the Head of the Estates department; ii) the Deputy Head of the Estates department; iii) the Head of the IT department; the Head of Facilities; iv) the Head of Security; and v) individual building managers from the Estates department. Practitioners were asked a series of semi-structured, open ended questions, designed to stimulate discourse amongst the contributing practitioners, importantly the researcher's role in this approach was to facilitate that discourse, and not to contribute to it. To contribute to this discourse, particularly when incorporating an interpretivist approach could introduce confirmation bias on behalf of the researcher. Upon completion of the practitioner focus group, the recorded practitioner focus group transcript was subsequently transcribed allowing analysis of the raw qualitative data (c.f. Appendix 3).

6.2.1 Focus Group Questions

The practitioners participating in the focus group were asked a series of ten questions, with associated follow-up points in order to interrogate BCU's POE planning and implementation procedures. The questions were derived from academic literature pertaining to POE and soft landings, augmented with themes derived from working with the Estates Department (c.f. Table 13).

Table 13 - An Overview of the Questions Prepared for the Practitioner Focus Group

No.	Topic	Question(s)	Underpinning
1	Challenges	a. What are the most significant challenges regarding the planning of a POE? i. How are they overcome? b. What are the most significant challenges regarding the implementation of a POE? i. How are they overcome?	Alborz and Berardi, 2015
2	Value	a. Are the findings of a POE considered useful to ongoing Estates activities? b. Does the planning and implementation of POE impact day to day activities? c. Do the findings of a POE report influence Estates strategy?	Zimmerman and Martin, 2001; Vischer, 2001
3	Skills	a. Are there any specific skills and training requirements for individuals involved in the POE process? b. What are those training requirements? c. What is the rationale for using a consultant for the university's POE?	Arayici and Coates, 2012; Abrishami <i>et al.</i> , 2015; Rahman <i>et al.</i> , 2016
4	Knowledge	a. What use does the university make of historic POE reports when embarking upon a new development? b. Why is this approach chosen? c. How are the findings of POE disseminated?	Bordass and Leaman, 2005; Cooper, 2001
5	POE guidance	a. What POE guidance documentation are you aware of? b. Which POE guidance documentation is utilised by BCU Estates? c. What is the rationale for this approach?	Guidance documentation provides a basis for HEI's to develop their approach to POE
6	IP and VP	a. What IP and VP considerations are taken into account when planning a POE? b. What would be considered to be sensitive information within a POE report?	Olatunji and Akanmu, 2014
7	Stakeholders	a. Who do you believe is responsible for funding POE? b. Which project partners cooperate with the POE process? c. Which parties involved in the project ask for POE findings?	Riley <i>et al.</i> 2010; Zimmerman and Martin, 2001; Vischer, 2001
8	Mitigation of liability	a. How is liability apportioned between multiple development partners? b. Are there any reasons why development partners would not cooperate with the POE process? c. What is the mode of procurement?	Khosrowshahi and Arayici, 2012; Jiao <i>et al.</i> , 2013; Barnes and Davies, 2014
9	Benchmarking and Iterative Improvement	a. How do POE report findings impact upon perceived facility performance? b. What facility benchmarking metrics are utilised when comparing facility performance?	Preiser and Vischer, 2005; Olivia and Christopher, 2014; Wauters, 2005; Hassanain <i>et al.</i> , 2016; Göçer <i>et al.</i> , 2015; Candido <i>et al.</i> , 2016
10	Space Survey	a. Do you think the space survey is having an impact upon the ongoing POE process and subsequent findings? b. Why?	Direct experience of utilising BCU facilities

6.3 FOCUS GROUP DEMOGRAPHICS

Each of the focus group participants' were asked at the outset of the focus group to fill out a questionnaire regarding their experiences of working in Estates departments as well as their direct experiences of the POE process. An ethical statement was included in this questionnaire, informing participants that they would be anonymised within the research (c.f. Appendix 1). The anonymisation is necessary in light of the ongoing nature of POE in context to BCU's growing city centre campus, as BCU's POE processes are still being developed, and critical analysis of these processes could negatively impact upon the participating practitioners.

Table 14 offers an overview the total experience focus group participants had of working with Estates departments as well as direct experience of the POE process. With the exception of participant no.2, every focus group participant recorded more Estates experience than POE experience. This not totally unexpected, Estates experience cover all of the day-to-day activities of an Estates department, POE falls within the remit of Estates activities. However, in consideration of the sample of practitioners selected to participate in the focus group, specifically for their involvement in BCU's POE process, practitioners 3, 4, 5, 7 and 8, have remarkably low levels of POE experience.

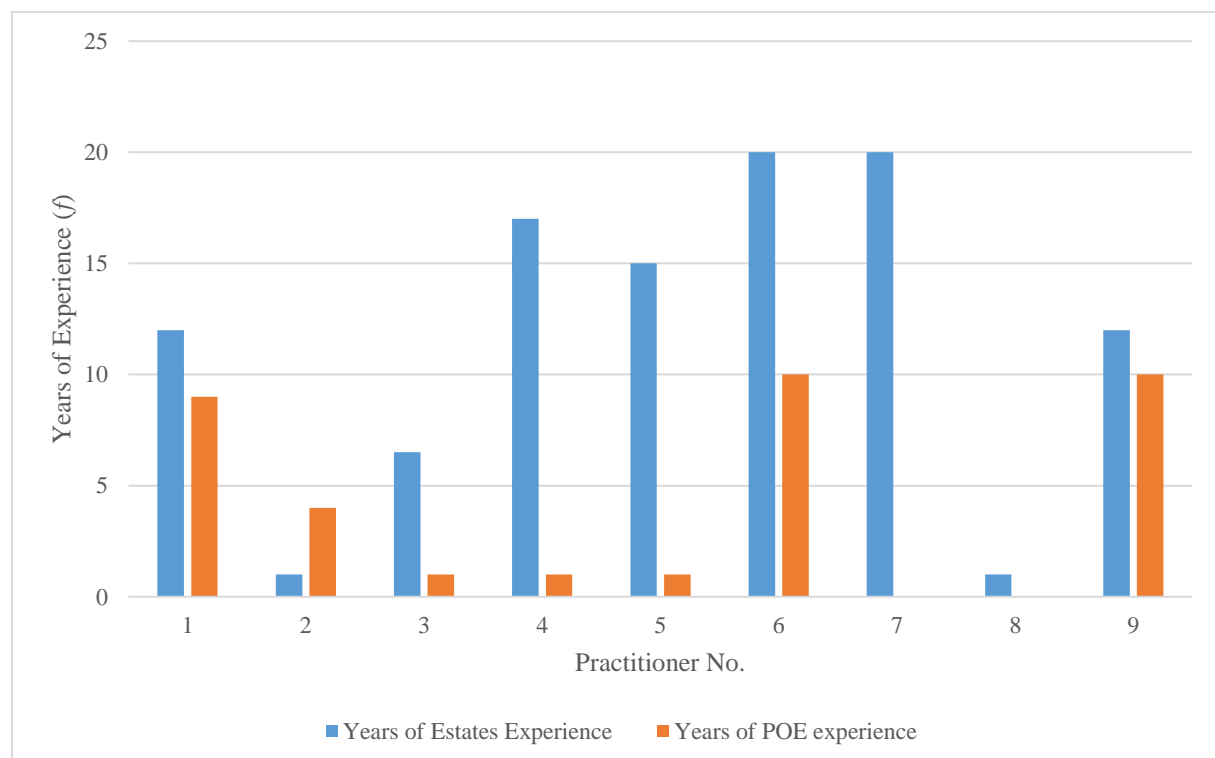
Table 14 - An Overview of the Focus Group Participants' Total Estates Experience and Total POE Experience

Focus Group Participant	Years of Estates Experience	Years of POE Experience
1	12	9
2	1	4
3	6.5	1
4	17	1
5	15	1
6	20	10
7	20	0
8	1	0
9	12	10
Total	104.5	36

Figure 27 offers a graph detailing the direct comparison of Estates experience versus POE experience. Immediately it can be observed that the majority of POE experience (80.555%) is centred on participants 1, 6 and 9, as opposed to being spread more evenly amongst the focus group participants. This may suggest that, certainly within BCU's Estates department and associated development partners, a core group of individuals with previous POE experience routinely contribute to the POE process, whilst Estates personnel with limited POE experience

appear to be seldom involved, or have been involved for the first time in this instance. Furthermore, participant number 7, recorded 20 years of Estates experience, but no experience of involvement with POE's in that period. Participants 4 and 5 likewise recorded substantial Estates experience (17 years and 15 years respectively), whilst only recording two years of POE experience between them.

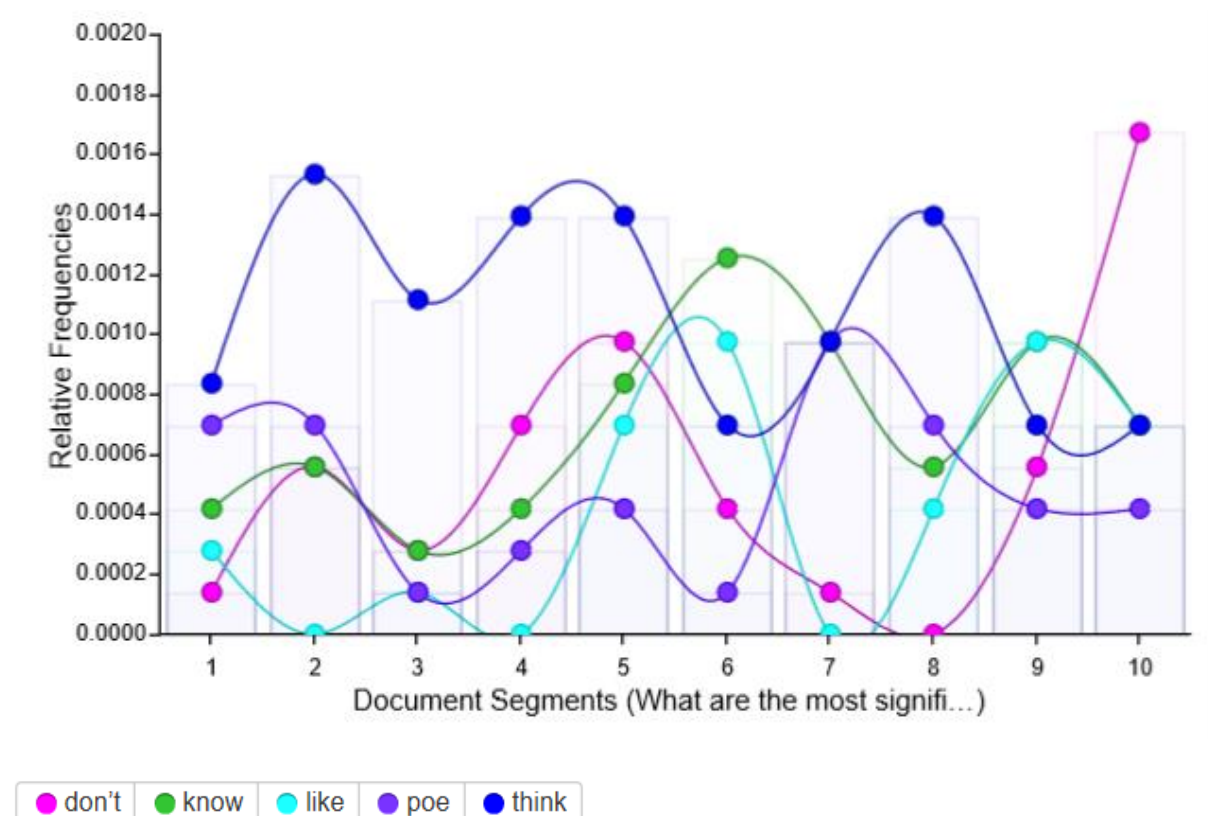
Figure 27 - A Graph Indicating the Experience of Personnel Participating in the Focus Group with Regards to both Estates and POE



6.4 SEMI-STRUCTURED FOCUS GROUP

This section details the findings emanating from the focus group. After the interview had been transcribed, the aforementioned: i) thematic analysis; and ii) SWOT analysis were undertaken. In addition, a word frequency analysis has also been undertaken. Whilst the word frequency analysis is conducted separately to the thematic and SWOT analyses, it offer an indication of the language utilised by practitioner's, and contributes to both Gillham's 'chain of evidence' and the post-positivist requirement for the collection of 'as much reality as possible' (c.f. #####).

Figure 29 - A Word Frequency Graph Emanating from the Practitioner Focus Group



6.5 THEMATIC ANALYSIS

The first stage of the main transcript analysis was undertaken utilising thematic analysis. The one hundred and fifty practitioner responses, each consisting of a passage of text, garnered during the practitioner focus group were coded according to themes derived from academic literature, emergent themes drawn from the focus group transcript, and from first-hand experience working with the Estates Department in a participatory action research paradigm. The themes which were developed were as follows: i) benchmarking (c.f. Preiser and Vischer, 2005; Olivia and Christopher, 2014); ii) communication (c.f. Arayici and Coates, 2012; Olatunji and Akanmu, 2014; Lindkvist, 2015; Pärn *et al.*, 2016); iii) concurrent analysis; iv) data/knowledge management (c.f. McGrath and Horton, 2011); v) dissemination; vi) feedback collection strategy; vii) financial constraints; viii) iterative improvement (c.f. Cooper, 2001; Göçer *et al.*, 2015); ix) organisational inhibitors; x) personnel; xi) procurement; xii) scheduling; xiii) skills and training (c.f. Arayici and Coates, 2012; Abrishami *et al.*, 2015; Rahman *et al.*, 2016); xiv) use of sub-contractors; xv) validity (a); xvi) validity (b); and xvii) value (c.f. Zimmerman and Martin, 2001; Vischer, 2001) (c.f. Table 15 and 16).

Table 15 - An Overview of the Themes emanating from the Focus Group Transcript Data

Theme	Overview
Benchmarking	Comments pertaining to the ability to utilise POE findings to formulate facility benchmarks standards for application in future developments.
Communication	Comments pertaining to interdepartmental information exchanges regarding POE planning and implementation phases.
Concurrent analyses	Comments pertaining to instances where multiple analyses, such as space usage or performance, are underway simultaneously with the POE.
Data/knowledge management	Comments pertaining to the practical application of knowledge and findings emanating from the POE process.
Dissemination	Comments pertaining to the sharing of findings of the POE to all applicable departments and personnel.
Feedback collection strategy	Comments pertaining to the selection of the most applicable method for collecting practitioner and end-user feedback.
Financial constraints	Comments pertaining to budgetary considerations which inhibit the planning and implementation of POE.
Iterative improvement	Comments pertaining to the utilisation of POE findings to consistently improve the performance and HEI facilities through formalised feedback mechanism.
Organisational inhibitors	Comments pertaining to institutional obstacles, personnel changes to the University Executive Group (UEG) for example.
Personnel	Comments pertaining to the amassing of an applicable team of practitioners with the required skills and training to effectively plan and implement a POE.
Procurement	Comments pertaining to the requirement for preplanning of the POE, for instance, contractual agreements with development partners regarding the POE at the outset of a project.
Scheduling	Comments pertaining to the organisation of key temporal points in the POE process, for instance, project team data needing to be collected within 3-6 months before dissolution of the project team.
Skills and Training	Comments pertaining to the assortment of skills and competences required by both the Estates personnel and project partners to successfully plan, implement and utilise the findings of a POE.
Use of sub-contractors	Comments pertaining to the use of external consultants when planning, implementing and utilising the findings of a POE.
Validity (a)	Comments pertaining to identified ‘good practice’, ensuring robust findings with tangible benefits if actioned for the commissioning organisation.
Validity (b)	Comments pertaining to the utilisation of industry standard guidance documentation for the planning, implementation and knowledge management phases of a POE process.
Value	Comments pertaining to considerations which directly improve the Estates departments day to day activities - value adding implications.

The themes: i) concurrent analysis; ii) feedback collection strategy; iii) financial constraints; iv) organisational inhibitors; v) procurement; vi) scheduling; vii) use of sub-contractors; and viii) validity (a and b); are derived from working in close proximity to Estates personnel, as well as from the interview transcript itself. Whilst most of these themes familiar with regard to the requirements of a contemporary built environment, the theme ‘concurrent analysis’ may not be. This theme was included due to a separate space survey being conducted on one of BCU’s newly developed HEI facilities, this separate evaluation was conducted during the ‘9-18 months after occupation’ slot suggested in the HEFCE Guide to Post-occupancy Evaluation (2006). Conducting a space use survey, aimed at maximising the usage of HEI facilities, may

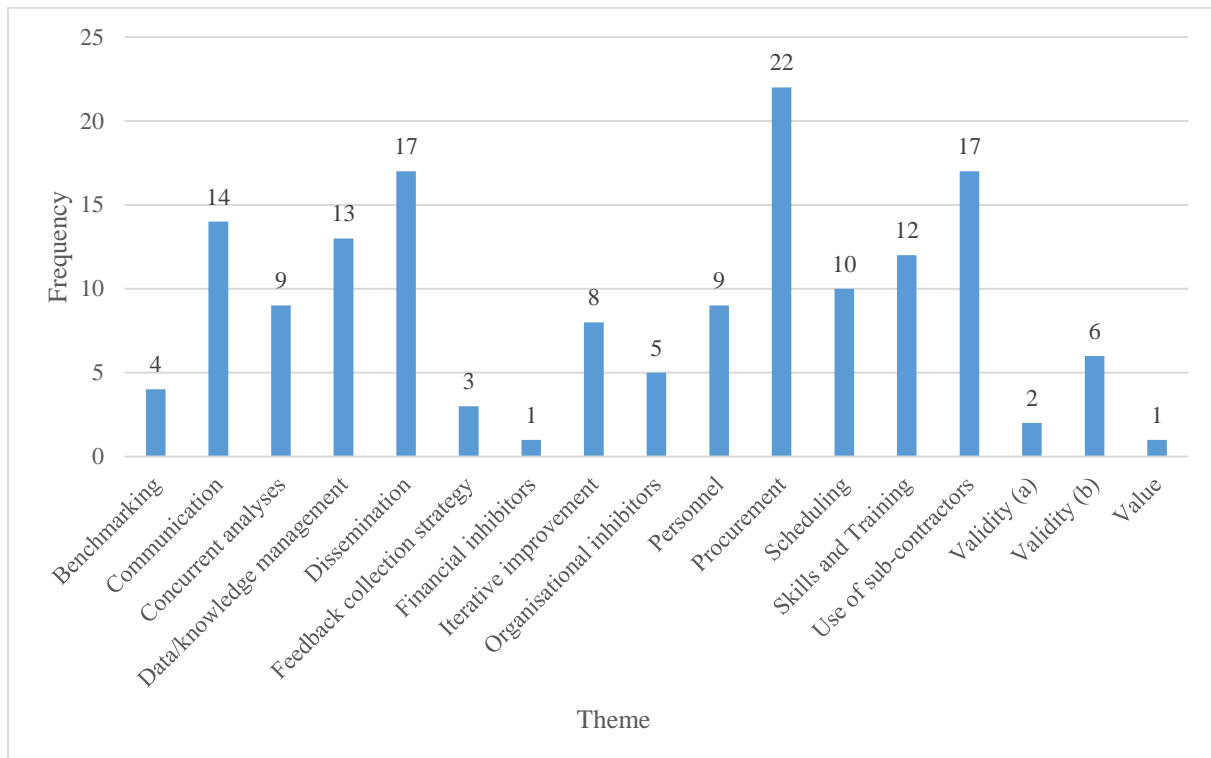
have an effect on the findings of the POE, yet does not fall within the remit of what a POE measures.

Table 16 - The Total Frequency of Comments Relating to each Theme

Theme	Frequency (<i>f</i>)
Benchmarking	4
Communication	13
Concurrent analysis	7
Data/knowledge management	13
Dissemination	17
Feedback collection strategy	3
Financial constraints	1
Iterative improvement	8
Organisational inhibitors	5
Personnel	9
Procurement	22
Scheduling	10
Skills and Training	12
Use of sub-contractors	17
Validity (a)	2
Validity (b)	6
Value	1

Table 16 list the themes utilised in the thematic analysis, in conjunction with the frequencies of responses found in each instance. Figure 30 visualises the findings in Table 15. The three highest frequency themes were found to be: i) procurement ($f = 22$); ii) dissemination ($f = 17$); and iii) use of sub-contractors ($f = 17$). Procurement denotes the POE considerations that are required to occur during the early phases of the development cycle. Dissemination refers to the distribution of POE findings to applicable personnel at the conclusion of the POE process. Whilst use of sub-contractors refers to the POE considerations applicable to the universities interaction with external development partners, particularly ensuring sub-contractor cooperation with the POE process.

Figure 30 - A Graph Indicating the Total Frequencies of Themes Emanating from the POE Focus Group Transcript Data



Beyond the initial three themes with the highest frequencies, the next highest frequency themes were: i) communication ($f = 14$); ii) data/knowledge management; iii) skills and training ($f = 12$); and iv) scheduling ($f = 10$). In contrast to the first three themes which largely referred to external considerations, the next four highest frequency themes focus on internal considerations. Communication and data/knowledge management both refer to the way in which information is managed within the Estates department, one referring to inter-departmental communications regarding POE, and the other referring to the management and utilisation of information emanating from the POE process itself. Similarly with regard to internal considerations, skills and training refers to possessing the right experience and skills within the Estates department to perform the required tasks, and scheduling refers to the specific time intervals selecting by practitioners to perform the required functions of the POE process.

6.6 SWOT ANALYSIS

Once the thematic analysis was complete, each comment was further analysed in terms of: i) strengths; ii) weaknesses; iii) opportunities; and iv) threats (c.f. Table 17). The SWOT analysis

is undertaken to contextualise the findings of the thematic analysis, without which there would be no indication as to whether the practitioners were referring to each theme in support of current POE processes and procedures, or indeed highlighting concerns with current processes and procedures. The SWOT analysis was conducted manually utilising Excel spreadsheets to code responses with regards to the themes generated in the thematic analysis.

Table 17 - An Overview of the Rationale of the SWOT Analysis

SWOT Designation	Rationale
Strength	Practitioner comments referring to elements of BCU's POE processes which indicated where 'something could be built upon' (Barrow <i>et al.</i> , 2001).
Weakness	Practitioner comments referring to elements of BCU's POE processes which indicated where 'something requires correction' (Barrow <i>et al.</i> , 2001).
Opportunity	Practitioner comments referring to elements of BCU's POE processes which indicated where something could conceivably amplify beneficial outcomes (Boddy, 2014).
Threat	Practitioner comments referring to elements of BCU's POE processes which indicated where something could conceivably amplify negative outcomes (Boddy, 2014).

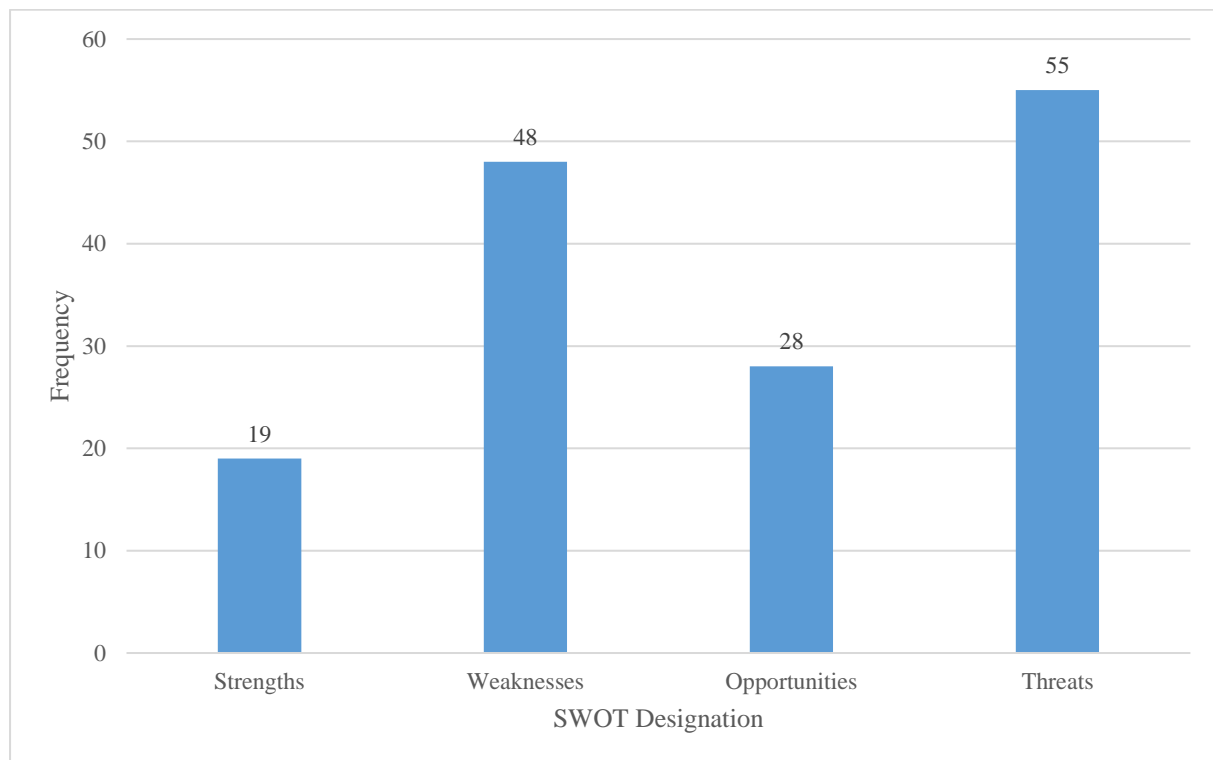
Table 18 show a complete overview of the frequencies of each theme, and the breakdown of strengths, weaknesses opportunities and threats emanating from the transcript data. Immediately it can be observed that the three highest values within table 18 are: i) procurement ($f = 22$); ii) dissemination ($f = 17$); and iii) use of sub-contractors ($f = 17$). This initial observation suggests that practitioners are chiefly concerned with: i) the planning phase of a POE denoted by procurement; and ii) the management of the findings of the POE denoted by dissemination. The use of sub-contractors can effect both of these perspectives, with prior sub-contractor agreement required with regards to organising a POE, and the management of the more sensitive findings of a POE in a neo-liberal contractual environment.

Table 18 - An Overview of the Total Frequencies of Themes Emanating from the Focus Group Transcript Data

SWOT Analysis Total					
Theme	Strengths	Weaknesses	Opportunities	Threats	Total
Benchmarking	0	3	0	1	4
Communication	2	9	0	2	13
Concurrent analyses	0	0	2	5	7
Data/knowledge management	0	3	1	9	13
Dissemination	2	4	6	5	17
Feedback collection strategy	0	1	2	0	3
Financial inhibitors	0	0	0	1	1
Iterative improvement	1	4	2	1	8
Organisational inhibitors	0	3	0	2	5
Personnel	1	1	5	2	9
Procurement	1	9	5	7	22
Scheduling	0	1	2	7	10
Skills and Training	1	8	0	3	12
Use of sub-contractors	4	2	3	8	17
Validity (a)	2	0	0	0	2
Validity (b)	4	0	0	2	6
Value	1	0	0	0	1
Total	19	48	28	55	150

Figure 31 depicts a graph showing the total strength, weaknesses, opportunities and threats emanating from the focus group transcript data. It is instantly noticeable that both weaknesses ($f = 48$) and threats ($f = 55$), significantly outweigh the strengths ($f = 19$) and opportunities ($f = 28$). This cursory analysis highlights that the practitioners whom participated in the focus group discussed more negative considerations of the POE process presently utilised at BCU than they did positive considerations.

Figure 31 - A Graph Indicating the Total Strengths, Weaknesses, Opportunities and Threats Emanating from the POE Focus Group Transcript Data



The next stage of the analysis involved separating the strengths, weaknesses, opportunities and threats, which had been recorded for each theme. Figure 32 shows the total strengths for each theme emanating from the transcript data. Two themes are immediately noticeable: i) use of sub-contractors ($f = 4$); and ii) validity (b) ($f = 4$). In the context of having been recorded as a strengths, the observation of these two themes suggest practitioners believe there are beneficial implications to both use of sub-contractors and reference to recognised industry guidance documentation. The use of subcontractors in particular is evidenced by a quote emanating from the focus group in response to a question querying the rationale for the use of external consultants and sub-contractors:

“A degree of independence, you get that separation from the project team.”

With regard to the use of guidance documentation, this was also seen as a positive implication, adding validity to the planned POE processes through utilisation of industry standard guidance. Notably, no strengths ($f = 0$) are recorded for: i) benchmarking; ii) data/knowledge management; iii) financial inhibitors; iv) organisational inhibitors; and v) scheduling. To have registered as theme, at least one instance of each theme must have been recorded as either a strength, weakness, opportunity or threat, absence of a value in one of these categories suggests

the theme was not prominent in the view of the practitioners with regard to the overriding category.

Figure 32 - A Graph Indicating the Total Frequencies of Themes Recorded as Strengths

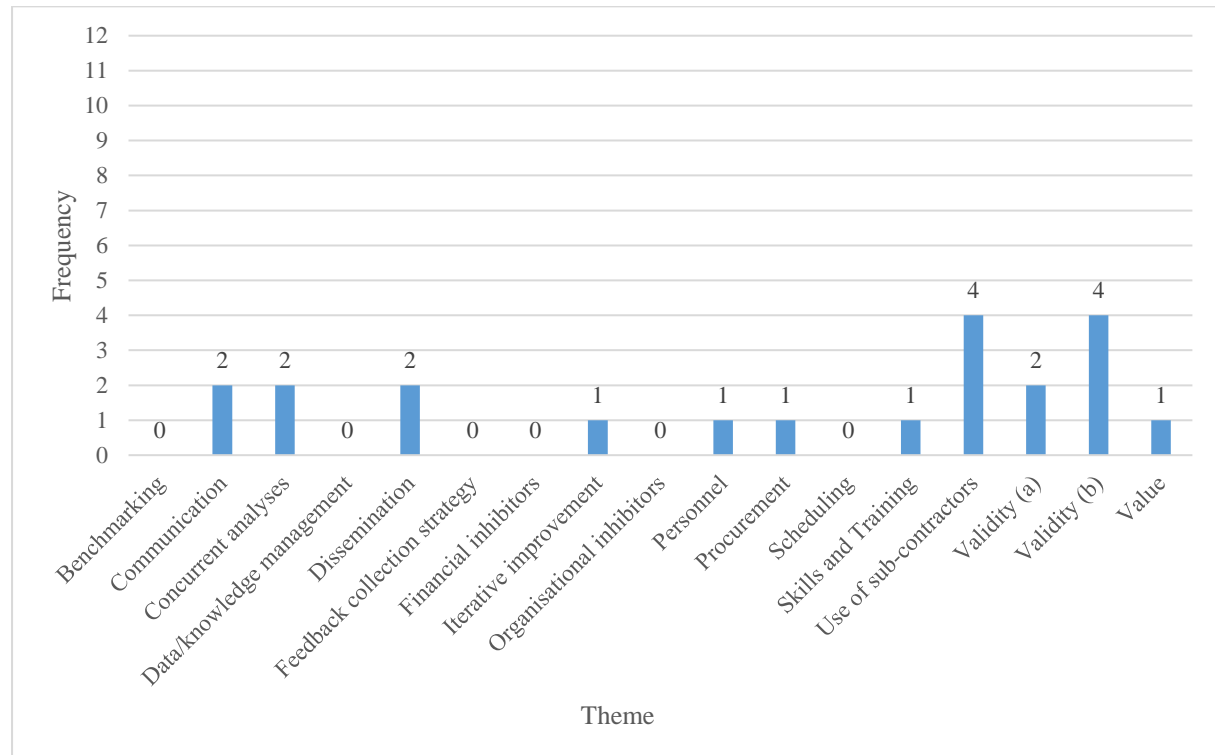


Figure 33 details all of the recorded weaknesses emanating from the analysis of themes. Immediately observable are the frequencies of the top three themes, all of which record a value of over double that of the top strengths recorded in Figure 30, suggesting practitioners saw far more weaknesses with the POE process at BCU than they did strengths. The top three themes emanating from Figure 31 were: i) communication ($f = 10$); ii) procurement ($f = 9$); and iii) skills and training ($f = 8$). In terms of weaknesses, these can be interpreted as: i) practitioners having concerns around inter-departmental communication regarding POE processes; ii) concerns around the initial planning of POE in terms of pre-POE organisational requirements; and iii) concerns over whether the correct personnel with the correct experience were available for the POE. Notably, five themes recorded no weaknesses ($f = 0$): i) concurrent analysis; ii) financial inhibitors; iii) validity (a); iv) validity (b); and v) value.

Figure 33 - A Graph Indicating the Total Frequencies of Themes Recorded as Weaknesses

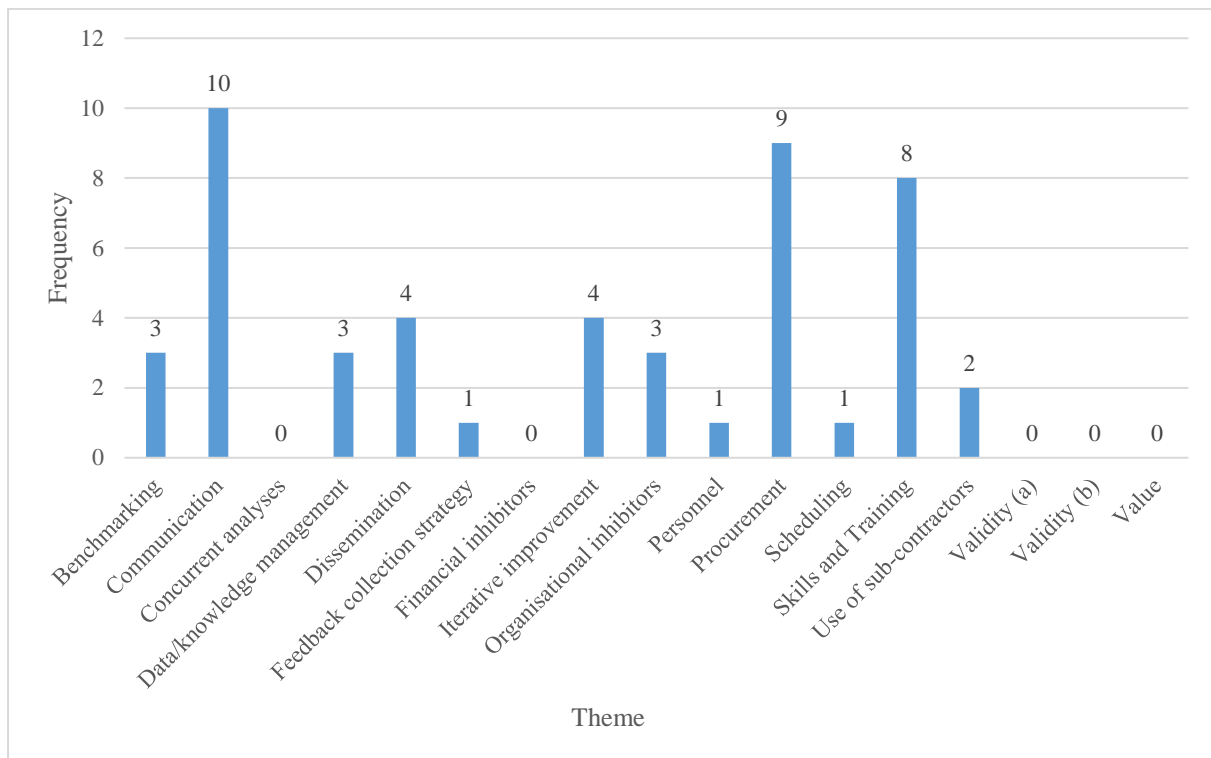
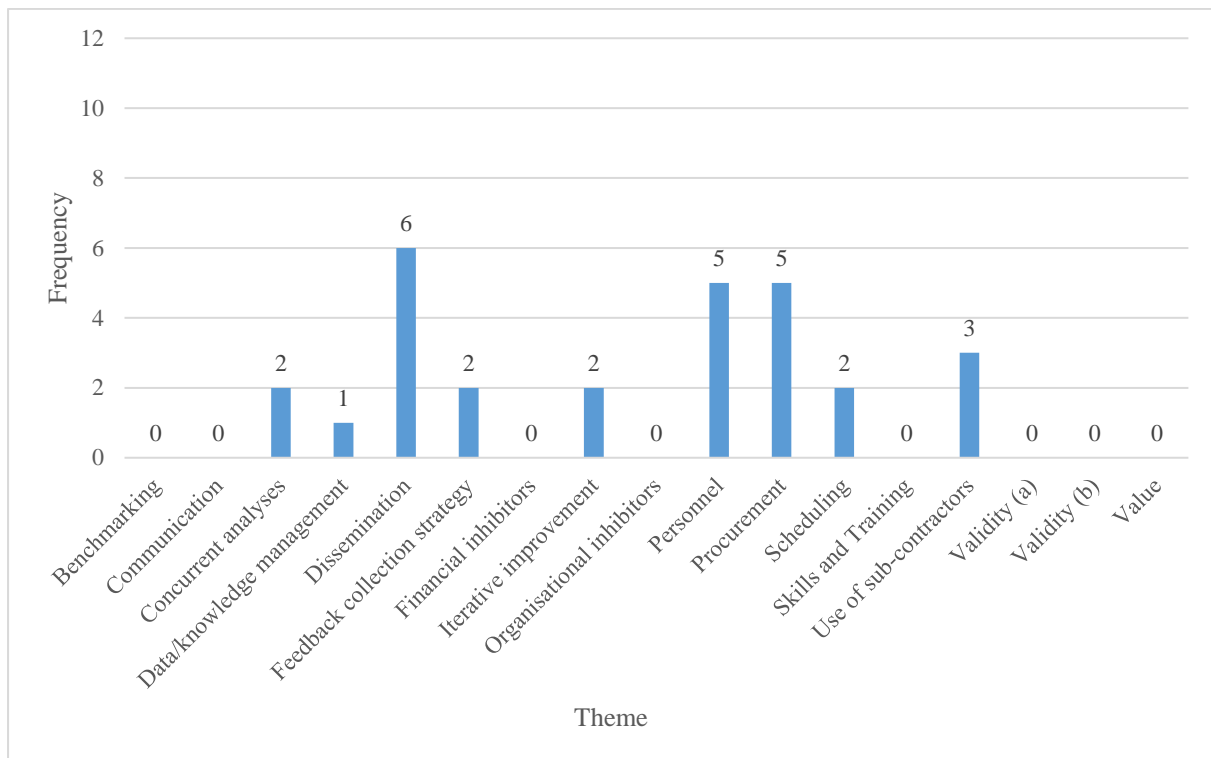


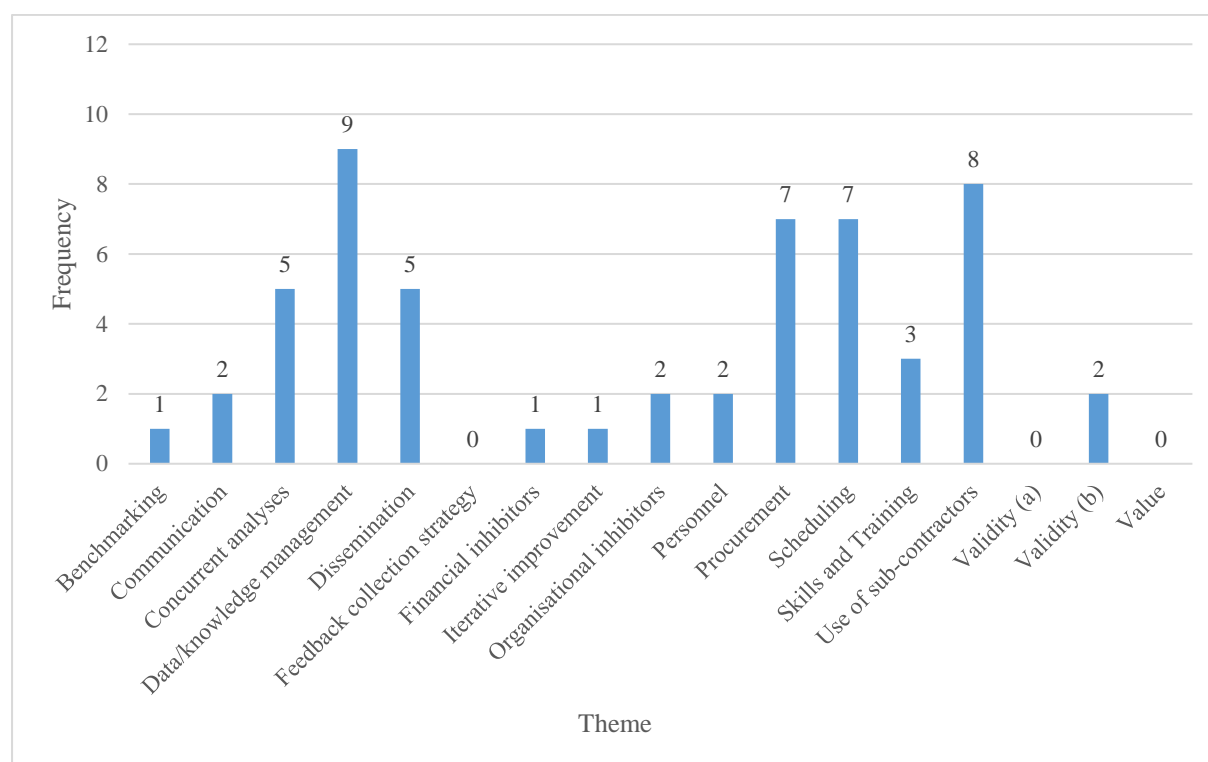
Figure 34 details all of the opportunities emanating from the analysis of themes. The three highest frequency themes regarding opportunities were: i) dissemination ($f = 6$); ii) personnel ($f = 5$); and iii) procurement ($f = 5$). This indicates that the practitioners whom participated in the focus group believed improvements could be made to: i) the democratisation of results to applicable university departments and staff (dissemination); ii) the skills and experience of Estates personnel contributing to the delivery of the POE (personnel); and iii) the initial planning of the POE at the procurement phase.

Figure 34 - A Graph Indicating the Total Frequencies of Themes Recorded as Opportunities



Finally, Figure 35 depicts the total threats emanating from the analysis of themes. The threats recorded in Figure 33 are observably at higher frequencies than the previous three categories (total $f = 55$ compared to $f = 19$, $f = 28$ and $f = 48$ for strengths, weaknesses and opportunities respectively). This may suggest that the practitioners whom participated in the focus group perceived the management of the task as the most pressing consideration as the highest recorded frequencies were: i) data knowledge management ($f = 9$); ii) use of sub-contractors ($f = 8$); iii) procurement ($f = 7$); and iv) scheduling ($f = 7$). Three of these themes (ii; iii; and iv) refer to intricacies of the POE planning phase, and the other (i) refers to the utilisation of the findings, all of which in the context of ‘threats’, can if not managed correctly, have significant impacts upon the overall success of the evaluation.

Figure 35 - A Graph Indicating the Total Frequencies of Themes Recorded as Threats



6.7 POE PHASE SWOT ANALYSIS

In an effort to ascertain further clarity on the specific temporal considerations of the POE process, the process itself has been divided into three categories: i) the planning phase; ii) the implementation phase; and iii) the knowledge management phase (c.f. table 19).

Table 19 - An Overview of the Temporal Breakdown of the Current POE Processes

Temporal breakdown	Description
Planning phase	The planning phase of the POE process refers to all of the requirements for conducting an evaluation. For instance: i) development partner agreement; ii) budget allocation; iii) scheduling; and iv) apportioning/mitigation of liability; to name just a few.
Implementation phase	The implementation phase of the POE process refers to the actual execution of the planned POE, this usually takes place in three intervals: i) 3-6 months; ii) 9-18 months; and iii) 3-5 years after initial handover.
Knowledge management phase	The knowledge management phase refers to the utilisation of the findings resultant of the process, these can take the form of physical actions on an existing facility, or may be comprised of ‘lessons learned’ for application in future projects.

Figure 36 visualises current HEI POE processes with the addition of the newly developed temporal points. It can immediately be observed that ten of the nodes (71.429%) present within the data flow diagram fall within the planning phase. In contrast, the implementation and

knowledge management phases contain one (7.143%) and three (21.429%) nodes respectively. This initial observation suggests that the HEFCE Guide to Post-occupancy Evaluation focuses heavily on the planning of a POE with significantly less focus on the implementation and knowledge management phases. The separation of the three temporal points within the POE process, allows an even more detailed overview of the specific strengths, weaknesses, opportunities and threats could be ascertained, as each previously recorded instance now has a temporal component with regarded to the process.

To assign temporal designations to comments, each previously evaluated comment within the transcript was assigned one of the aforementioned temporal designations based upon the subject of the comment. This was done so not to contradict previously assigned themes. For instance, if a 'procurement' based comment arose in the 'knowledge management phase' irrespective of whether it is a strength, weakness, opportunity or threat, this would mean the root cause of the issue playing out in the 'knowledge management phase' could be found in the 'planning phase'. An example of this could be the refusal of a development partner to cooperate with the POE process due to it not having been agreed in the procurement phase, this would have a major impact on knowledge management phase as the opportunity to reflect upon the work done by this development partner would be emitted from the evaluation.

Figure 36 - A POE Process Map Indicating the Planning, Implementation, and Knowledge Management Phases of a POE

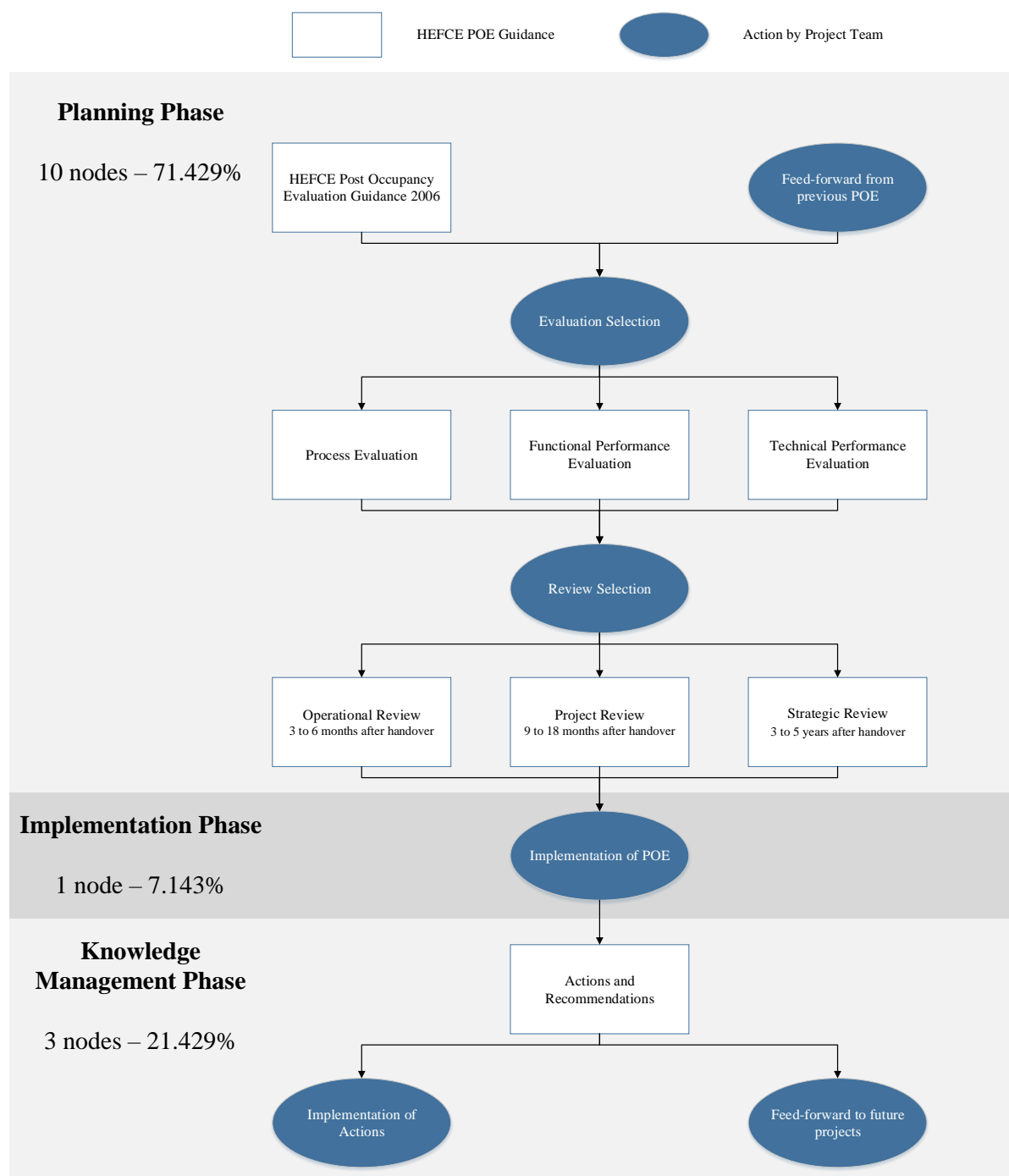


Table 20 shows the strengths, weaknesses, opportunities and threats of the focus group transcript, organised by the temporal points within the POE process. It is immediately noticeable that the implementation phase had only seven comments referring to it (4.575%) whereas the planning phase had 84 comments (54.901%) and the knowledge management phase had 62 comments (40.522%). As previously mentioned, the HEFCE Guide to Post-

occupancy Evaluation (2006) focuses largely on the planning phase of a POE rather than the implementation and knowledge management phases. This is backed up, at least in part, by the findings of the SWOT analysis organised temporally, which found that the planning phase was indeed in need of attention from the perspective of practitioners, however so to was the knowledge management phase as it presently.

Table 20 - An Overview of the Total Frequency of Strengths, Weaknesses, Opportunities and Threats of the Knowledge Management Phase of a POE

	Strengths	Weaknesses	Opportunities	Threats	Total
Planning Phase	12	35	13	24	84
Implementation Phase	3	0	2	2	7
Knowledge Management Phase	6	14	11	31	62

Figure 37 shows a visual representation of the instances of strengths, weaknesses, opportunities, and threats, from the planning phase of the POE process. In keeping with previous observations, the findings from the planning phase specific visualisation echo the wider analysis, that is the participating practitioners discussed far more weaknesses and threats than they did strengths and opportunities. In contrast to the wider analysis, the planning phase recorded more instances of weaknesses than threats, the opposite being true when looking at the combined values. This indicates that the practitioners whom participated in the focus group felt there were more direct flaws in the POE planning process than there were potential threats to it, suggesting despite the HEFCE Guide to Post-occupancy Evaluation offering granular detail on the planning of a POE, there is still room for improve upon it.

Figure 37 - A Graph Showing the Total Strengths, Weaknesses, Opportunities and Threats pertaining to the Planning Phase of the POE Process

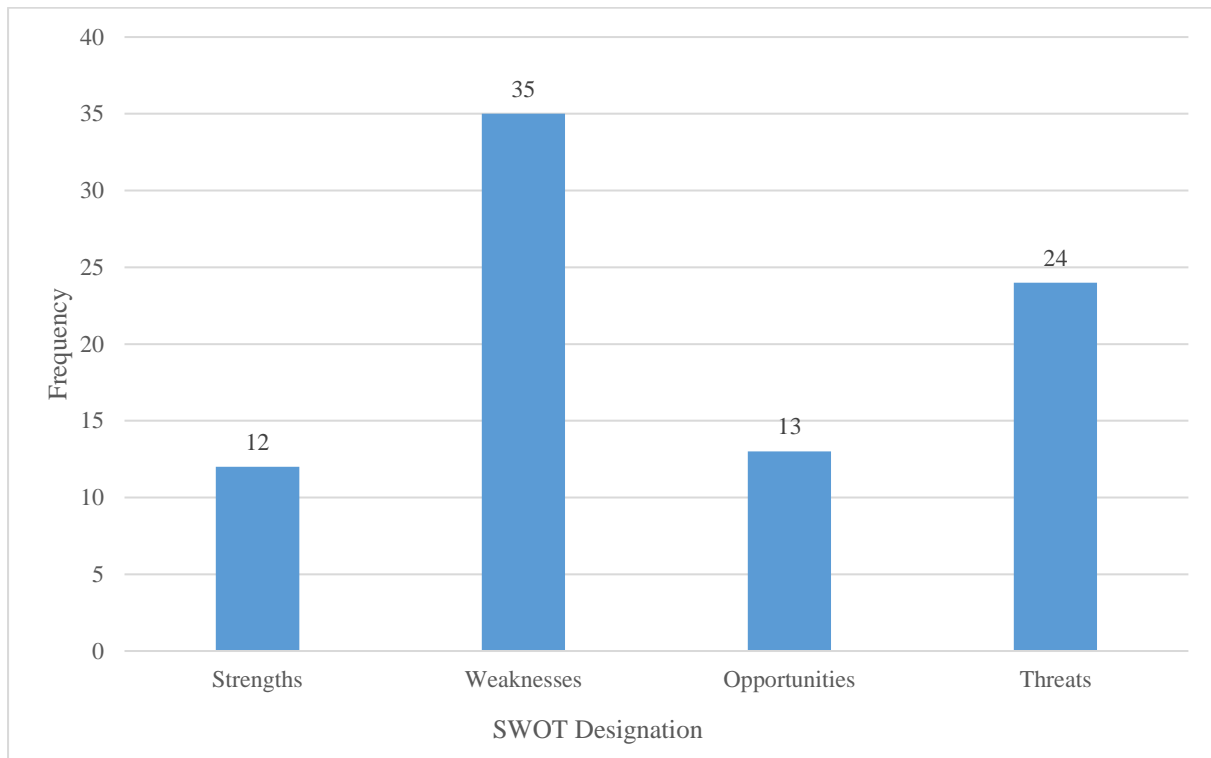
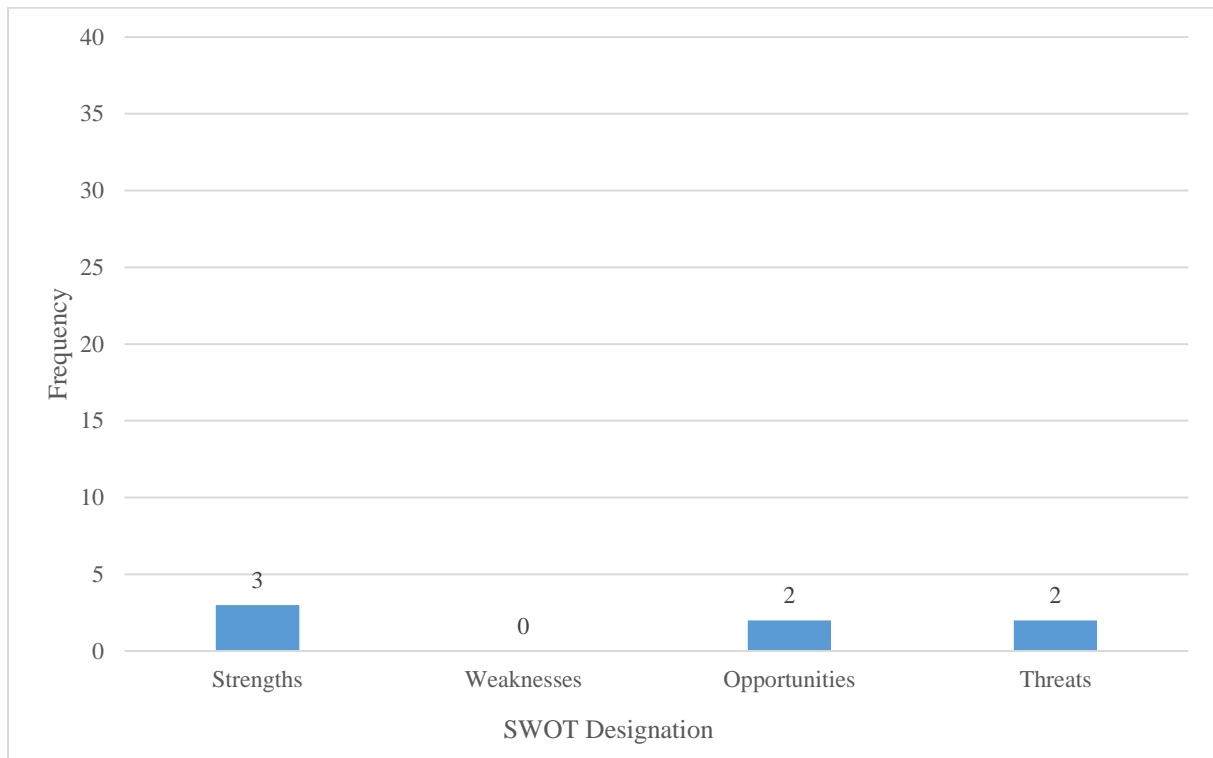


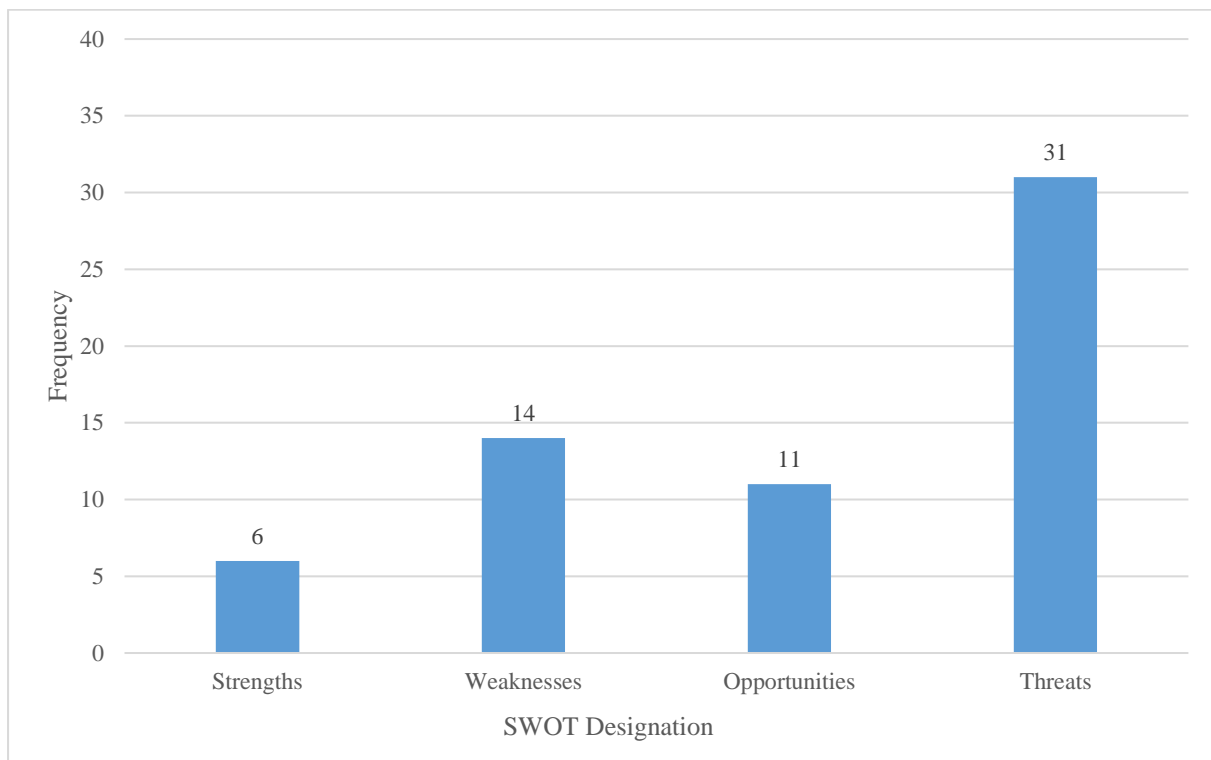
Figure 38 shows a visualisation of the strengths, weaknesses, opportunities and threats pertaining to the implementation phase, emanating from the focus group transcript data. The standout observation from this graph is the notably reduced instances of strengths, weaknesses, opportunities and threats recorded, where in fact no instances of weaknesses are recorded at all. This graph strongly suggests that practitioners perceive the areas requiring improvement are focused around the planning and knowledge management phases. Where instances are recorded, in general terms if strengths and opportunities are considered positive considerations, and weaknesses and threats considered negative considerations, then the positives outweigh the negatives regarding the implementation phase with a cumulative score of strengths and opportunities scoring five, and the cumulative scores of the weaknesses and threats scoring two. Notably, Birmingham City University outsource their POE's to an external consultant, this may also go some way to explaining the relatively low score recorded in the implementation phase.

Figure 38 - A Graph Showing the Total Strengths, Weaknesses, Opportunities and Threats Pertaining to the Implementation Phase of the POE Process



Finally, Figure 39 depicts the total strengths, weaknesses, opportunities and threats pertaining to the knowledge management phase. In contrast to the planning phase findings, the knowledge management phase has threats outweighing weaknesses, suggesting practitioners at this point are more concerned about potential pitfalls emanating from the process than the flaws they have actually identified within the process. However, when contrasted against the implementation stage findings, similar to the planning phase findings, it can clearly be observed that every field records significantly higher values.

Figure 39 - A Graph Showing the Total Strengths, Weaknesses, Opportunities and Threats Pertaining to the Knowledge Management Phase of the POE Process



Similar to the first stage of the SWOT analysis, the findings of the temporally organised SWOT analysis are now further broken down and organised by the individual strengths, weaknesses, opportunities and threats pertaining to each individual theme.

Table 21 shows the specific strengths, weaknesses, opportunities and threats recorded for each of the themes within the planning phase. Within the planning phase, strengths ($f = 12$) and opportunities ($f = 13$) when compared to weaknesses ($f = 35$) and threats ($f = 24$) suggest practitioners have reservations on current POE practice. The strengths recorded on each theme within the planning phase were as follows: i) ‘use of sub-contractors’ ($f = 4$); ii) ‘validity (b)’ ($f = 4$); iii) ‘validity (a)’ ($f = 2$); iv) ‘procurement’ ($f = 1$); and v) ‘scheduling’ ($f = 1$). These findings meant that twelve themes did not register any strengths at all, this may be down to practitioner satisfaction with the current processes, or simply the interrelationships of different factors not necessarily being apparent. Likewise, the opportunities recorded for the planning phase by theme were: i) ‘dissemination’ ($f = 4$); ii) ‘procurement’ ($f = 4$); iii) ‘iterative improvement’ ($f = 2$); iv) ‘personnel’ ($f = 1$); v) ‘scheduling’ ($f = 1$); and vi) ‘use of sub-contractors’ ($f = 1$). Interestingly within these findings, ‘procurement’ arose in both strengths and opportunities, which at the planning phase is to be expected. However, within

opportunities, dissemination (the democratisation of findings to applicable university personnel) also arose. Practitioners commented on being new to the process:

“The first one. I know there have been some in the past with the other project team, but I never went along to any of those. I think some of them actually, with Curzon A there wasn’t one at all, so, this is a good thing.”

This lack of previous interaction with POE appears to hamper future POE’s through unfamiliarity with process and expected outcomes. This also raises a separate consideration, where ‘iterative improvement’ is raised within the focus group, it is referring to the iterative improvement of HEI facilities. However, the finding of ‘dissemination’ within the planning phase could be interpreted as the requirement for iterative improvement of the POE process.

Table 21 - A Table Showing the Total Strengths, Weaknesses, Opportunities and Threats Pertaining to each Theme in the Planning Phase

Planning Phase					
Theme	Strengths	Weaknesses	Opportunities	Threats	Total
Benchmarking	0	0	0	1	1
Communication	0	9	0	0	9
Concurrent analyses	0	0	0	2	2
Data/knowledge management	0	0	0	0	0
Dissemination	0	2	4	0	6
Feedback collection strategy	0	1	0	0	1
Financial inhibitors	0	0	0	0	0
Iterative improvement	0	0	2	0	2
Organisational inhibitors	0	3	0	2	5
Personnel	0	1	1	2	4
Procurement	1	8	4	6	19
Scheduling	0	1	1	4	6
Skills and Training	1	8	0	1	10
Use of sub-contractors	4	2	1	4	11
Validity (a)	2	0	0	0	2
Validity (b)	4	0	0	2	6
Value	0	0	0	0	0
Total	12	35	13	24	84

With regard to the weaknesses and threats of the planning phase, there are nearly three times as many weaknesses, and twice as many threats as either strengths or opportunities. The highest frequency (f) weaknesses were: i) ‘communication’ ($f = 9$); ii) ‘procurement’ ($f = 8$); and iii) ‘skills and training’ ($f = 8$). These three themes all point to opportunities to tighten up the planning procedures for a POE: i) ‘communication’ denoting the information exchanges between applicable university departments and personnel; ii) ‘procurement’ denoting the POE planning requirements during design and construction phases of development; and iii) ‘skills and training’ referring to the level of competence and previous experience of undertaking POE’s. The highest frequency threats were: i) ‘procurement’ ($f = 6$); ii) ‘scheduling’ ($f = 4$); and iii) ‘use of sub-contractors’ ($f = 4$). Again these three themes point to opportunities to mitigate potential issue practitioners felt may arise from current processes: i) ‘procurement’ as previously stated; ii) ‘scheduling’ denoting the temporal points at which components of a POE are organised; and iii) ‘use of sub-contractors’ denoting the management requirements of multiple development stakeholders and their cooperation with the POE process.

Table 22 shows the total strengths, weaknesses, opportunities and threats pertaining to individual themes within the implementation phase. As previously stated, it is immediately noticeable that the implementation phase has substantially less instances of strengths, weaknesses, opportunities and threats, possibly down to an external consultant implementing the POE. The theme with the highest frequency of instances was ‘concurrent analysis’, this refers to where two separate building evaluation techniques are being conducted simultaneously. An example of this could be the undertaking of a space utilisation survey, evaluating the usage of spaces within a facility, commenced within the handover to 18 month window that two of the components of a POE are scheduled to take place in. Notably, this theme has had four instances recorded, two in strengths and two in threats. Space utilisation evaluations have alternatively aligned objectives to POE’s, focusing far more on efficiency and value for money than end-user feedback and quality control. The opportunities in relation to ‘concurrent analysis’ were focused around adding more detail to the findings of a POE:

“testing the popularity of those social spaces, anecdotally [they] are popular, [but it] would be aided by some harder evidence.”

However, despite this rationale for conducting a concurrent analysis, when questioned on the potential effect this could have on end-user feedback at the 9-18 month time interval, it was stated:

“There may be an interesting correlation when we do the second half of the POE.

This suggests that practitioners are aware conducting a concurrent analysis could affect the findings of the end-user feedback stage of the POE, particularly as the findings of a space utilisation survey may cause the space end-users have been becoming accustomed to for the required 9-18 months to be altered or removed if deemed superfluous or inefficient. Notably there is no mention in any POE guidance documentation of conducting concurrent analysis outside of the methods prescribed for the planning and implementation of POE.

Table 22 - A Table Showing the Total Strengths, Weaknesses, Opportunities and Threats Pertaining to each Theme in the Implementation Phase

Implementation Phase					
Theme	Strengths	Weaknesses	Opportunities	Threats	Total
Benchmarking	0	0	0	0	0
Communication	0	0	0	0	0
Concurrent analyses	2	0	0	2	4
Data/knowledge management	0	0	1	0	1
Dissemination	0	0	0	0	0
Feedback collection strategy	0	0	1	0	1
Financial inhibitors	0	0	0	0	0
Iterative improvement	0	0	0	0	0
Organisational inhibitors	0	0	0	0	0
Personnel	0	0	0	0	0
Procurement	0	0	0	0	0
Scheduling	0	0	0	0	0
Skills and Training	0	0	0	0	0
Use of sub-contractors	0	0	0	0	0
Validity (a)	0	0	0	0	0
Validity (b)	0	0	0	0	0
Value	1	0	0	0	1
Total	3	0	2	2	7

Finally, Table 23 shows the total strengths, weaknesses, opportunities and threats by theme pertaining to the knowledge management phase. Whilst less instances of strengths, weaknesses, opportunities and strengths are observable in the knowledge management phase ($f = 62$) than in the planning phase ($f = 84$), there are still substantially more instances recorded than were in the implementation phase ($f = 7$). The breakdown of these findings show substantially more weaknesses ($f = 14$) and threats ($f = 31$) emanating from the knowledge management phase,

than strengths ($f = 6$) and opportunities ($f = 11$). Notably, when investigating the total instances of strengths, weaknesses, opportunities and threats by individual theme within the knowledge management phase, ‘data/knowledge management’ ($f = 12$) and ‘dissemination’ ($f = 11$) had the highest number of instances, with ‘use of sub-contractors’ ($f = 7$) having the next highest number of instances. The themes ‘dissemination’ and ‘data and knowledge management’ refer to the democratisation and utilisation respectively of the findings of the POE. The ‘data and knowledge management’ theme was found to have no instances of either strengths or opportunities, with all instance being shared between ‘weaknesses’ ($f = 3$) and ‘threats’ ($f = 9$). This suggests there is significant room for improvement regarding the utilisation of the findings of a POE. The ‘dissemination’ showed a more consistent set of findings strengths, weaknesses and opportunities all recording two instances each, whilst the threats recorded five instances.

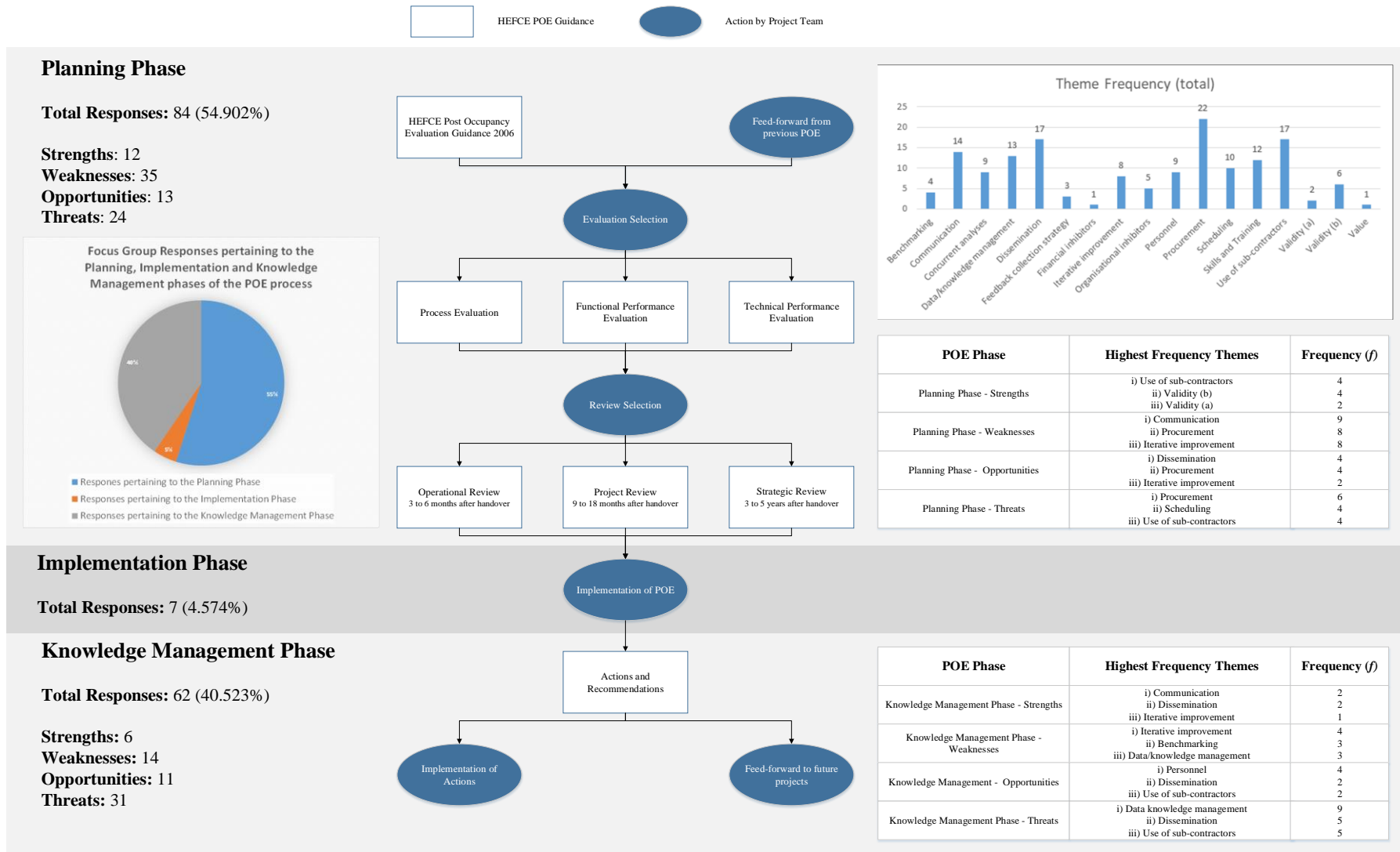
Table 23 - A Table Showing the Total Strengths, Weaknesses, Opportunities and Threats Pertaining to each Theme in the Knowledge Management Phase

Knowledge Management Phase					
Theme	Strengths	Weaknesses	Opportunities	Threats	Total
Benchmarking	0	3	0	0	3
Communication	2	1	0	2	5
Concurrent analyses	0	0	0	1	1
Data/knowledge management	0	3	0	9	12
Dissemination	2	2	2	5	11
Feedback collection strategy	0	0	1	0	1
Financial inhibitors	0	0	0	0	0
Iterative improvement	1	4	0	1	6
Organisational inhibitors	0	0	0	1	1
Personnel	1	0	4	0	5
Procurement	0	1	1	2	4
Scheduling	0	0	1	3	4
Skills and Training	0	0	0	2	2
Use of sub-contractors	0	0	2	5	7
Validity (a)	0	0	0	0	0
Validity (b)	0	0	0	0	0
Value	0	0	0	0	0
Total	6	14	11	31	62

6.7.1 Planning Phase SWOT Findings

Figure 40 shows an infographic summarising the main findings from the focus group transcript data analysis, this includes: i) the POE process diagram with temporal phases identified; ii) the total number of strengths, weaknesses, opportunities and threats from each temporal phase; iii) the total number strengths weaknesses, opportunities and threats for each identified theme; and iv) the three highest frequency themes in terms of strengths, weaknesses, opportunities and threats for the planning and knowledge management temporal phases. Immediately it is observable that the vast majority of amendments and modifications emanating from the focus group transcript are focused around the planning phase (54.902%), and the knowledge management phase (40.523%). The implementation phase in comparison received scant attention, only recording seven instances (4.574%) of a strength, weakness, opportunity or a threat.

Figure 40 - An Overview of the Results of the Thematic and SWOT Analysis of the Focus Group Transcript



Within Figure 40 can be seen the three highest frequency themes in terms of instances of strengths, weaknesses, opportunities and threats emanating from the planning phase of the POE process. The three highest frequency strengths within the planning phase were: i) use of sub-contractors ($f = 4$); ii) validity (a) ($f = 4$); and iii) validity (b) ($f = 2$). The ‘use of sub-contractors’ has already been acknowledged as a diligent approach in light of the independence and specialist knowledge external development partners bring to a project. However, the findings of validity (a) and validity (b), suggests that practitioner’s view the process utilised at BCU at present as adhering to guidance documentation and as having robust procedures delivering reliable results.

The three highest frequency weaknesses within the planning phase were: i) communication ($f = 9$); procurement ($f = 8$); and iii) iterative improvement ($f = 8$). The finding of communication as the top weakness suggests practitioners believe interdepartmental communication is of the upmost importance, whilst also acknowledging that current communication practices may not be sufficient to successfully plan a POE. A number of comments emanating from the focus group transcript support this assertion, in response to a question regarding practitioners’ direct experiences of previous POE’s:

“The first one [I’ve experienced]. I know there have been some in the past with the other project team, but I never went along to any of those. I think some of them actually, with Curzon A there wasn’t one at all, so this is a good thing.”

Another practitioner commented:

“Previously to this, unless I’m uninformed, I’m not aware of any structured POE’s ever conducted.”

Whilst practitioners state that there have been significant changes to the project team in recent years, for a number of focus group participants, despite significant Estates experience, this was their first interaction with POE. Notably, ‘procurement’ was found to be a top three frequency theme in three of the four categories, with the exception being the ‘strengths’ category. Procurement in this context denotes the planning requirements for a POE required before a development is embarked upon. The observation of ‘procurement’ arising in weaknesses ($f = 8$), opportunities ($f = 4$) and threats ($f = 6$), and not in strengths, strongly suggests practitioners have concerns regarding the current planning of POE. Much of the practitioner concern regarding ‘procurement’ within the planning phase of a POE appears to centre on non-

cooperation with the POE process from development partners. On the subject of having pre-agreed participation in a POE with applicable development partners, practitioners commented:

“I think it [is] what you get in their contracts really, if they haven’t included it, then they won’t want to do it.”

Also, a second quote highlighted the difficulties of not having pre-agreed contractual framework for participation in the POE process:

“...write it into the terms and conditions of appointment, but generally my experience is you’ve relied on good will, with architects and so on.”

Both of these statements affirm the importance of pre-agreed participation in the POE prior to commencement of the development, agreed by all development partners. Finally, ‘iterative improvement’ arose as the third most frequent theme in the weaknesses category of the planning phase. Iterative improvement is considered a prime objective of POE’s in academic terms, allowing the ‘learned lessons’ on previous developments to be avoided on future developments.

The three highest frequency opportunities emanating from the planning phase were: i) dissemination ($f = 4$); ii) procurement ($f = 4$); and iii) iterative improvement ($f = 2$). Dissemination (referring to the process of democratising POE results to applicable university departments and personnel) and procurement (referring to the initial POE planning requirements) being identified as the two most frequent themes in terms of opportunities almost represents a microcosm of the overall finding of the SWOT analysis, with the planning phase (54.902%) and knowledge management (40.523%) phases requiring improvement from the perspective of practitioners. Iterative improvement also arose as the third most frequent opportunity, suggesting practitioners realise the innate opportunities to utilise POE’s to improve facility performance through the implementation of ‘lessons learned’ in the future.

The three highest threats emanating from the planning phase were: ‘procurement’ ($f = 6$); ‘scheduling’ ($f = 4$); and iii) use of sub-contractors ($f = 4$). Both procurement and scheduling refer to structural planning considerations of the POE process, procurement as previously mentioned referring to pre-development requirements, whereas scheduling refers to the direct temporal arrangement of POE process components. Furthermore, ‘use of sub-contractors’ in the context of the planning phase also refers to the difficulties inherent with management of neo-liberal contractual structure. Being as this section refers to the planning phase of the POE

process, these are not unexpected outcomes, however, the finding of ‘procurement’, ‘scheduling’, and ‘use of subcontractors’, as the three top threats, highlights significant practitioner concern regarding the structural planning of POE at present.

6.7.2 Knowledge Management Phase SWOT Findings

Within Figure 38 is an overview three most frequent themes with regard to strengths, weaknesses, opportunities and threats pertaining to the knowledge management phase of the POE process. The three most frequent strengths were: i) ‘communication’ ($f = 2$); ii) ‘dissemination’ ($f = 2$); and iii) ‘iterative improvement’ ($f = 1$). The finding of two instances each for both ‘communication’ and ‘dissemination’ suggests practitioners felt both interdepartmental communication and the sharing of applicable findings with appropriate departments and personnel had, on previous evaluations gone relatively well. However, the frequency of two for both themes is a comparatively low value, not only compared with the like for like strengths found in the planning phase, but also having the lowest cumulative value of instances (five instances) recorded in comparison with all other fields falling in a range between 8 instances (knowledge management phase opportunities) and 25 instances (planning phase weaknesses). The finding of ‘iterative improvement’ ($f = 1$) suggests in at least one recorded comment emanating from the focus group, a ‘lesson learned’ has been taken forward from one development to another, and subsequently the initial issue was not repeated. However, the finding of a frequency of one for ‘iterative improvement’ within the knowledge management phase strengths, represent the lowest value in any field across the two tables detailing most frequent themes.

The three highest frequency weaknesses emanating from the knowledge management phase were: i) ‘iterative improvement’ ($f = 4$); ‘benchmarking’ ($f = 3$); and iii) ‘data/knowledge management’. The three top themes from this category are all similarly aligned in their objectives. Benchmarking denotes the utilisation of previous POE findings to produce criteria upon which future developments can be evaluated. Iterative improvement denoted a process of implementing ‘lessons learned’ from previously completed POE’s to improve quality and performance of future developments. Data/knowledge management denotes the appropriate use of POE findings for alternative objectives such as developing Estates strategy or developing information technology (IT) and audio visual (AV) infrastructure strategies. Again, the frequencies in this category, whilst not as infrequent as the strengths found in the knowledge management, still represent findings at the lower frequency end of the spectrum.

The three most frequent themes pertaining to opportunities at the knowledge management phase were: i) 'personnel' ($f = 4$); ii) 'dissemination' ($f = 2$); and iii) 'use of sub-contractors' ($f = 2$). The finding of personnel as the most frequent theme related to opportunities, suggests practitioners feel the management of personnel could be improved to further ensure the correct skills and training requirements are in place to successfully undertake a POE. However, this theme does not arise as a weakness or threat, also indicating that despite room for improvement in this regard, this is probably not a primary concern of the focus group participants, in a field of competing considerations. Dissemination, similar to procurement in the planning phase, arises on three separate occasions in three different categories. Again, similar to procurement, dissemination at the knowledge management phase is a key consideration, as without the sharing of findings at the conclusion of the POE, the 'lessons learned' cannot be incorporated in future developments - rendering the entire process as more of a 'tick box' activity as opposed to a process with tangible benefits to practitioners and end-users. The finding of sub-contractors as the third most frequently observed theme within opportunities, suggests that despite focus group participants offering 'independence' and knowledge' as reasons for utilising sub-contractors, it was still felt that improvements could be made in the way these professional relationships are managed with regard to POE.

The three most frequent threats pertaining to the knowledge management phase were: i) 'data/knowledge management' ($f = 9$); 'dissemination' ($f = 5$); and iii) 'use of subcontractors' ($f = 5$). The combination of these three themes as threats in the knowledge management phase, could be interpreted as being interrelated. The dissemination of POE findings to applicable departments and personnel as well as utilising the garnered knowledge to maximum effect, as previously stated, remain elusive objective. The use of sub-contractors at the knowledge management phase adds another dimension of complexity, particularly if no pre-contractual arrangements are in place, as decisions regarding the sensitivity of findings within a grouping of development partners take on extra significance.

6.8 DISCUSSION

The first significant observation emanating from the analysis of the focus group transcript, is that practitioners largely spoke on issues centred on the planning phase and the knowledge management phase of the POE process. The implementation phase in comparison received scant attention. This finding could suggest that the implementation phase of BCU's POE process is, in the opinion of practitioners, without any major issues in need of rectification.

However, the majority of practitioners involved in BCU's POE processes, exceptions being the soft landings representative as well as an external consultant, have relatively little input on the implementation phase when compared to the planning and knowledge management phases, as at present the POE are a service which the university currently outsources.

BCU's POE's are undertaken by an external consultant whom has worked with the university's Estates department since 2009. Since 2009, BCU has relocated from its former suburban campus in the Perry Barr area of Birmingham, to a new city centre campus located in Birmingham's educational quarter, and as such, the construction of a new campus has given rise to the opportunity to conduct a whole series of POE reports. The continuing relationship between the Estates department and the consultant suggests BCU are satisfied with the level of expertise, and as stated in the focus group, feel an external consultant delivers a 'degree of independence.' Outsourcing this task to an external partner with expert knowledge, and separate from any potential conflict of interest appears intuitive. However, if considered in the context of intellectual property (IP) and virtual property (VP), this approach may undervalue the findings of a POE. The findings of the POE represent IP and VP generated from the feedback of the built asset, and as such, if utilised correctly, can be value adding in terms of future development. A lack of understanding to this end is evidenced by two quotes, the first being offered as an answer to a focus group question regarding the Estates department's handling of IP and VP in light of the planning of a POE:

"We're not the pharmaceutical sector [laughter] I think is the answer."

The second quote was an annex to the initial answer above, pertaining to the same question from a different focus group participant:

"it's really a non-issue for us, I mean, we also think do we then share these reports across the wider sector, put them out in the public domain."

Utilisation of an external consultant, despite the need for independence, without a pre-agreed framework for the IP and VP generated, may leave the commissioning institution as having given away a large quantity of building data, and having paid to do so. Furthermore, the routine nature with which POE is outsourced, also may have diminished practitioner attention on the implementation phase.

The second major finding of the transcript analysis is the requirement for more thorough planning procedures regarding POE at the outset of a development. At present, the first phase

of evaluation within the POE process, the project review 3-6 months after handover of the facility, requires the POE facilitator to collect all of the required project team feedback data before the project team disassembles. In the fast paced construction sector, this can be a significant challenge. An avenue for mitigating this issue has been contractual agreement stipulating cooperation, with ten percent of the final fee dependent upon a development partners cooperation with the POE process. However, as stated in the focus group, ten percent of the fee being withheld may not hold the development partner to participation with the POE, particularly if the professional working relationship between two development partners has become strained over the course of the development. A participant of the focus group recalled when working in America, that thirty percent of the fee was held back until completion of the POE, a far more substantial sum for a development partner to walk away from.

Contractual agreements within the planning phase were not practitioners only concern, with communication also being observed as a reoccurring theme. Many of the participants of the focus group asserted they had been largely uninformed regarding the planning, implementation, and knowledge management phases as well as the overall progress of the ongoing evaluations. A number of factors can contribute to this, personnel changes in university executive group (UEG), organisational and personnel changes to the development team, as well as legislative and policy changes to name but a few. Nevertheless, practitioners saw communication between applicable departments and personnel as a key requirement of the POE process, and an objective that will aid efficient management of the universities facilities - failure to do so having direct consequences in terms of costs and efficiency.

A number of reoccurring themes also arose from the knowledge management phase of the POE process. In particular, dissemination was seen as a major area in need of improvement. Many of the practitioners participating in the focus group asserted that they had not seen previously completed POE reports. POE can be a significant task to manage, requiring cooperation from development partners, access to end users, and temporally sensitive scheduling according to specific time intervals. The findings of a POE have a direct impact upon Estates strategy, increasing efficiencies and reducing costs. If a POE is undertaken, and the findings not democratised to appropriate departments and personnel, the process has been rendered as a 'tick box' exercise, particularly in light of the previous requirement for government funded projects to undergo a soft landings process (Riley *et al.*, 2010).

Another significant theme which arose from the knowledge management phase regarded the theme data/knowledge management. Beyond simply ensuring reports are disseminated to applicable departments and personnel, the application of the knowledge created can prevent issues which have been highlighted in previous developments. However, failure to utilise POE findings appropriately can have significant impacts upon schedules and costs, as ‘lessons learned’ from previous projects are not incorporated into future developments, incurring the same time and expense to rectify as was expended when the issue was initially observed in the original development.

6.9 CONCLUSION

The concept of implementing ‘lessons learned’ from previous developments through a formalised feedback mechanism is a central tenant of POE. Leaman and Bordass (2001) introduce the idea of ‘virtuous circles of improvement’ whilst research ‘sick building syndrome back in the 1960s (c.f. Collinge, 2014). As such, two of the key objectives for POE emanating from academic literature is the prospect of being able to benchmark facility performance and iteratively improve HEI facilities.

However, the theme ‘benchmarking’ had two instances arise in the planning phase, both as threats, no instances in the implementation phase, and three instances in the knowledge management phase, all of which were weaknesses. Similarly, ‘iterative improvement’ had two instances of opportunities recorded at the planning phase, no instances at the implementation phase, and recorded one strength, four weaknesses, and one threat at the knowledge management phase. The relatively low instances strengths, weaknesses, opportunities and strengths recorded for the themes ‘benchmarking’ and ‘iterative improvement’, despite the academic importance placed upon these themes, suggest whilst practitioners are aware of these objectives, they may not be taking precedence amongst a diverse field of competing requirements.

CHAPTER 7

HYBRID MODEL DEVELOPMENT

7.1 INTRODUCTION

The development of the hybridised model for user-friendly planning and implementation of POE in HEIs is discussed in this chapter, comprising the findings of: i) the bibliometric analysis; ii) the delineated POE process iii) the case study of BCU's newly developed HE facilities; iv) the analysis of publically available POE reports; and v) the findings of the practitioner focus group, in conjunction with elements of the HEFCE Guide to Post-occupancy Evaluation (2006). Temporal phases are added to the hybridised POE model also: i) a pre-planning phase; ii) a planning phase; iii) an implementation phase; and iv) a knowledge management phase. In addition, three accompanying evaluation pathway guidance flow diagrams are also presented. The POE model has been visually represented twice, the first showing the process model as a simple flow diagram, the second integrating the temporal component, utilising the RIBA Plan of Work Stages (2013), a prominent document within the UK construction sector.

7.2 DEVELOPMENT OF THE HYBRIDISED POE MODEL

The findings of the bibliometric analysis highlighted the small academic CoP working in the field of POE. This small community of practice is having a direct impact upon the academic objectives of: i) developing benchmark criteria (c.f. Preiser and Vischer, 2005; Olivia and Christopher, 2014); and subsequent ii) iterative improvement of HE facilities (c.f. Göçer *et al.*, 2015), as current POE processes are designed to ensure practitioners have flexibility with regard to the planning and implementation of POE. This innate flexibility prevents the development of a sequential POE processes incorporating common points of data comparison, preventing direct comparison of the findings of one POE with another.

The delineation of POE processes and analysis of publically available reports highlighted a process of iterative improvement on the POE process itself as an institution develops its own approach. Over a series of buildings, the POE process utilised is updated and improved upon with each occurrence, leaving many of the early POE reports incomparable with later reports due to the increasing sophistication of the process and lack of common points of comparison.

Furthermore, when these reports were interrogated in terms of compliance - the number of POE components selected by practitioners in comparison to the maximum component's that could possibly be selected, the levels of compliance were found to be remarkably low, never incorporating more than 50% of the total number of evaluation components which could be selected. The evaluations not selected by practitioners are lost, leaving the HEI unable to utilise what would have been measured. Subsequently, these evaluations which are never undertaken cannot be compared to the performance of future developments, severely hampering benchmarking and iterative improvement efforts.

The case study of BCU's POE reports saw the same shortcomings observed in the publically available POE reports repeated. Evaluations either differed completely, or were found to be undertaken at differing time intervals. Furthermore, no BCU POE report was found to incorporate more than 37.50% of the total evaluation selections possible, with two reports having only 25.00% compliance. The focus group of BCU practitioners involved in the institutions POE processes offered a rich source of information regarding BCU's POE processes, and potential ways in which practitioners felt POE processes could be improved upon. This included: improved dissemination; pre-agreement regarding POE involvement with external development partners; and a sequential process as opposed to bespoke process in each instance, and formalised review of previous POE findings.

7.2.1 Introduction of POE Phases

The HEFCE Guide to Post-occupancy Evaluation (2006) offers an in depth guide to practitioners undertaking a POE investigation within the HE sector. However, the document consists of a list of guidance and evaluation templates, with only limited rationale as to when and why an evaluation should take place. Furthermore the guidance is deliberately written to ensure flexibility for practitioners. The overriding assumption in this instance is that POE practitioners have the prerequisite experience to competently develop an evaluation strategy. This, in the case of BCU's practitioners is difficult to attest, as practitioner experience of POE's was found to be limited, despite the selected practitioners being directly linked with BCU's POE processes. As such, a sequential structured approach facilitating a user-friendly approach is required to maximise HEI value from conducting such evaluations. The first step to developing a sequential pathway was to organise the hybridised POE temporally. In much the same way as the RIBA Plan of Work (2013) stages break the construction process down into temporal points, a similar requirement is necessary for POE processes. The POE hybridised

model is designed to run parallel to construction process outlined in the RIBA stages, the prime document with regards to commercial and HE developments in the UK. The POE process has thus been broken down into four temporal stages: i) pre-planning phase; ii) planning phase; iii) implementation phase; and iv) knowledge management phase (c.f. Figure 41).

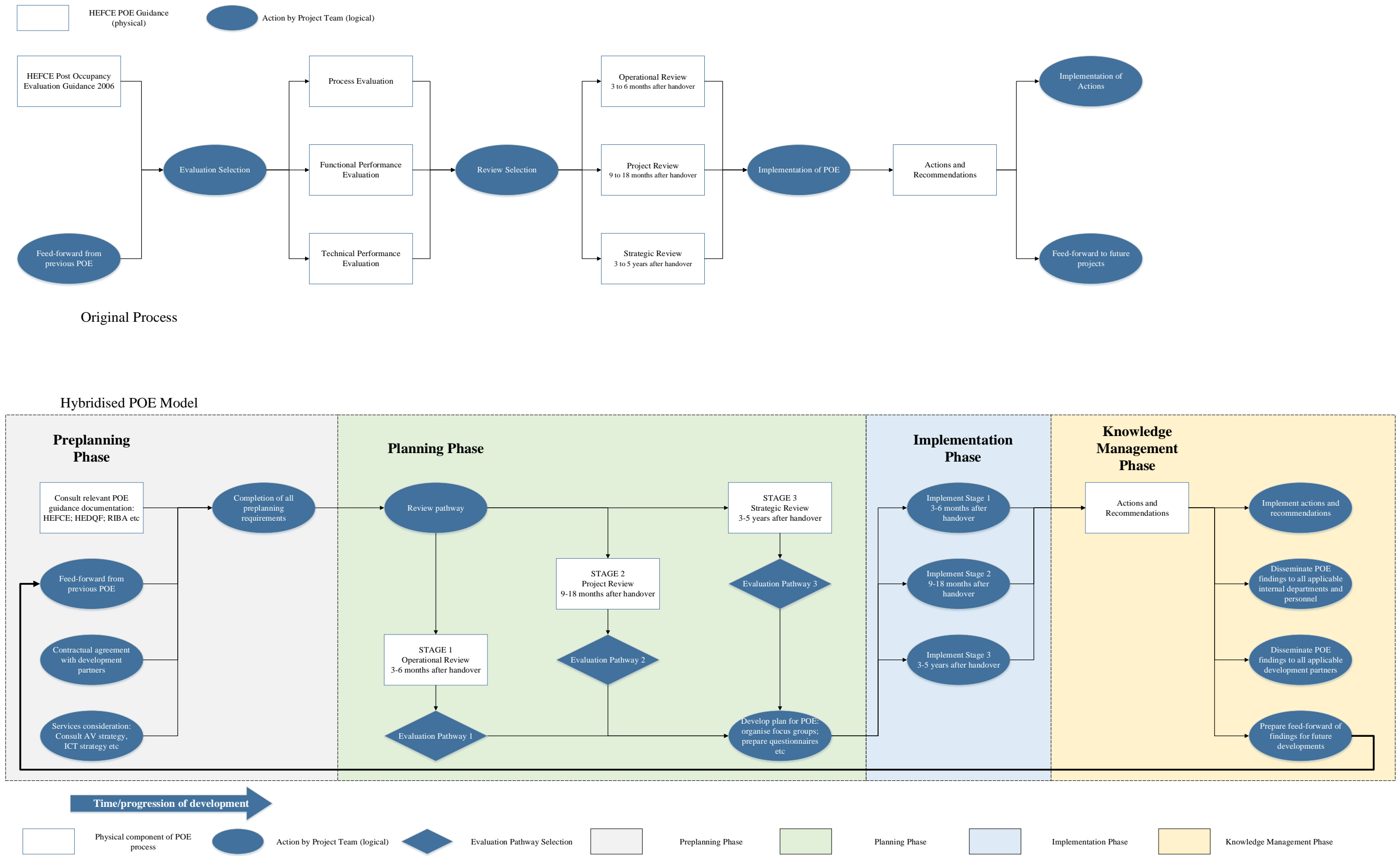
The Preplanning phase - practitioners are required to review previous findings, feeding forward ‘lessons learned’ into the new development project. It is also at this stage pre-agreements regarding POE cooperation are established, as well as the consideration of service provision (ICT and AV).

The Planning phase - evaluations intended to be conducted by practitioners are planned. Focus groups and interviews are widely used in POE’s, and require planning before they are executed, particularly in terms of preparation of focus group and interview questions and specifying intended participants.

The Implementation phase - the previously planned evaluations are conducted.

The Knowledge management phase - encompasses the: i) dissemination of findings to applicable internal departments and personnel as well as external development partners; ii) actions and recommendations pertaining to the completed evaluation; and iii) the preparation of findings for feed-forward to future developments.

Figure 41 - A Comparison of Original Interpretation of POE Processes and the Hybridized Model presented as part of this Research



7.2.2 *Evaluation Pathways*

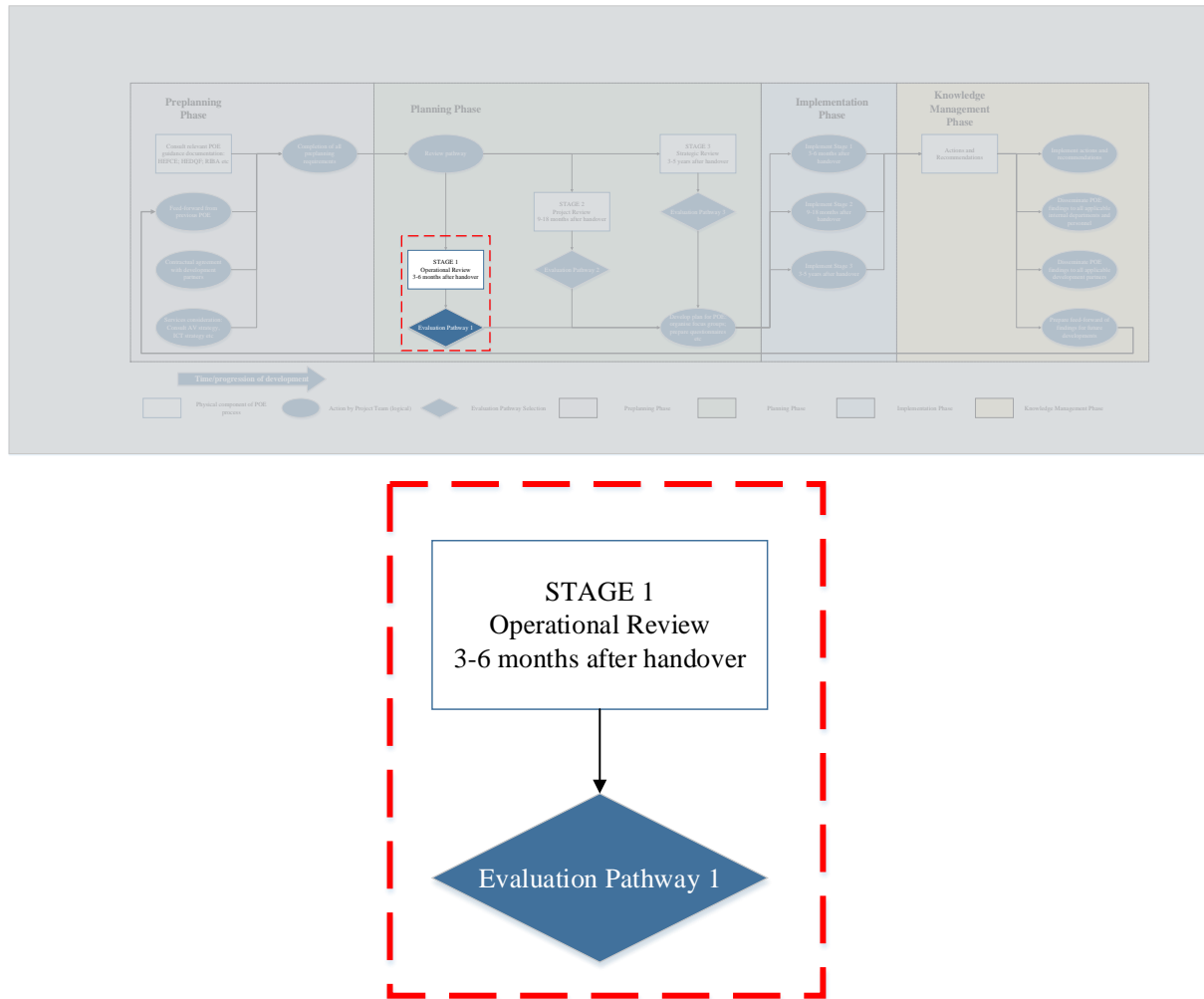
The three stage approach detailed in the HEFCE Guide to Post-occupancy Evaluation (2006) (3 to 6 months after occupation, 9 to 18 months after occupation, and 3-5 years after occupation) is incorporated into the hybrid model. However, the designation of a separate ‘review selection’ and ‘evaluation selection’ is not incorporated due to the similarities in the rationale of these selection points (process evaluation and operational review for example). In efforts to organise these components more rationally, at each of the three assigned temporal evaluation points, a pathway has been developed in the form of an additional flow diagram, offering practitioners a user-friendly tool for selecting the most applicable evaluation strategies and specific methods for undertaking the evaluation. These pathways are made up of pre-existing components organised into a flow diagram to aid practitioners in the planning of a POE. These pathways require further future research to differentiate different approaches for different evaluations - this has been recorded within the future research requirements within the final chapter of this thesis.

Figure 39 shows the original HEFCE POE process as well as the completed hybridised POE model for user-friendly planning and implementation within the UK HE sector. The original POE process flow diagram has been rotated 90° so to be arranged horizontally, allowing direct comparison with the hybridised model. Each of the three evaluation points detailed within the hybridised model has an accompanying flow diagram detailing the selections practitioners are required to make (c.f. Figures 41, 43, and 45). Each of these decision making aids is based upon a four point protocol, three questions followed by the selection of applicable methods for the specific evaluation that practitioners are required to make. The protocol for each decision aid flow diagram was as follows: i) what is to be evaluated; ii) what does that entail; iii) what is the most applicable evaluation method (process, functional performance and technical performance evaluations); followed by iv) the selection of the most applicable method to undertake the evaluation.

Figure 42 shows the location within the hybridised process where evaluation pathway one is located. Figure 43 shows the decision making flow diagram applicable to evaluation point one. At this juncture, in the original HEFCE Guide to Post-occupancy Evaluation (2006), practitioners are required to select the aspect of the project delivery they wish to evaluate: i) the delivery of the project; or ii) the operational management of the project. However, both pathways within the original guidance documentation brought the reader to the same evaluation

technique, namely a ‘process evaluation’. As such, rather than requiring practitioners to differentiate between the two components, they should be considered as complementary parts of the same evaluation, as both are supported by the same entailments (brief, procurement, design, construction, commissioning process and occupation) (c.f. Figure 43).

Figure 42 - Evaluation Pathway Point One within the Hybridised POE Model



The evaluation pathway for each flow diagram, have a number of applicable methods for undertaking each evaluation, these are listed in the ‘applicable methods’ stage. These methods can be both specific and non-specific. Specific methods are designed to meet the requirements of the specific evaluation in question, whereas non-specific methods generally have a wider remit which encompasses the original specific objective. The specific evaluation methods proposed for the ‘process evaluation’ are: i) CIC Design Quality Indicators (DQIs); and ii) the Energy Assessment and Reporting Methodology (EARM). The non-specific evaluation methods are: i) PROBE; and ii) the BUS Occupant Survey.

Figure 43 - The Decision Pathway at Evaluation Selection One

Evaluation Pathway 1

- i) What is to be evaluated?
- ii) What does that entail?
- iii) Most applicable evaluation pathway?
- iv) Applicable methods

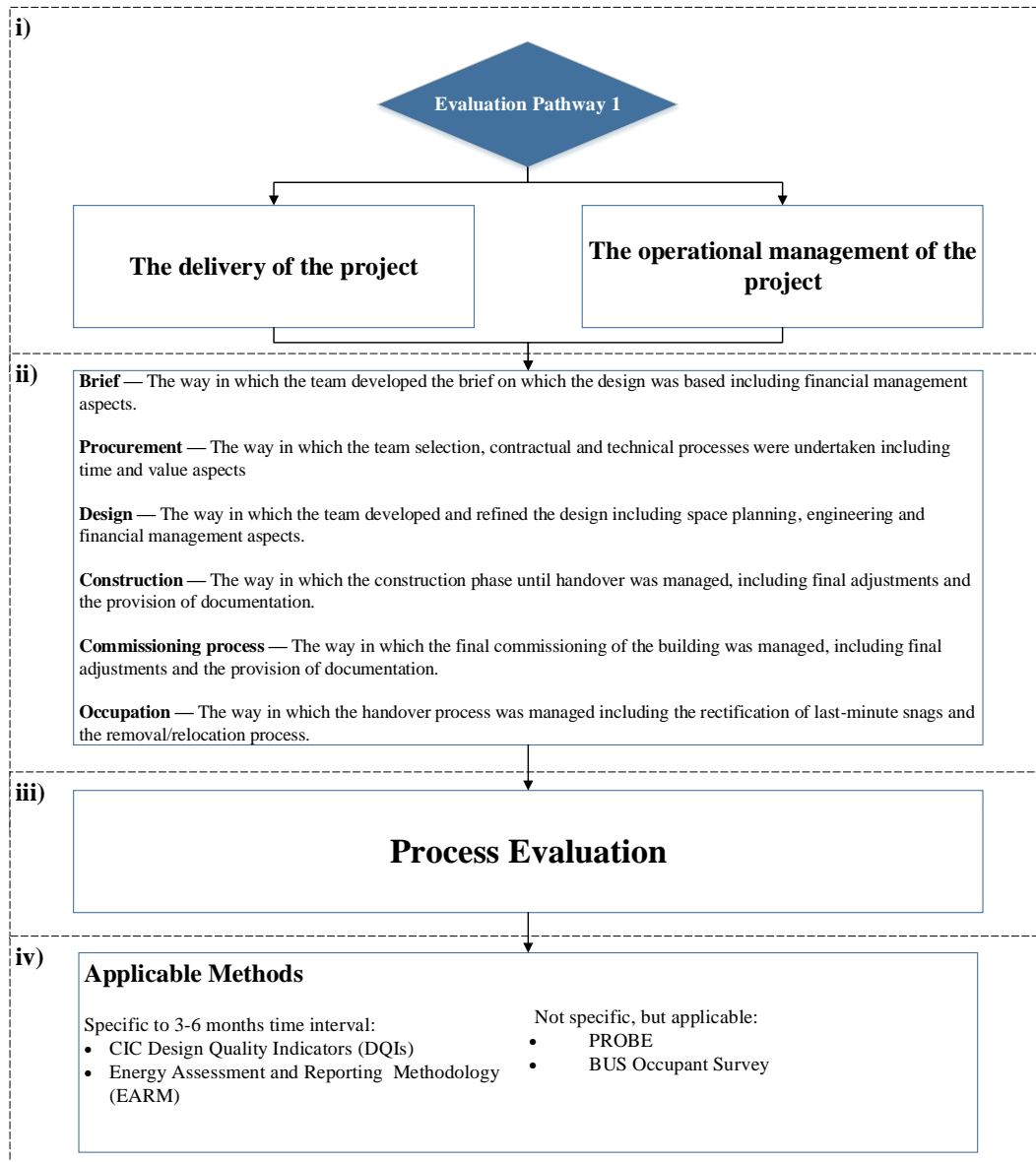
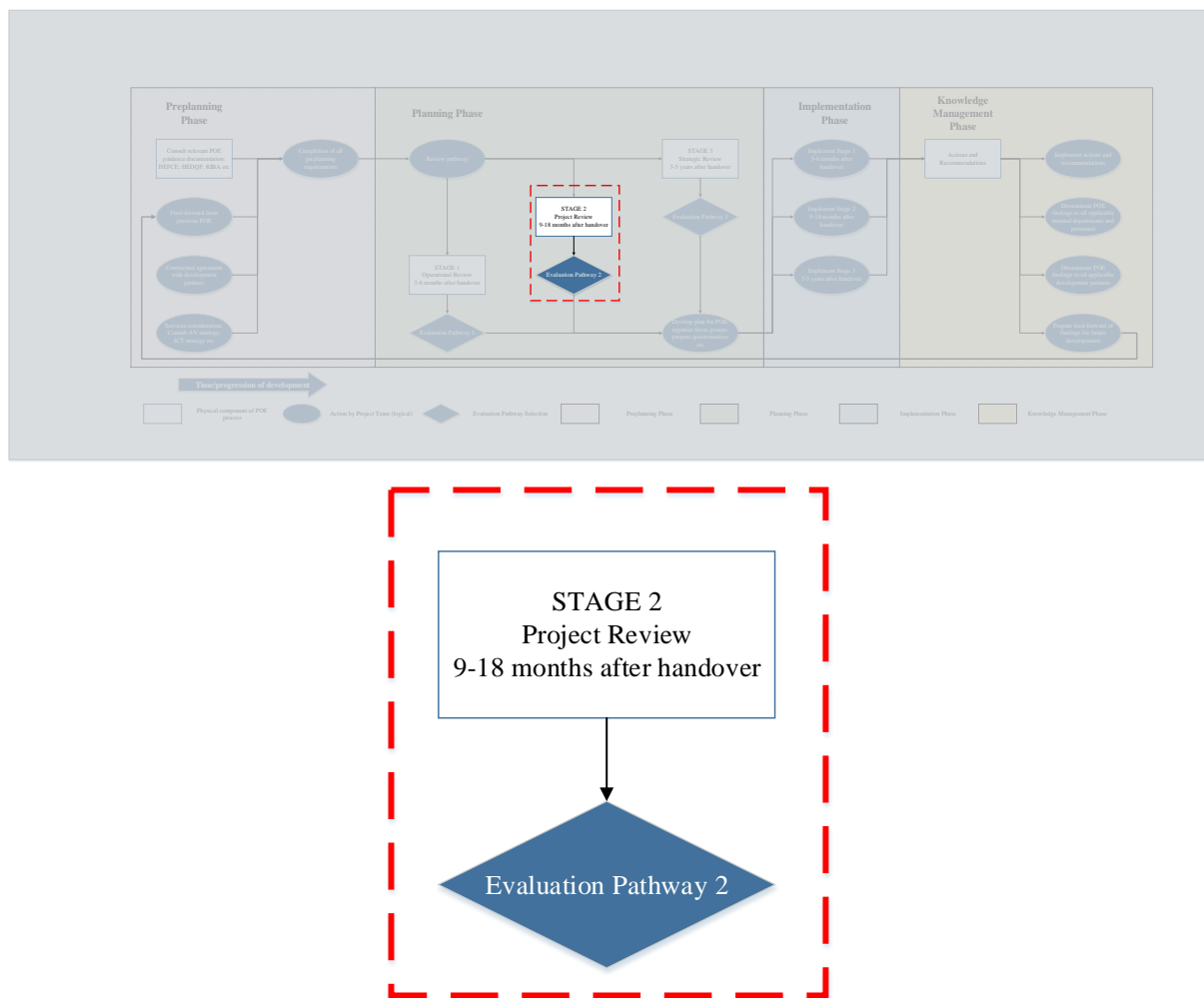


Figure 44 shows the location within the hybridised process where evaluation pathway two is located. Figure 45 depicts the supporting flow diagram at evaluation pathway two. Similar to stage one, the flow diagram also diverges into two options, namely: i) the ‘facilities appropriateness at meeting organisational requirements’; and ii) the ‘performance of physical systems’. However, in contrast to stage one, different entailments support the two options. The ‘facilities appropriateness at meeting organisational requirements’ entails: i) strategic value; ii) aesthetic and image; iii) space; iii) comfort; iv) amenity; v) serviceability; vi) operational cost;

vii) life-cycle cost; and viii) operational management, whereas, ‘the performance of physical systems’ entails: i) physical systems; ii) environmental systems; iii) adaptability; and iv) durability. Whilst both of the pathways presented in evaluation pathway one led to a single evaluation option (process evaluation), the two pathways options presented in evaluation pathway two lead to two different evaluation options. The ‘facilities appropriateness at meeting organisational requirements’ leads to a ‘functional performance evaluation’, whilst ‘performance of physical systems’ leads to a ‘technical performance evaluation’.

Figure 44 - The Evaluation Pathway Point Two within the Hybridised POE Model



Despite the two components within evaluation pathway two being independent of one and other, to complete one aspect, and omit the other may impact upon the ability of practitioners to benchmark performance or iteratively improve specific aspects of either the development process, or the physical facilities in the future. As such, despite these two approaches being relatively independent, they should still be considered as complimentary components to the

same evaluation. This is evidenced somewhat by the applicable methods, as both the ‘functional performance evaluation’ and the ‘technical performance evaluation’ utilise the same methods. The specific methods for ‘Evaluation Pathway 2’ are: i) the De Montfort Method; and ii) Overall Liking Score, whilst the non-specific methods are again: i) PROBE; and ii) BUS Occupant Survey.

Figure 45 - The Decision Pathway at Evaluation Selection Two

Evaluation Pathway 2

- i) What is to be evaluated?
- ii) What does that entail?
- iii) Most applicable evaluation pathway?
- iv) Applicable methods

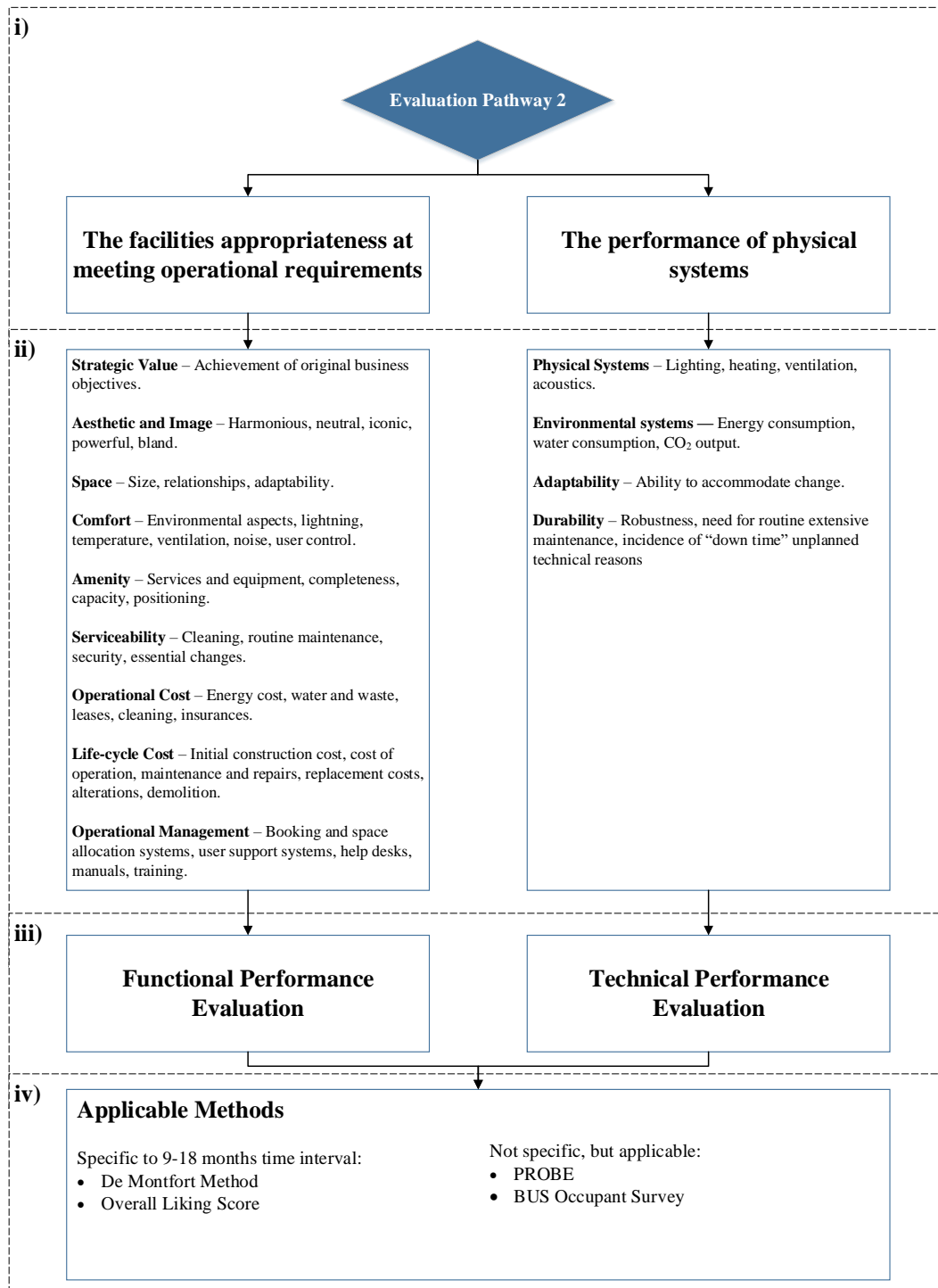
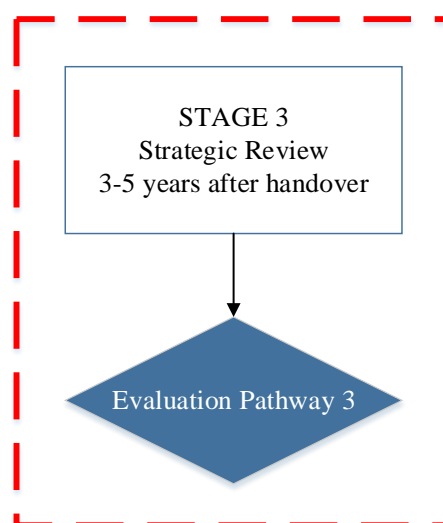
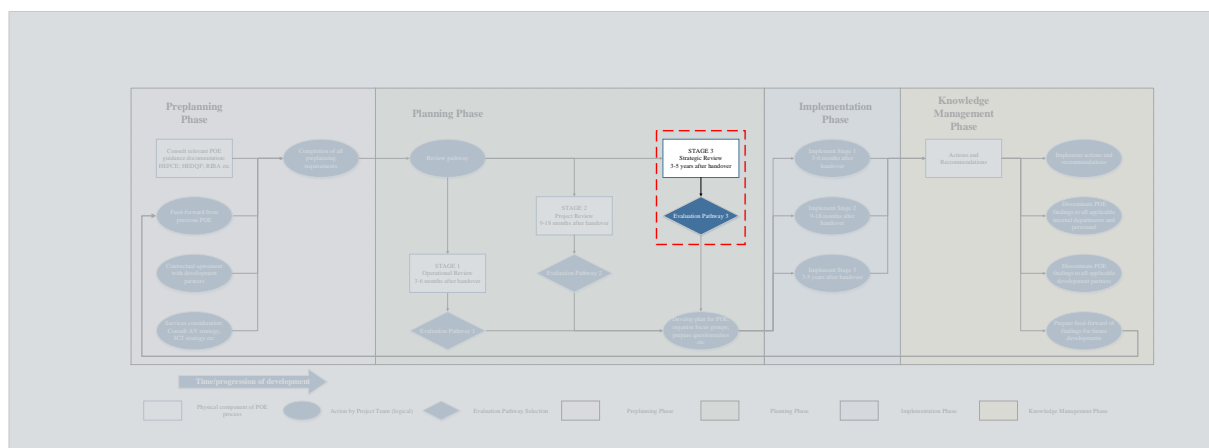


Figure 46 shows the location within the hybridised process where evaluation pathway three is located. Figure 47 depicts the supporting flow diagram at evaluation pathway three. At

evaluation pathway three, similar to evaluation one, there is only one option with regard to selecting what is to be evaluated, in this case ‘organisational change and building response’. Unlike the previous two evaluation pathways, no new evaluation techniques are presented at this juncture. Instead, at point two of the protocol: ‘what does this entail’, a review of the findings of the previous POE stages is recommended. At this point, three to five years after the handover of the facility, a substantial amount of building data will have been amassed in terms of: i) maintenance reports; ii) incident reports; iii) costing information (running costs and maintenance costs for example); and iv) other applicable building evaluations (space utilisation surveys for example). All of this supplementary information can contribute to the stage three evaluation, offering a wealth of in-use building data to review in addition to the previously collected project team feedback data and end-user feedback data.

Figure 46 - The Decision Pathway at Evaluation Selection 3 within the Hybridized Model



At the third stage of the evaluation pathway protocol: ‘most applicable evaluation pathway’, all three of the previously identified evaluations are applicable (process evaluation, functional performance evaluation, and technical performance evaluation). However, each of these evaluation pathways are not repeated at this stage, instead the historic findings from the previous completed stage is holistically reviewed in addition to supplementary building data. This overarching review, incorporating an: i) evaluation of the construction process; ii) evaluation of end-user feedback; and iii) evaluation of technical performance, has direct implications for formulating Estates strategy in terms of avoiding pitfalls (implementing ‘lessons learned’) from previously completed developments as well as facilitating the development of benchmarking criteria and a process for iterative improvement of HEI facilities.

The final point of the four point protocol, offering the most applicable methods for completing the tasks assigned in the previous three steps of the protocol. At the third evaluation pathway, there is no recognised method for completing the strategic review, instead the HEFCE Guide to Post-occupancy Evaluation (2006, p.15) states that practitioners should implement a process of:

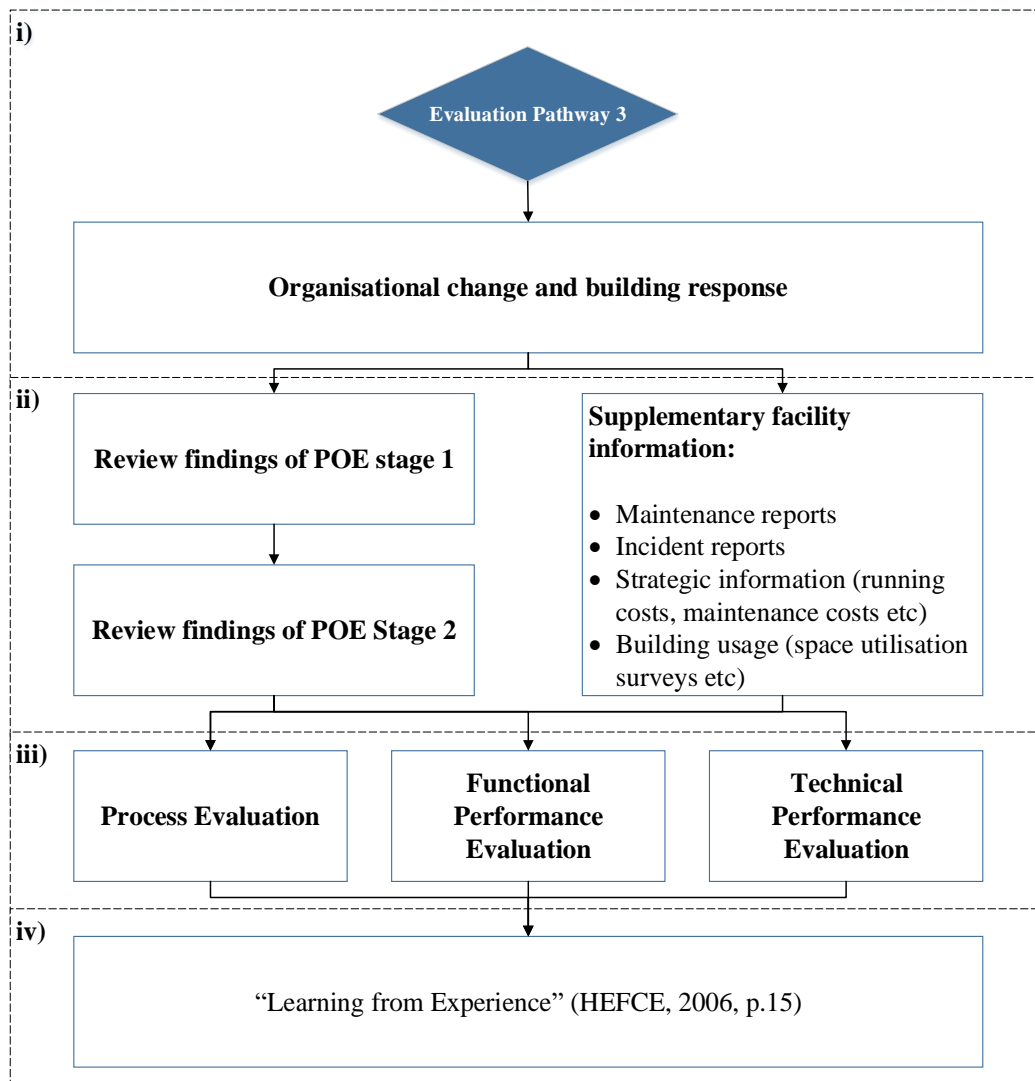
“learning from experience.”

Whilst the idea of ‘learning from experience’ represents the overall rationale of conducting a POE, without a formalised strategy for achieving this, many of the key objectives emanating from academic literature regarding a building feedback mechanism may be missed in practice.

Figure 47 - The Decision Pathway at Evaluation Selection Three

Evaluation Pathway 3

- i) What is to be evaluated?
- ii) What does that entail?
- iii) Most applicable evaluation pathway?
- iv) Applicable methods



7.2.2.1 Benchmarking and Iterative Improvement

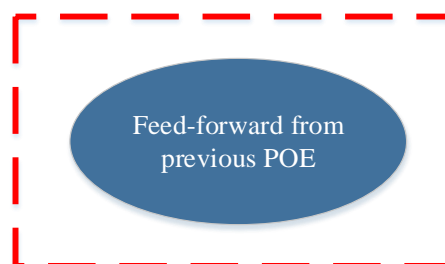
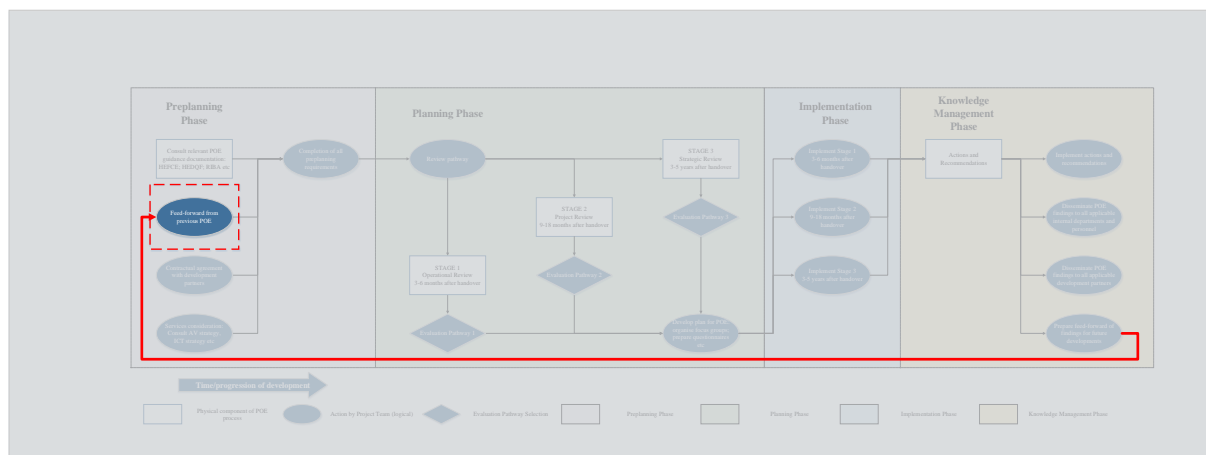
The literature review for this study highlighted numerous academic objectives regarding POE. In particular, Leaman and Bordass (2001) states that the development cycle should follow a process of 'virtuous circles of improvement'. At present within the construction sector, due to a lack of a formalised feedback mechanism, the majority of developments remain as 'untested prototypes' (Cooper, 2001; Riley *et al.*, 2010). Furthermore, this lack of building feedback also prevents the establishment of performance benchmarks, further precluding the ability to evaluate the successes and failures of a project, and crucially, prevent them occurring again on

future developments (c.f. Göçer *et al.*, 2015). In efforts to overcome these inherent issues with current POE processes, the hybrid POE process has been developed to follow the aforementioned sequential pathways. This approach requires all three pathways to be followed to complete a full POE, simultaneously increasing compliance with the process.

7.3 AUGMENTED PREPLANNING PHASE

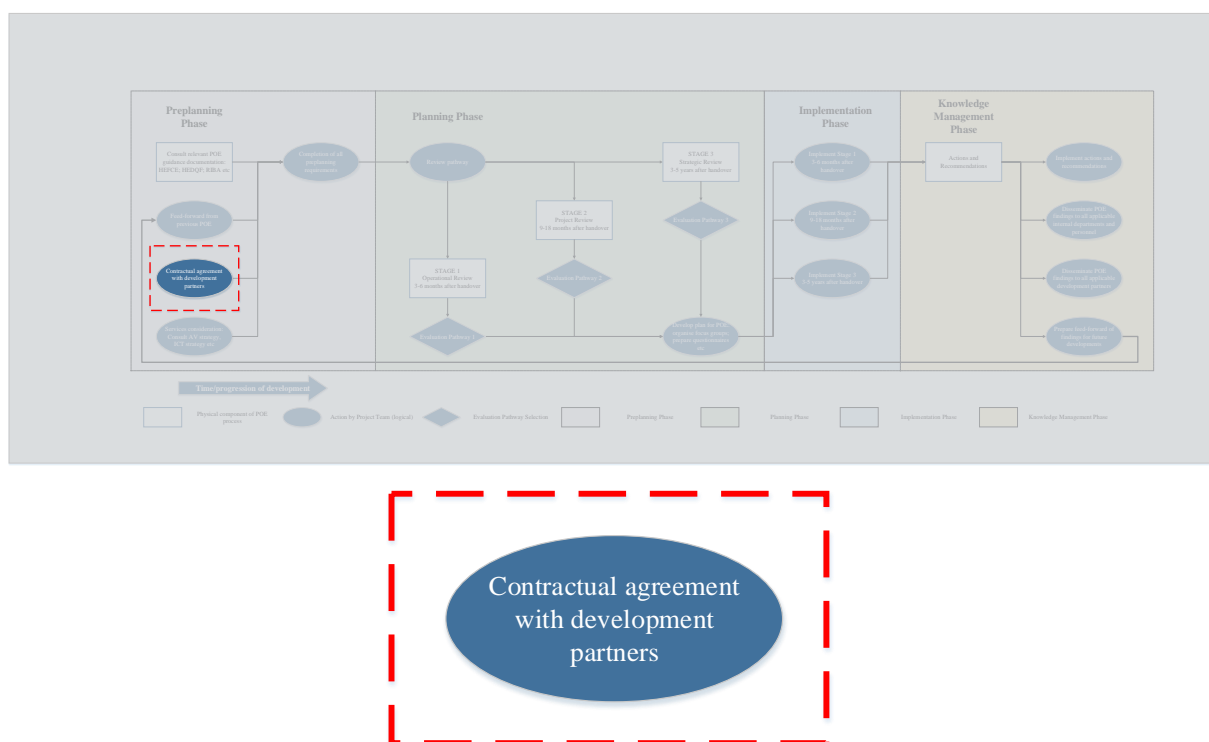
The findings from the focus group transcript offered extensive detail, from a practitioner perspective, regarding augmented preplanning requirements for the planning and implementation of POE at the outset of a development. Of critical importance at this stage, and in keeping with academic aspirations for the role of POE within the built environment, is the development of cyclical approach to the POE process. This is achieved through the addition of a node detailing this requirement, as well as a connection between the outputs of a POE (knowledge management phase) and the initial inputs within the newly added preplanning phase (c.f. Figure 48). The additional node requires practitioners to review previously completed POE reports when embarking upon a new evaluation, making the ‘lessons learned’ from previous projects the fundamental starting point of future developments.

Figure 48 - The Hybridised POE Model with Implemented Feedback Loop



Another major finding regarded the need for a formalised contractual agreements regarding cooperation with the POE process. Whilst uptake of POE within the industry increases, with many developers and contractual partners beginning to see the value of POE in both reputational and efficiency terms, without a formalised agreement, POE facilitators are dependent upon ‘good will’ from development partners regarding POE completion. As such, the newly developed hybridised POE process presented in this study formalises the requirement for pre-agreed cooperation with the POE process by assigning a node within the newly added preplanning phase (c.f. Figure 49). Whilst the findings of a POE are ultimately to the benefit of all concerned parties (development partners, building owners/managers, and end-users alike), the lack of widespread implementation of POE in the UK may indicate a lack of understanding as to the importance of a formalised feedback mechanism within the UK construction sector, emphasising the importance of pre-agreed cooperation.

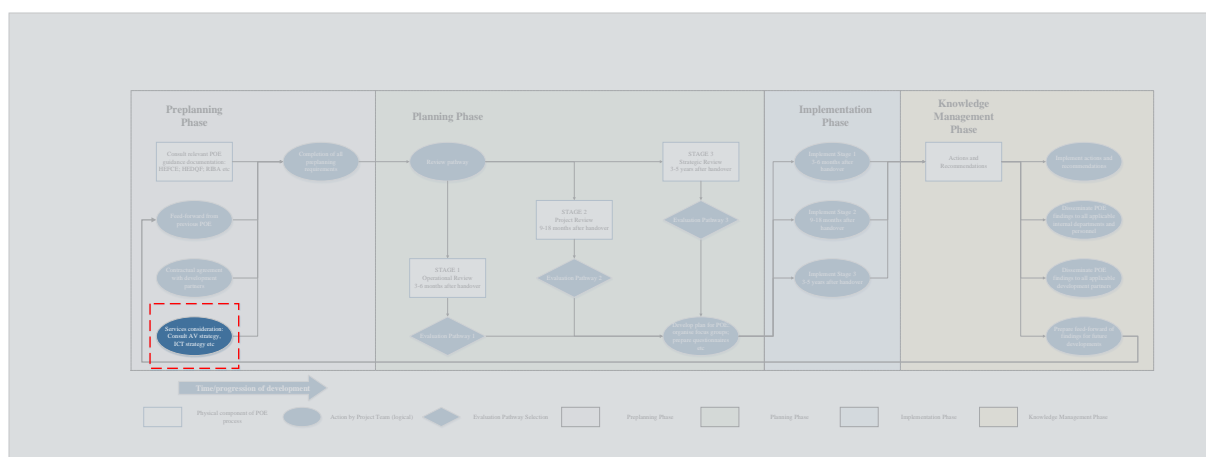
Figure 49 - The Additional Node in the Preplanning Phase Requiring Contractual Pre-agreement for POE Participation



The final additional node within the preplanning phase concerns the inclusion of building services in the preplanning of a POE (c.f. Figure 50). Building services such as audio visual (AV) provisions and information communication technology (ICT) provisions are critical to the day-to-day activities of a contemporary HEI. Emanating from the focus group transcript, practitioners stated that failure to incorporate AV and ICT into the early stages of the

development process, exacerbated snagging issues later in the development cycle. Whilst inclusion of services at the earliest stages of the POE process does not directly infuse services into the development process, if the newly developed hybrid model is utilised correctly in practice, then the pitfalls experienced in previous developments can be avoided. This principal applies to building services also, reporting upon historic difficulties regarding building services within POE reports will aid in increasing the attention this consideration receives at the earliest stages of the development cycle in practice.

Figure 50 - The Additional Node in the Preplanning Phase Requiring Practitioners to be Aware of Building Services Provision



Despite the addition of new nodes within the preplanning phase of the process diagram, as well as the new decision making pathways, the number of selections available for practitioners to select from has been reduced. The HEFCE Guide to Post-occupancy Evaluation (2006) explicitly states:

“this guidance is prepared so colleagues can choose according to their needs and preferences, as few or as many of the areas identified in this report.”

Furthermore, the guidance also states:

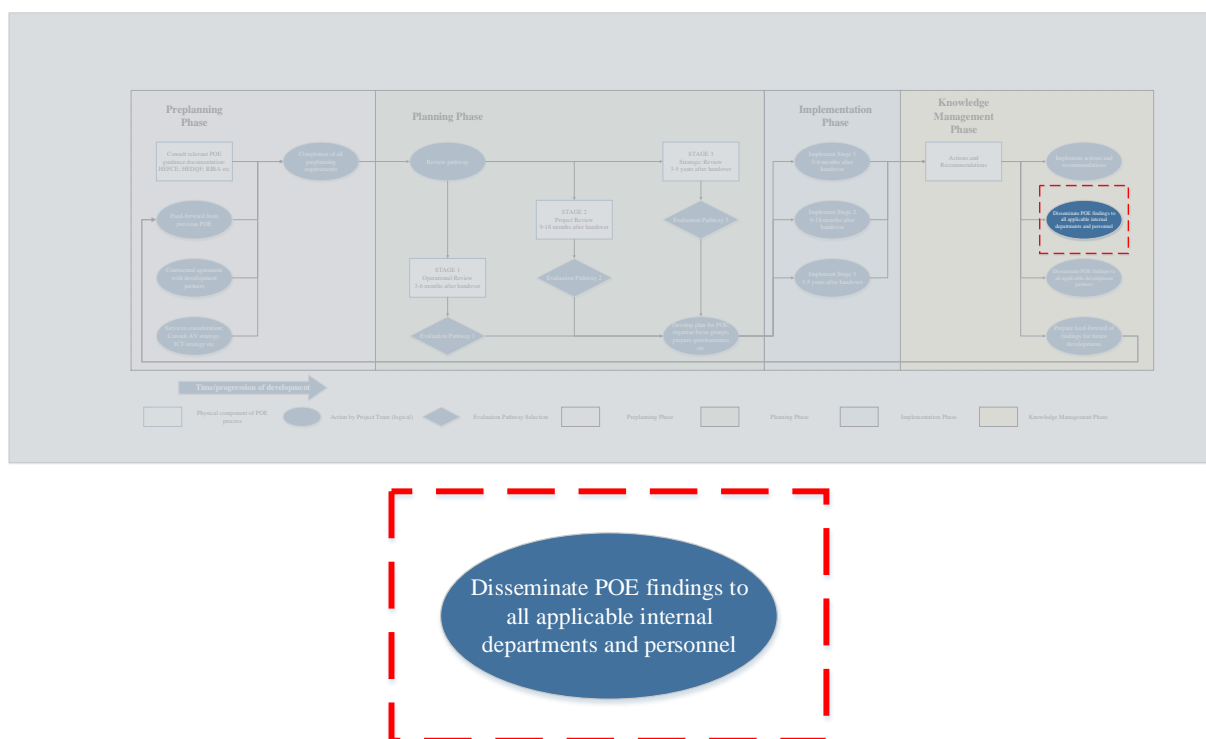
“rather than use every technique for each area of the review select those which will best meet your purpose.”

Whilst streamlining the evaluation process to meet the specific requirements of the specific facility or institution may seem initially intuitive, in practice this may be severely hampering the development of a cycle of iterative improvement and benchmark criteria due to a lack of comparable findings collected utilising the same methods at the same temporal junctures. The lack of an overarching holistic approach to POE's at present despite increased uptake in industry, means in many instances, despite the planning and implementation of a POE, the facility being evaluated remains an 'untested prototype', despite the undertaking of a POE (c.f. Cooper, 2001; Riley *et al.*, 2010).

7.4 AUGMENTED KNOWLEDGE MANAGEMENT PHASE

A number of augmentations have also been made to the knowledge management phase of the POE process. Two additional nodes have been added as well as the augmentation of an existing node present in the original flow diagram pertaining to the HEFCE Guide to Post-occupancy Evaluation (2006).

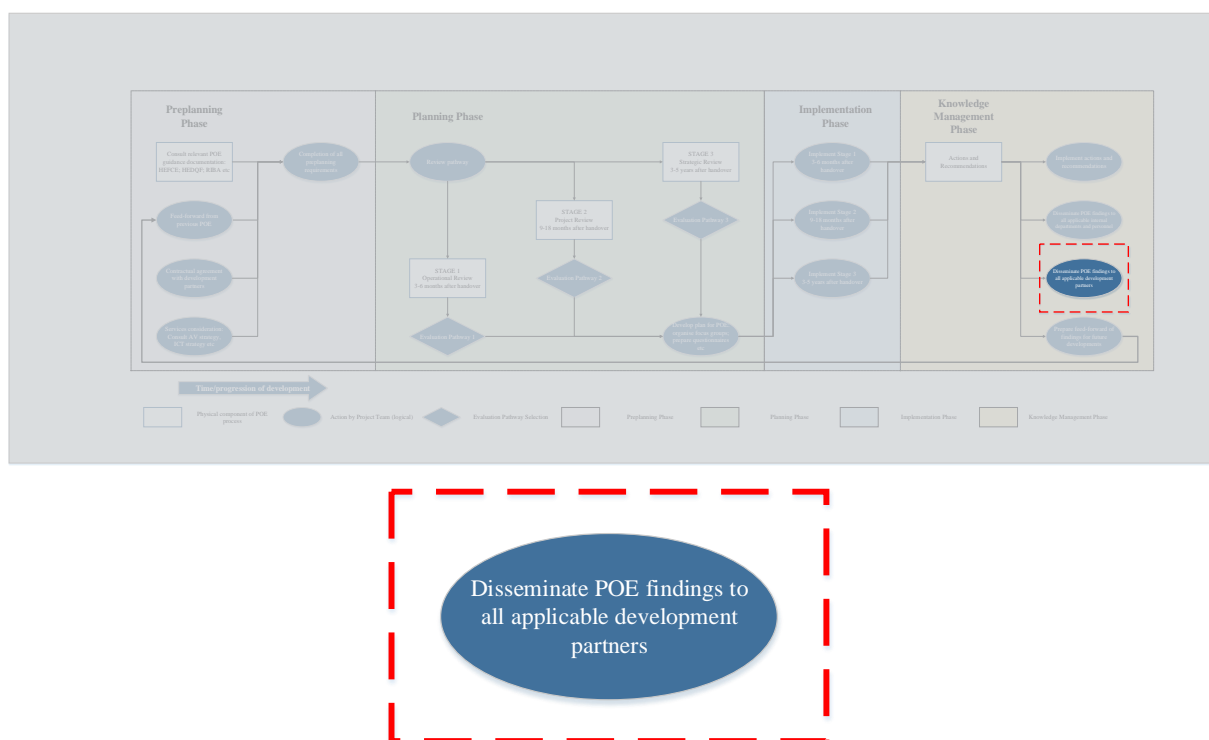
Figure 51 - The Additional Node in the Knowledge Management Phase Requiring Dissemination to Internal Departments and Personnel



The first additional node presented calls for the findings of the POE to be disseminated to all applicable internal departments and personnel (c.f. Figure 51). Anecdotally, POE reports are

often said to reside in draws upon completion. Indeed the findings from the focus group transcript confirmed this at BCU, with participants of the focus group asserting they had never seen previously completed POE reports pertaining to BCU's more recent developments, despite the evaluations having being conducted. Failure to disseminate the findings of a POE, particularly internally, raises the question as to whether the task is seen as a 'tick-box' requirement as opposed to a value adding activity. Dissemination to applicable departments, particularly the Facilities department, can have significant impacts upon the management of a facility, increasing efficiencies and reducing costs. By formalising this requirement in the hybridised POE model, an effort is being made to enshrine the practice of dissemination to all applicable internal departments and personnel into the POE process as a matter of procedure.

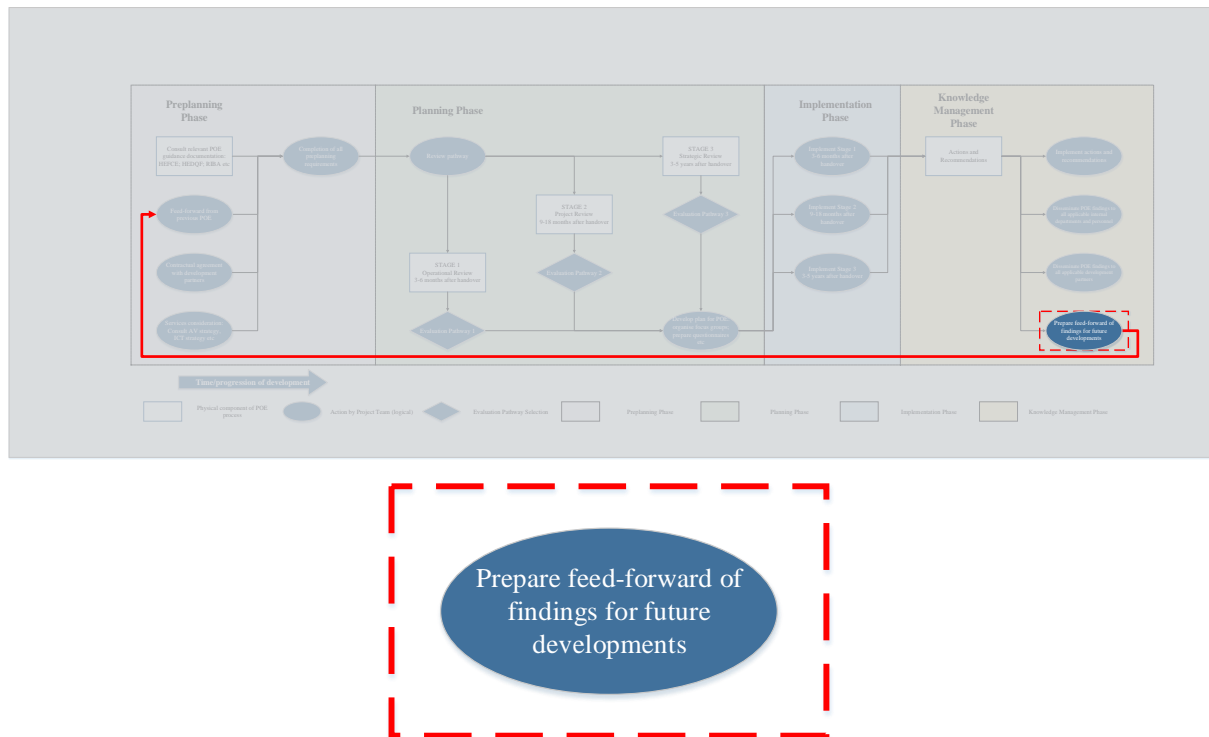
Figure 52 - The Additional Node in the Knowledge Management Phase Requiring Dissemination to External Development Partners



The second additional node in the knowledge management phase refers to dissemination of POE findings to all applicable development partners (c.f. Figure 52). At this stage, having followed the hybridised POE model, all of the development partners whom had agreed to cooperate with the undertaking of the POE, should receive the disseminated findings. Failure to supply the findings to these development partners raises the question as to why they have cooperated in a process with the potential for the apportioning of liability without any receiving

any feedback, indeed any incentive at all, with which to improve their own performance. The democratisation of POE findings remains an academic objective, with some academics even calling for POE findings to be made publically available at the conclusion of a POE process.

Figure 53 - The Additional Node in the Knowledge Management Phase Requiring Preparation of Findings for Feed-forward to Future Developments



The final additional node added to the knowledge management phase requires practitioners to prepare findings from the completed POE process, for review at the outset of future developments, and subsequent POE's (c.f. Figure 53). As previously stated, POE reports often end up filed away and not utilised, rendering the entire process as a 'tick box' activity. By formalising this requirement and enshrining it within the hybridised POE process, the circle of 'virtuous improvement' identified within academic literature can be realised (c.f. Leaman and Bordass, 2001). The development of a cyclical process for POE working simultaneously with the development cycle, allows buildings to undergo a process of 'iterative improvement'. It has been suggested, without a feedback mechanism, that all buildings remain as 'untested prototypes' (c.f. Cooper, 2001; Riley *et al.*, 2010). Whilst conducting a single POE garnering feedback on a facility prevents this, without feeding forward the findings for review at the outset of a new development, the evaluated building remains an isolated case, with neither positive or negative findings informing the design of future developments.

7.5 RIBA TEMPORAL SYNTHESIS

In accordance with practitioner feedback referring to BCU's development processes, the RIBA Plan of Work (2013) is the preeminent guidance document utilised by the university, as well as more widely across the built environment sector. In order for the hybridised POE process to be adopted by practitioners, the RIBA stages have been utilised as a 'host', with the scheduling of requirements pertaining to the hybridised POE process synchronised with the scheduling of the RIBA plan of work. Figure 54 shows the RIBA plan of work stages with an initial concept for the inclusion of the hybridised POE process. However, due to the complexity entailed in conducting a full 100% compliant POE inclusive of all of the modifications implemented in this research, 'shoehorning' the hybridised POE process into the RIBA plan of work may create as much confusion as observed with current processes. As such a second visualisation of the hybrid model has been developed, containing all of the same components, but organised to correspond with the RIBA stages (c.f. Figure 55).

Figure 54 - Initial concept for the synthesis of the hybridized POE model with the RIBA Plan of Work (adapted from RIBA, 2013)

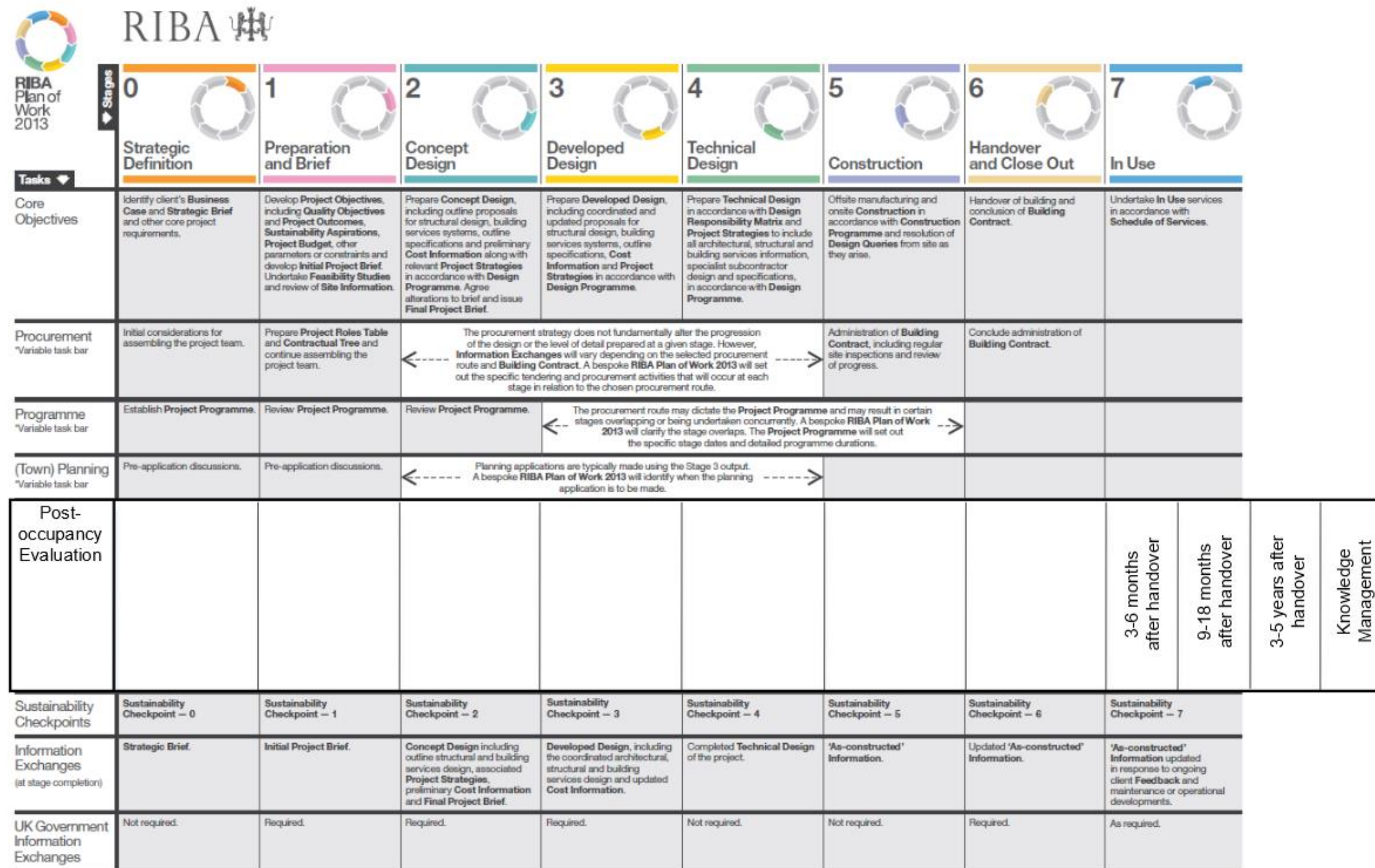
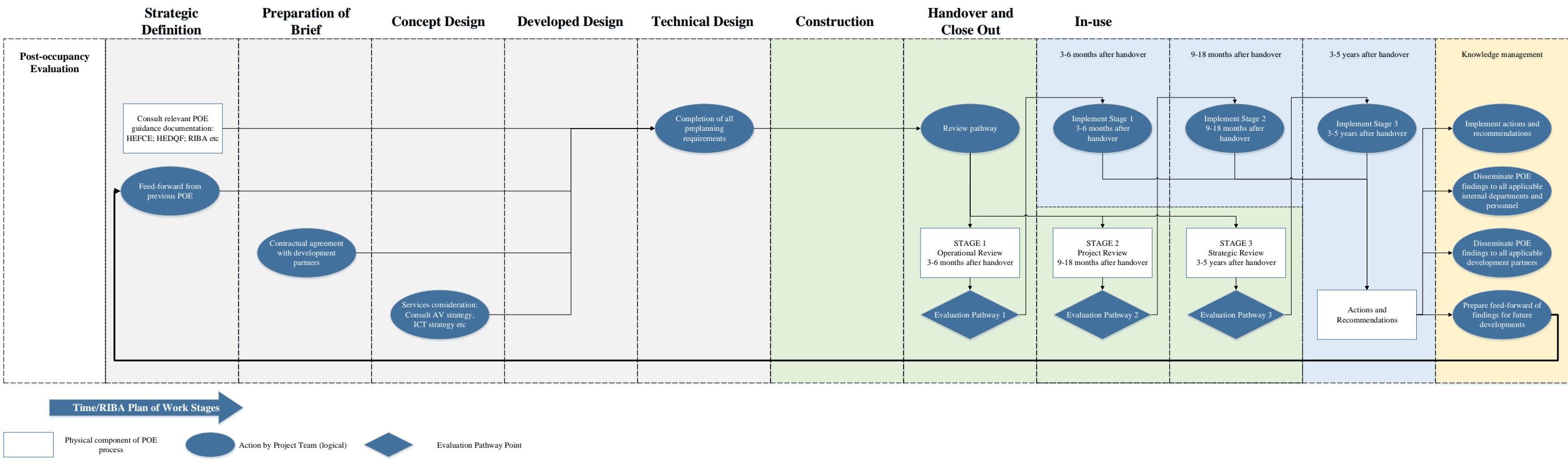


Figure 55 - The Hybrid POE Model Synthesized with RIBA Plan of Work Stages



The colour scheme found within the synthesised hybrid POE model represents each of the four newly implemented POE phases. When synthesised with the RIBA stages, it can be observed that the phases of the hybrid model are warped. The pre-planning phase occupying five of the eight RIBA stages, the planning phase occupying two and a half stages, the implementation phase occupying half of a stage, and the knowledge management phase being an annex to the original stages. The reason for cross over between the planning and implementation phases is due to the timings of different evaluations within the POE model. The first evaluation pathway requires planning during the ‘handover and close out phase’, as if it is planned any later than this point, the practitioners working on the development will have moved on to alternative projects. The planning of evaluation pathways two and three however, will require planning during the operational phase of the building lifecycle, as end user feedback requires end-users to have occupied the building for a period of time, and the strategic review taking into account further information generated during the ongoing occupation of the building.

7.6 DISCUSSION

The development of the hybridised model for user-friendly planning and implementation of POE has utilised various findings observed over the course of the research. The bibliometric analysis of the extant POE literature indicated a small CoP working in the area of POE. Furthermore it was observed, that despite the importance placed upon the development of ‘benchmark’ criteria and subsequent ‘iterative improvement’ of HEI buildings, only seven academic papers had been published to this end as of May 2018. This enshrined the importance of developing a sequential process incorporating common comparison points, facilitating the direct comparison of one facilities performance against that of another facility having undergone the same POE process. The analysis of industry guidance documentation highlighted a significant amount of practitioner interpretation of current POE processes, with guidance documentation being written in such a way as to allow practitioners to develop bespoke approaches to POE. Whilst the freedom to develop a bespoke process based upon the individual needs of an organisation in terms of its own facilities, this lack of a sequential approach to POE has direct impacts upon the usefulness of the findings emanating from these processes. This was echoed in the findings of the BCU case study. The case study offered a snapshot of BCU’s approaches to POE, which, in keeping with the observations of guidance documents, lacked consistency whilst also indicating remarkably low levels of compliance with regard to the total number evaluations that could be employed upon a specific facility. The

bespoke nature of current POE processes may also have a limiting effect upon the feedback garnered about a facility - as with all business endeavours, POE requires the allocation of time, and a budget for completion. The analysis of publically available POE reports, suggested HEIs develop approaches to POE which become more and more sophisticated with each instance of a POE being conducted, further confirming the requirement for a sequential process available from the first facility through to the last to be evaluated. Having established these contributory factors as to the current state of POE in the UK HEI sector, the findings of the practitioner focus group offered significant insights into the perceived requirements for POE at BCU, offering intricate detail on the specific requirements needed to develop a sequential HEI POE process facilitating the academic objectives of: i) 'benchmarking'; and ii) 'iterative improvement'; whilst also increasing compliance and, of critical importance, being available for implementation from the first facility within a series of HEI facilities. All of these emergent findings coalesced to form the hybrid POE model for user-friendly planning and implementation of POE within the UK HEI sector.

7.7 CONCLUSION

The hybrid model for user-friendly POE planning and implementation within the UK HE sector has been developed based upon the multiple contributions to knowledge garnered over the course of this study. The final model incorporates the findings of: i) the literature review; ii) the bibliometric analysis; iii) the case study of BCU POE reports; iv) the analysis of publically available POE reports; and v) the practitioner focus group. By incorporating all of these findings into the final model, a sequential POE model incorporating: i) common points of comparison; ii) pre-agreement with development partners; iii) consideration of services; iv) a staged approach to evaluating the facility; v) dissemination to internal personnel; vi) dissemination to external development partners (pre-agreed at the initial stages of the process); and vii) the preparation of findings for feed-forward to future development. The model now requires validation with practitioners separate from the interest group to ensure the model represents an advancement in POE process, rather than an institution specific process.

CHAPTER 8

HYBRID MODEL VALIDATION

8.1 INTRODUCTION

Validation is a process of ensuring the reliability of a piece of research, validation is in the context of interpretive research is:

“a judgement of the trustworthiness or goodness of a piece of work” Angen (2000, p.387).

This chapter seeks to validate the hybridised POE model for user-friendly POE in HEI Buildings through a series of semi-structured practitioner interviews, conducted with practitioners from a number of HEIs, soft landings representatives as well as POE consultants, but all having direct experience of planning and implementing POE in a HEI context. The interviews are designed so to introduce the newly developed hybrid POE model to experienced practitioners, and garner their feedback.

8.2 VALIDATION INTERVIEWS

Each of the five validation interviews were conducted one to one (interviewer and interviewee), and were audio recorded. The validation interviews utilised a pre-prepared semi-structured questionnaire as the basis for the discussion, with a view to assigning each item raised in the interview as a: i) ‘sign-off’; ii) ‘amendment’; or a iii) ‘future research’ requirement. Despite outlining this requirement at the outset of each interview, understandably, practitioners rarely utilised these terms within the transcripts. As such a certain amount of interpretation is required to ascertain the whether each point was indeed signed-off, amended or in requirement of future research. However, the practitioners participating in the validation interviews often elucidated on their own experiences dealing with the pitfalls to POE processes which the model is designed to mitigate. As such, a number of ‘emergent’ themes emanate from the validation interviews offering a valuable insight into further improvement of POE processes, as well as considerations which may further integrate POE with the requirements of the wider built environment.

8.2.1 Semi-structured Questionnaire

The validation interviews utilised a questionnaire based upon the modifications implemented in the hybridised POE model. The questionnaire utilised five questions, with a number of further points aligned with each overarching question. The five questions regarded: i) the preplanning phase; ii) the planning phase; iii) the implementation phase; iv) the knowledge management phase; and v) the temporal organisation of the newly hybridised model (c.f. Table 24). Previously, the different phases of the POE process were implied as opposed to stipulated, with the requirements of the HEFCE Guide to Post-occupancy Evaluation (2006) requiring in depth knowledge of the construction cycles and processes to implement effectively. However, the addition of phases is designed to aid practitioners, even with limited experience or cursory knowledge of construction process, in implementing a POE in a complete and consistent manner.

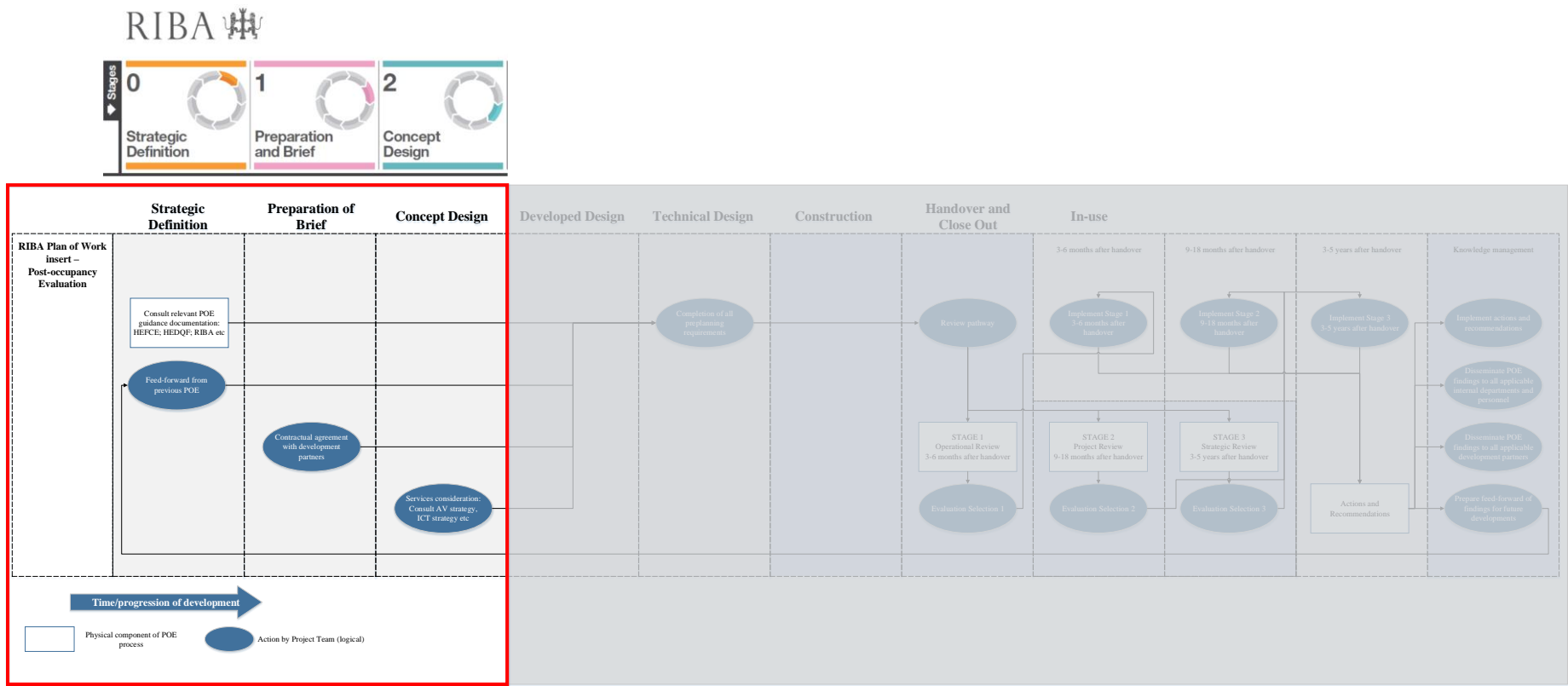
Table 24 - An Overview of the Questions Posed during the Validation Interviews

No.	Theme	Validation Point	Explanation
1	Preplanning Phase	a. Process organised temporally to coincide with the RIBA Plan of Work 2013 Gateways 0-3 b. Additional node for pre-contractual POE agreements with development partners c. Additional node for review of previous POE findings at outset of new development d. Additional node for inclusion of services	8.2.1.1
2	Planning Phase	a. Separation of theoretical and practical POE planning b. Reduction choices within POE processes in favour of more sequential approach c. Replacement of 'review' and 'evaluation' selection points in favour of three stage pathway	8.2.1.2
3	Implementation Phase	a. Implementation phase requires no amendment	8.2.1.3
4	Augmented Knowledge Management Phase /Circular Process - <i>Ouroboros</i>	a. Dissemination of findings to all applicable internal departments and personnel b. Dissemination to all external development partners - contractually agreed at outset of development c. Transparency of findings, institutional knowledge of findings increasing efficiency of 'action' implementation d. Preparation of POE findings for feed-forward to future developments completing the circularity of the process	8.2.1.4
5	Temporal Organisation	a. Hybridised POE model organised to coincide with the RIBA Plan of Work 2013	8.2.1.5

8.2.1.1 Preplanning Phase

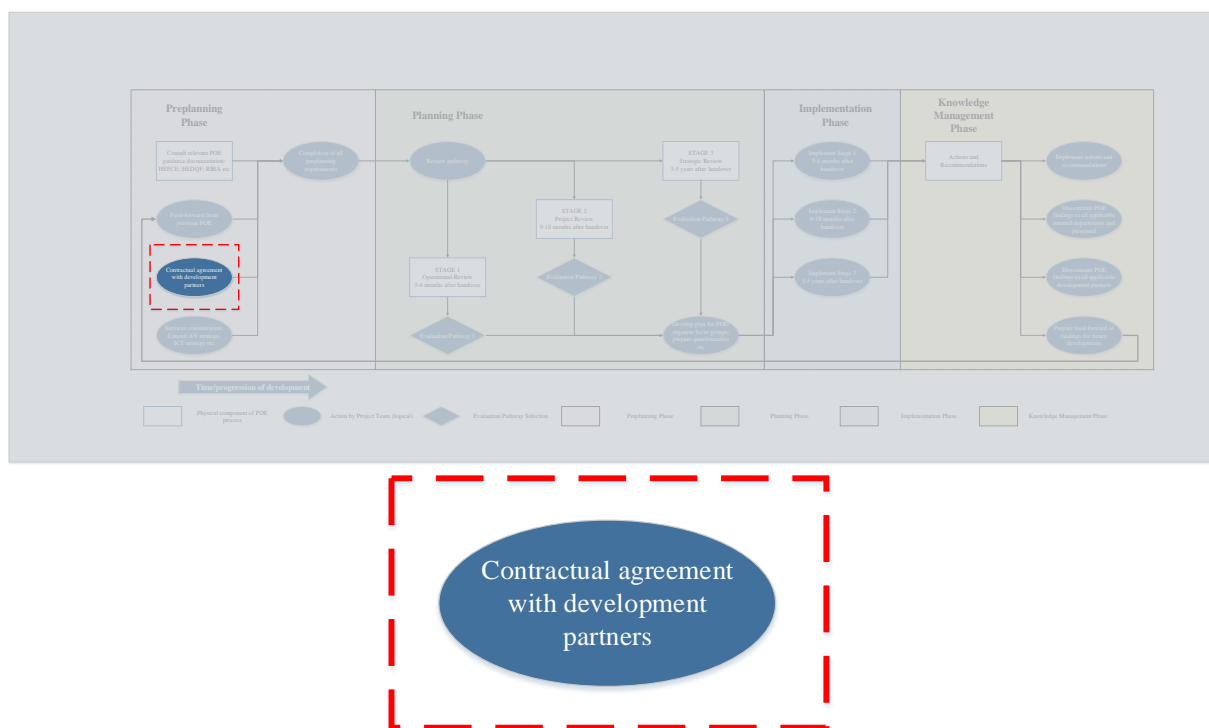
The first set of points referred to the newly assigned preplanning phase of the hybridised model. POE has a number of requirements which are considered during the initial procurement of a project, before the design phase gets underway. Notably, most POE's undertaken in industry today do not take account of these early considerations, therefore it is possible to successfully complete a POE without them having been considered. However, failure to account for these considerations can have exacerbated effects later in the development process. As such, the first point raised referred to the 'temporal organisation to coincide with RIBA gateways 0-3' (c.f. Figure 56).

Figure 56 - A Visual Representation of the Synthesis of the Preplanning Phase of the Hybridised POE Model and the First Three Gateways of the RIBA Plan of Work



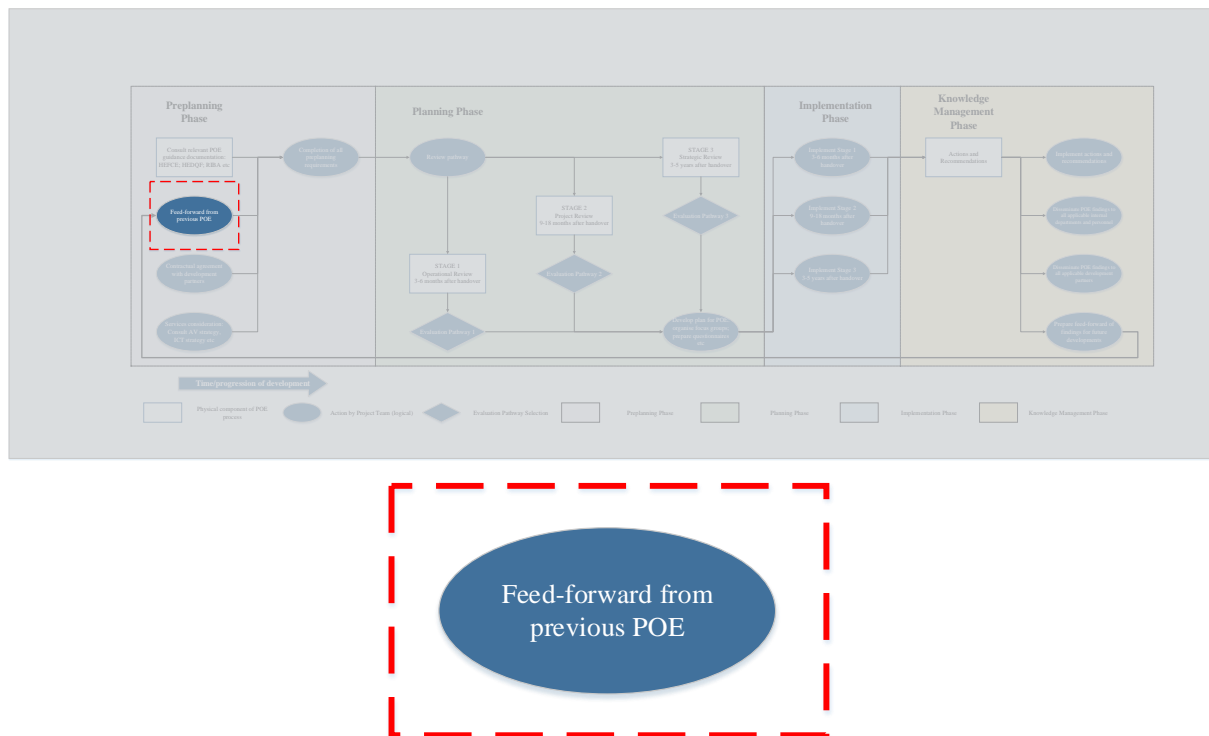
With regard to the second point, academic literature espouses practitioner fear regarding which development partner in particular benefits from the undertaking of a POE (c.f. Preiser and Vischer, 2005; Olivia and Christopher, 2014). Likewise, emanating from the focus group held to investigate BCU's POE process, cooperation with POE process largely relies on 'goodwill' from development partners. Thusly, next point introduced to the interviewees regarded 'an additional node for pre-contractual agreements with development partners' (c.f. Figure 57).

Figure 57 - A Visual Representation of the Additional Node Detailing the Requirement for Pre-contractual Agreements Regarding POE Participation



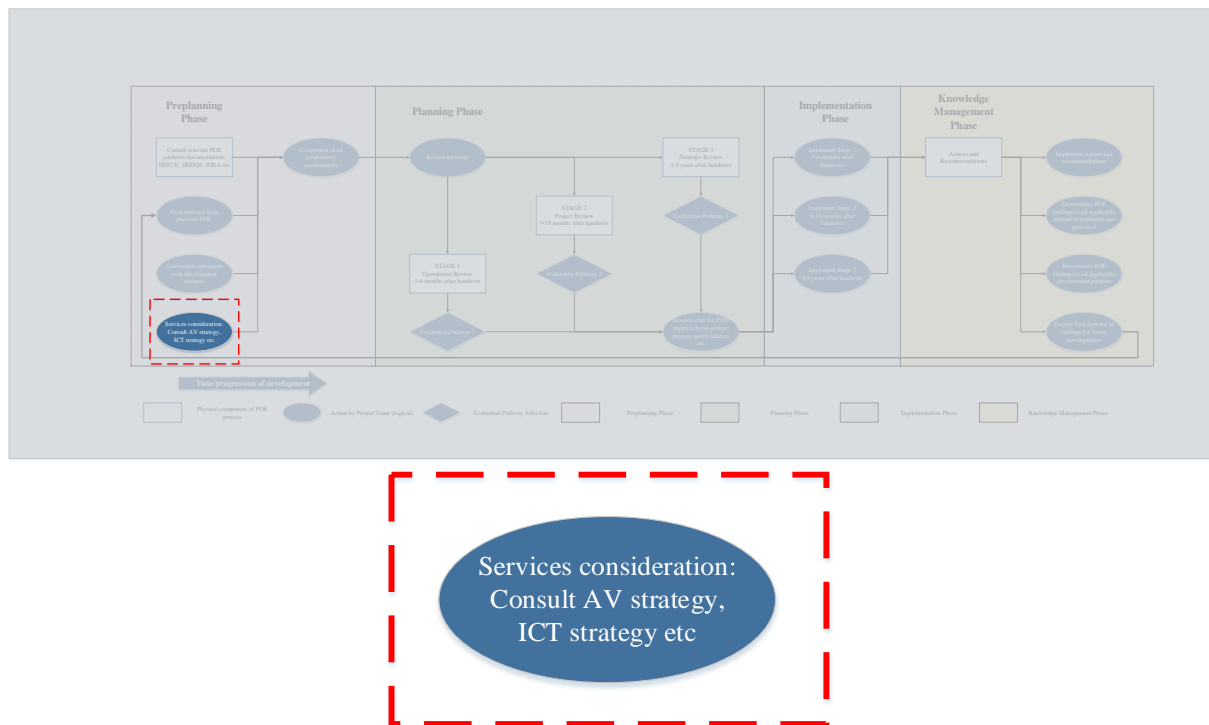
A further additional node is added detailing the requirement for the review of previously completed POE reports to be reviewed at the outset of a new development (c.f. Figure 58). Whilst this may seem an obvious, anecdotally, it appears this rarely happens in practice. Failure to review previous POE findings before embarking upon a new development, raises significant questions as to the purpose of doing a POE. Completion of a POE without feeding forward the findings so they can be learned from, renders the POE process a tick box activity as opposed to the value-adding activity it is envisaged to be.

Figure 58 - A Visual Representation of the Additional Node Detailing the Requirement for the Review of Previous POE Findings at the Outset of a New Development



Finally, consideration of services is also required at this early stage. ICT and AV are key resources, crucial to the operation of modern HEIs. Often ICT and AV considerations arise after the completed shell of a development is complete. Considering the completed shell will have had all of its internal finishes completed to the standards specified in the development brief, much of the ICT and AV resources will only be considered and installed after this point, creating the requirement for modifications and adjustments to the facility during occupation phase. As such, the final point introduced to the interviewees detailed an ‘additional node for the inclusion of services’ (c.f. Figure 59)

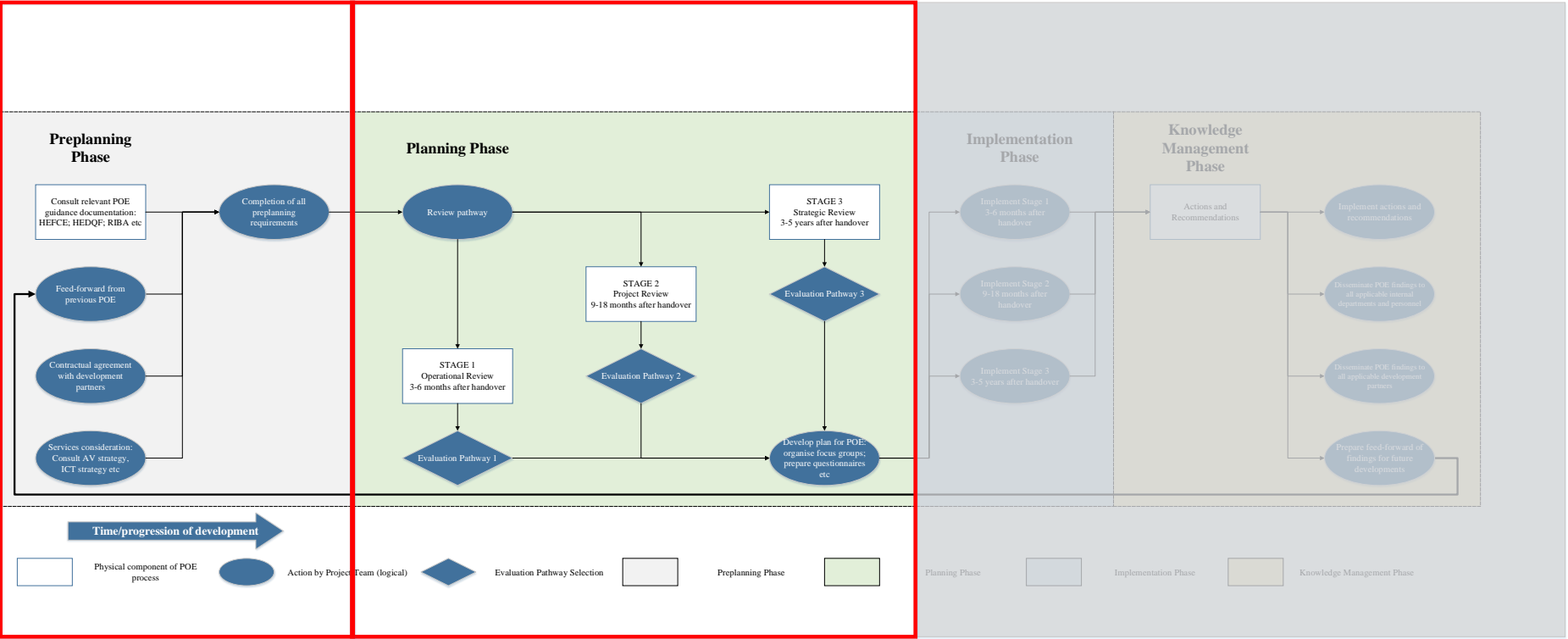
Figure 59 - A Visual Representation of the Additional Node for the Inclusion of Services Consideration at the Outset of a Development



8.2.1.2 Planning Phase

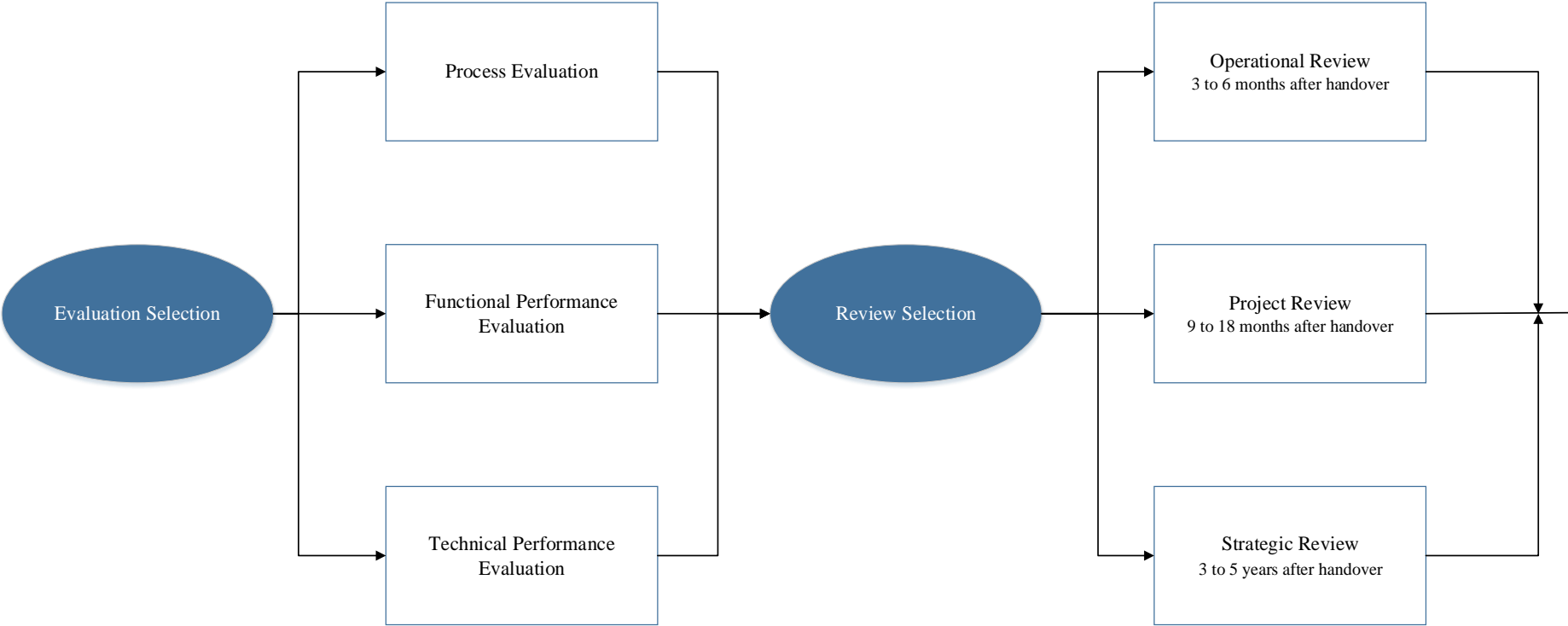
The second question, and associated points, refer to the newly implemented planning phase of the POE process. The first point regards the ‘separation of theoretical planning and practical planning’ (c.f. Figure 60). The rationale of this point centres around raising the awareness of practitioners that there are significantly more considerations required for the consistent and complete planning of a POE than simply preparing questionnaires and focus groups. The securing of agreement in the preplanning phase as well as the provision of services, have significant impacts upon the later stages of the POE. Failure to separate these two aspects of POE planning may be exacerbating well documented inhibitors of POE (c.f. Cooper, 2001; Zimmerman and Martin, 2001; Vischer, 2001; Jauzens *et al.*, 2003; Bordass and Leaman, 2005; Riley *et al.*, 2010; Khosrowshahi and Arayici, 2012; Jiao *et al.*, 2013).

Figure 60 - A Visual Representation of the Divide between Theoretical and Practical POE Planning



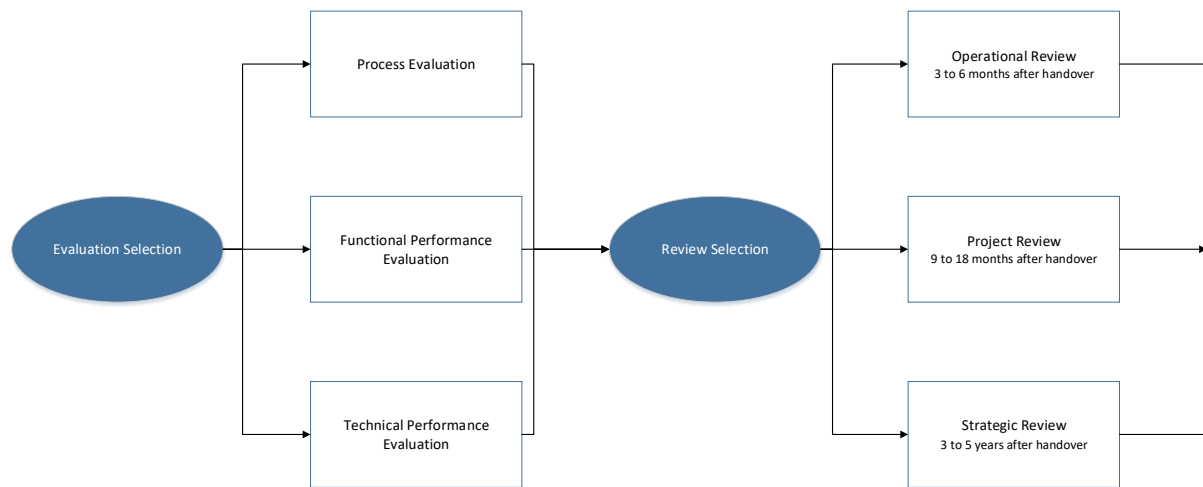
The next point referring to the planning phase regards the ‘reduction of choices emanating from POE processes’. Figure 61 depicts the current selections practitioners are required to make when planning a POE. The HEFCE Guide to Post-occupancy Planning 2006 is “prepared so colleagues can choose according to their needs and preferences, as few or as many of the areas identified in the report” (HEFCE, 2006, p.3). However, despite the rationale of selecting as appropriate based upon the experience of the practitioners conducting the review, this may be significantly diminishing the ability of practitioners to benchmark POE findings and subsequently iteratively improve HEI facilities.

Figure 61 - A Visual Representation of the Selections Practitioners are required to Make Emanating from Current POE Processes

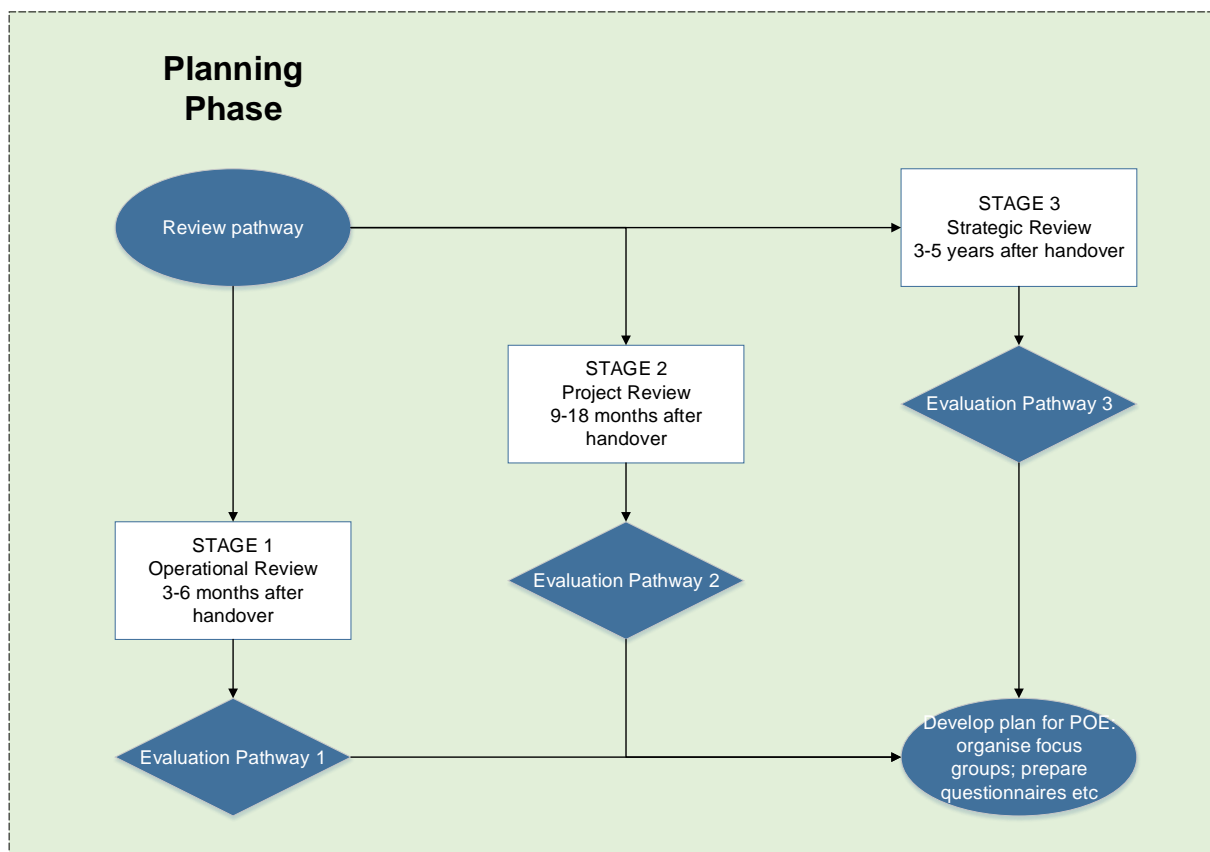


The next point, whilst similarly aligned to the last point, is focused on promoting greater compliance, as opposed to reducing inconsistency. The point details the ‘replacement of review and evaluation selection points with three sequential pathways’ (c.f. Figure 62). The rationale of this change regards increasing compliance with regard to the required selection points within the POE process. Replacing these selection points, are three sequential pathways, scheduling all applicable evaluations at applicable time intervals, and requiring the completion of all three evaluations.

Figure 62 - A Visual Representation detailing the current Planning Phase of the POE Process, and the Proposed Alteration to the Planning Phase utilised in the Hybridised Model



Current Process

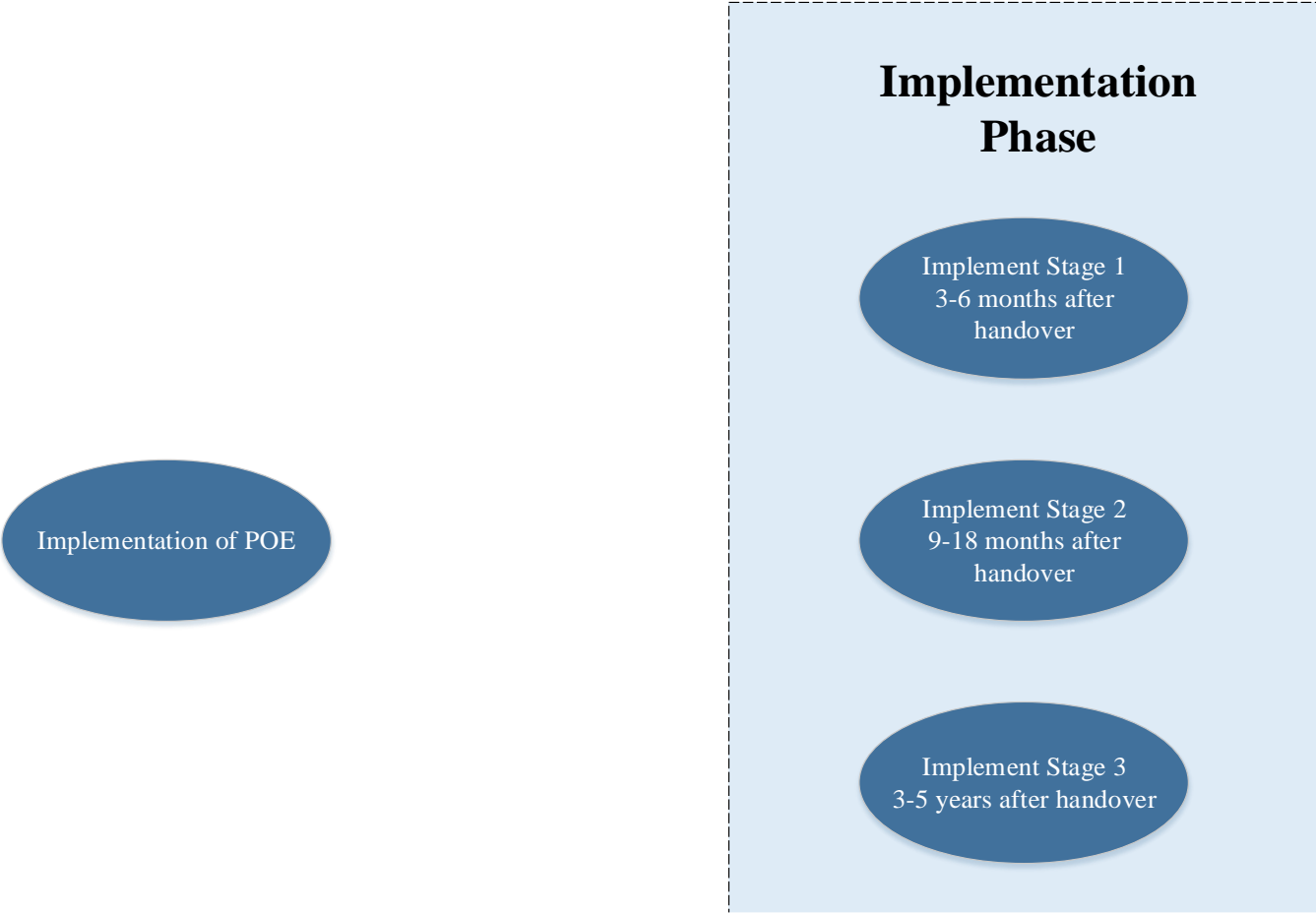


Proposed Alteration

8.2.1.3 Implementation Phase

When conducting the practitioner focus group which contributed to informing this research, it was notable that the implementation phase of the current POE processes received the least attention from practitioners (4.574% of responses). Of these responses, there was little in the way of concern, either in terms of weaknesses or threats, regarding current processes emanating from practitioners. The only alteration which has been implemented to the hybridised model is the separation of a single implementation point to three separate points. However, based upon the structure presented in the HEFCE Guide to Post-occupancy Evaluation 2006, this would be the case following that guidance also, despite the lack of it being stated explicitly. As such, practitioners were asked whether they agreed with a ‘largely unchanged implementation phase’ (c.f. Figure 63).

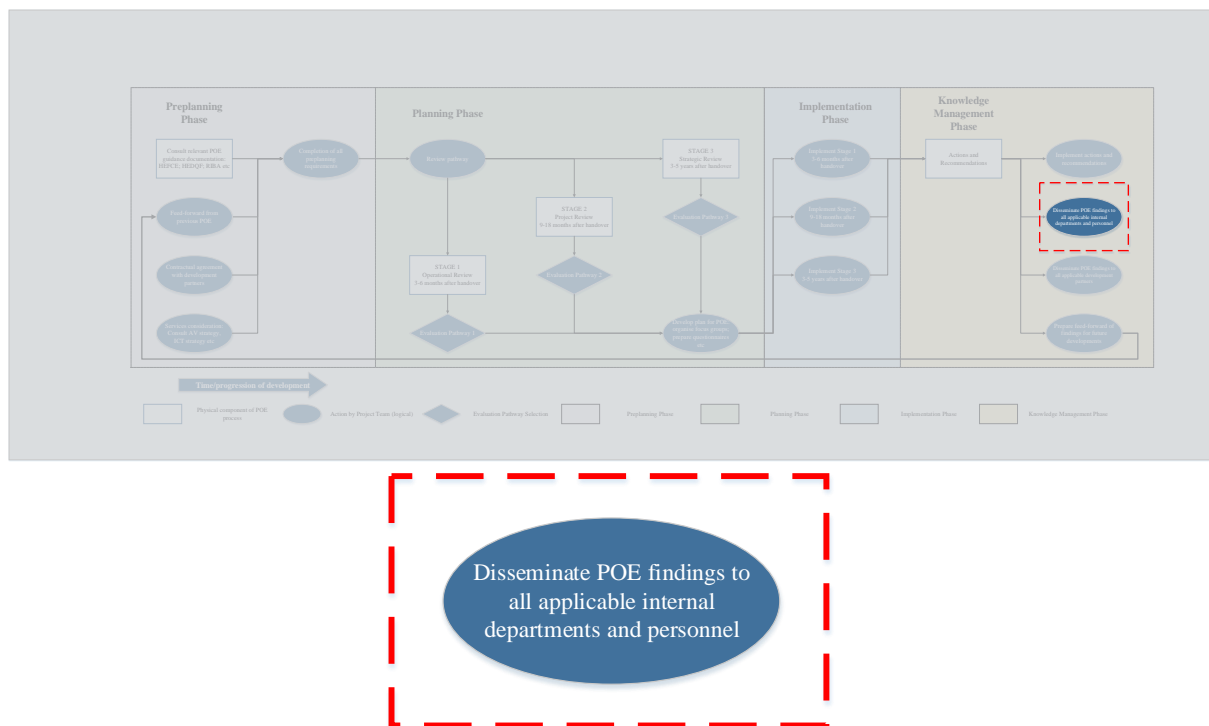
Figure 63 - A Visual Representation of the Alterations to the Implementation Phase of a POE



8.2.1.4 Knowledge Management Phase

The next question and associated points refer to the knowledge management phase. Anecdotally, it is often said that the findings of a POE report are filed away upon completion, and not reviewed again. This can be for a variety of reasons inclusive of: i) mitigation of liability; ii) IP and VP considerations; and iii) failure to recognise the value of design performance feedback; to name but a few. Consequently, the modifications suggested in this phase of the hybridised POE process are designed to ensure the findings from the completed POE reports are utilised to improve both current HE facilities as well as future HE developments. As such, the first point raised required the ‘dissemination of POE findings to all applicable internal departments and personnel’ (c.f. Figure 64).

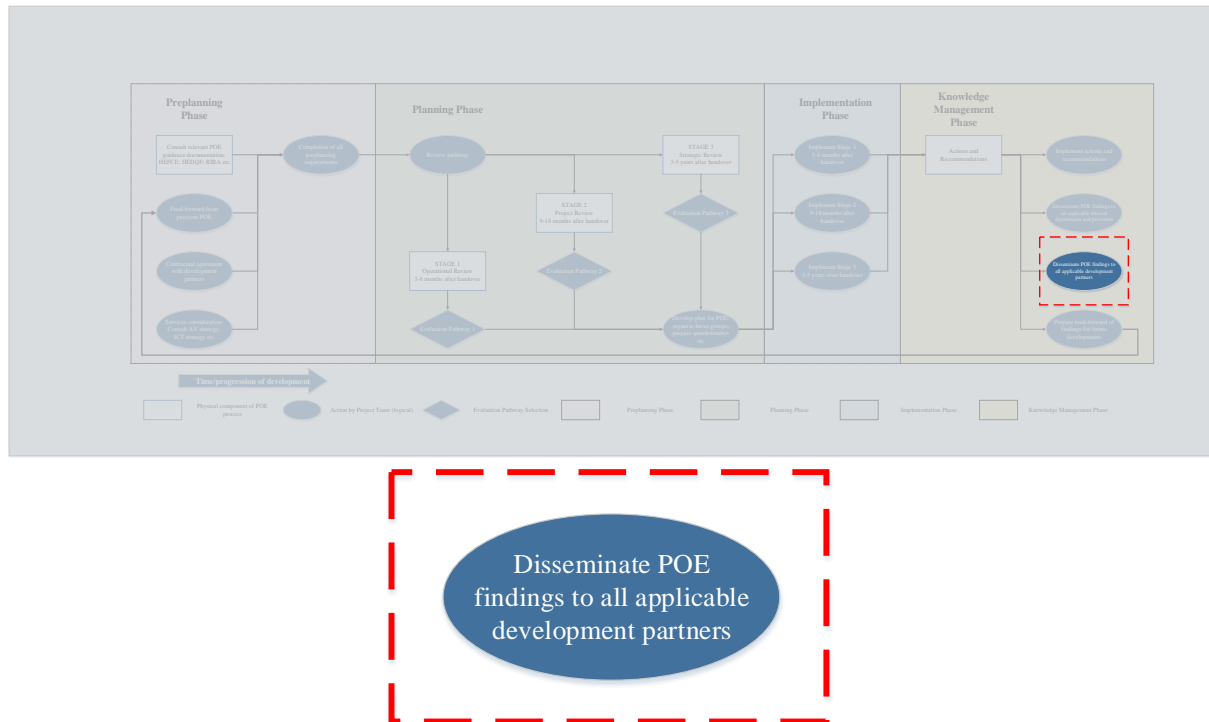
Figure 64 - A Visual Representation of the Additional Node requiring the Dissemination of POE Findings to All Applicable Internal Departments and Personnel



The second point within the knowledge management phase regards the additional node for the ‘dissemination of POE findings to external partners and contractors’ (c.f. Figure 65). This node, in conjunction with the additional node in the preplanning phase requiring pre-contractual agreements, creates a feedback mechanism for development partners and contractors. Without such feedback being made available, the development partner is expected to cooperate with an evaluation, with little incentive to do so. More importantly, this allows the dissemination of building knowledge garnered through the POE process into the myriad of development partners

and contractors, allowing them to improve upon their own processes, subsequently improving their business reputation.

Figure 65 - A Visual Representation of the Additional Node requiring the Dissemination of POE Findings to All Applicable Development Partners

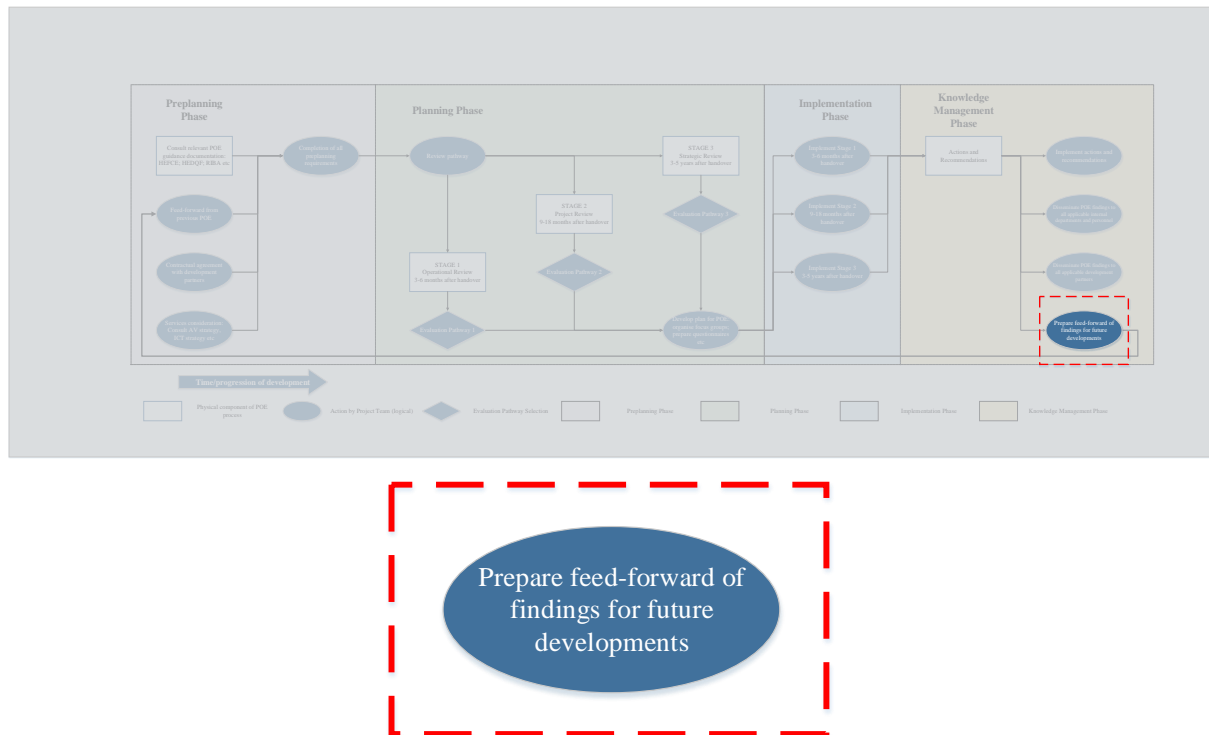


The next point within the knowledge management phase regards the ‘transparency of findings’. POE reports are often treated as highly sensitive information, even within the organisation which commissioned the POE. As such, dissemination to the head of a department may not be ensure that POE findings are utilised to improve the operation and performance of the building upon which the evaluation was based. Wider awareness of the findings of a POE, particularly amongst Estates personnel, may go some way to ensuring the tangible beneficial outcomes of a POE are realised. This corresponds to the finding of the PROBE case studies around the turn of the century, which called for greater democratisation of POE findings (c.f. Bordass *et al.*, 2001; Cohen *et al.*, 2001; Bordass and Leaman, 2007)

The final point within the ‘knowledge management phase’ regards an additional node for the ‘preparation of findings for feed-forward to future projects’ (c.f. Figure 66). Whilst this objective seems an obvious one, especially because the point of a POE is to facilitate a formal feedback mechanism to benchmark and iteratively improve buildings, the review of previous POE findings at the outset of a development has been found to rarely occur in practice. By

formalising this requirement, it is intended that this gap in the development feedback mechanism can be mitigated, allowing the prime objective of a POE to be regularly and consistently achieved in practice.

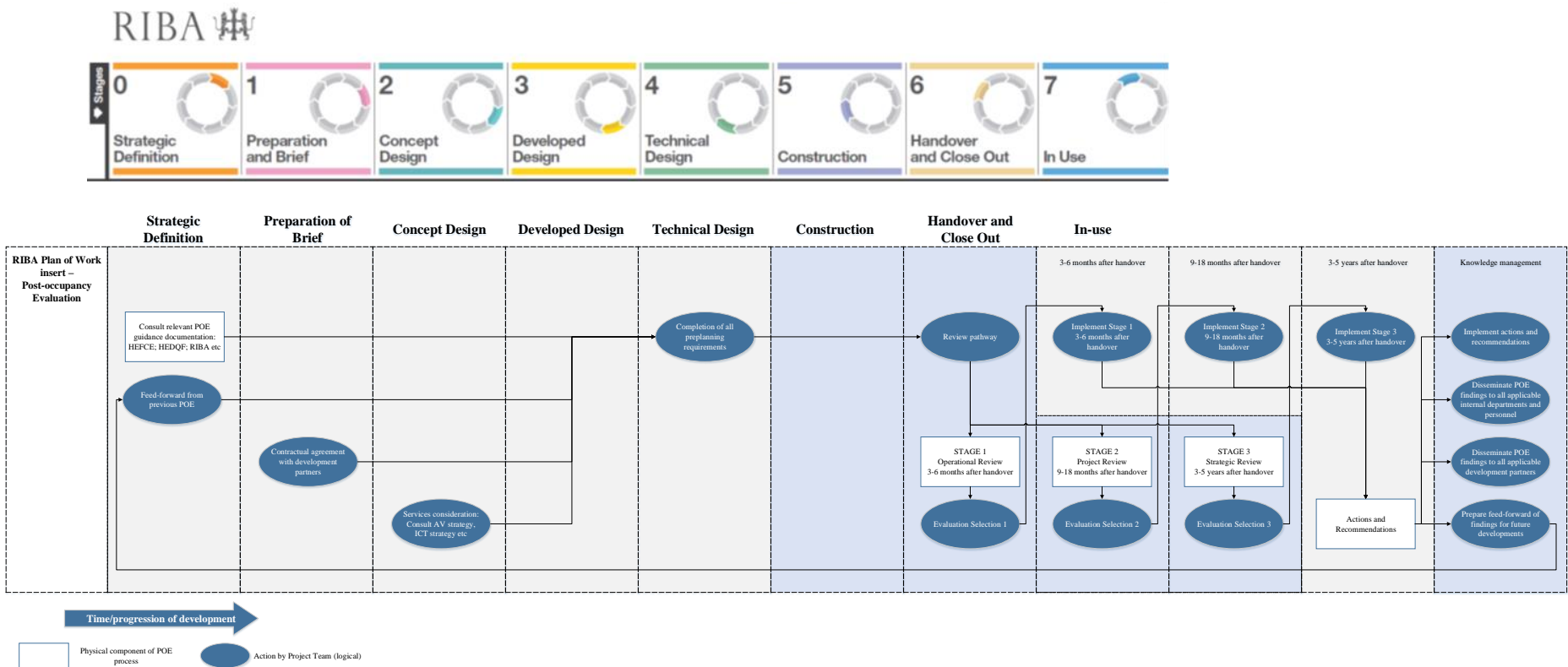
Figure 66 - A Visual Representation of the Additional Node requiring the Preparation of POE Findings for Feed-forward to Future Developments



8.2.1.5 Temporal Organisation

The final question referred to the temporal organisation of the newly developed hybrid model, in particular, synthesis with the full eight stages of the RIBA plan of work 2013. Unlike the first validation point, which aligned with the RIBA gateways 0-3 in the newly developed ‘preplanning phase’, aligning the entire process with the RIBA stages is designed to increase implementation of POE in practice. The RIBA Plan of Work 2013 is a preminent document in the UK construction sector, aligning the hybridised model with the RIBA stages allows for user-friendly planning and implementation of POE in practice, potentially across multiple sectors within the built environment, and crucially in a consistent manner. As such, the final point raised to practitioners regarded ‘POE model organised to coincide with RIBA plan of work 2013’ (c.f. Figure 67).

Figure 67 - A Visual Representation of the Hybridised POE Model Organised Temporally to Coincide with the RIBA Plan of Work 2013



8.2.2 Interview Participants and Sample Selection

Interview participants were selected based upon their direct involvement with POE processes. All of the participants have experience of planning POE within the HE sector, whether on behalf of their institution, or as a consultants called upon by the HEIs to conduct POE's (c.f. Table 25). Three of the participants (participant one, three and five) have no links to BCU whatsoever, and as such represent external validation, whilst participants two and four have interacted with BCU's POE processes in the course of their professional endeavours, and thus offer contextual validation in light of their increased awareness of POE's at BCU. Participant four, the director of a POE providing consultancy called 'Invigour', has conducted POE's for a multitude of different organisations, both within and external to the HEI sector, and thus brings further experience of conducting POE's in differing contexts. Participant two, whilst not with BCU anymore, had the role of promoting POE within BCU, and as such has direct experiences of the particular intricacies and pitfalls of planning POE's at BCU.

Table 25 - Validation Interview Participants, Corresponding Institutions, and Role

No.	Institution	Role
1	Aston University	Estates representative
2	Building Services Research and Information Association (BSRIA)	BSRIA Soft Landings Group representative (formerly)
3	Coventry University	BSRIA Soft Landings Group representative
4	Invigour	Invigour Consultancy representative
5	University of Birmingham	Estates representative

Whilst the sample of practitioners participating in the interviews is relatively small, this is justified in two ways: i) first, as identified in the literature review, the POE community of practice (CoP) operating in the built environment is relatively small compared to the CoP of other built environment activities; ii) second, the answers received for each validation question were at least 80% (four out of five practitioners) in agreement on any given point. Considering this level of agreement, the pursuit of further validation would likely produce repetition in results.

8.3 VALIDATION FINDINGS

Each of the five selected practitioners underwent a semi-structured interview where the aforementioned points of discussion were introduced for the purposes of validation. Once consent had been established, each interview was audio recorded, and then transcribed ready

for analysis. Each point raised, has been organised into a table facilitating direct cross referencing between the answers given by each of the practitioner.

8.3.1 Questions Referring to the Preplanning Phase of the Hybridised POE Model

Table 26 offers the responses gathered from the five POE practitioners regarding the temporal organisation of POE model with gateways 0-3 of the RIBA Plan of Work 2013. Four of the five practitioners (80.00%) interviewed agreed that the temporal organisation of preliminary POE activities to coincide with RIBA gateways 0-3 would aid in the consistent planning of POE. Furthermore, the response from interview no.5 raises the idea of ‘maturity delivering projects’. If an institution has previous experience of planning and implementing POE’s, then these initial considerations of POE processes are likely accounted for. However, if this were an institutions first attempt at a POE, then many of these considerations are not accounted for, leaving the comparable findings emergent from an institutions first POE incompatible with the findings of later POE’s delivered in a more ‘mature’ manner. The response which evaluated as ‘future research’ (interview no.2), talked about the institution’s approach being based upon a Project Execution Plan (PEP), as opposed to the RIBA stages. This is only raised in a single response from the five interviews, and as such, would appear to be an approach specific to the organisation interviewee no.2 represents as opposed to a sector wide approach.

Table 26 - A Table detailing the Validation Responses pertaining to Validation Question One

Validation Point		Process organised temporally to coincide with the RIBA Plan of Work 2013 Gateways 0-3	
Interview No.	Comment(s)	Comment No.	Sign-off/ amend/ future research
1	<i>"I think that, from experience, the success and occupation of building starts from point zero in terms of the RIBA stages."</i>	6	Sign-off
2	<i>"BCU uses a PEP, a Project Execution Plan, that PEP document is the DNA and blueprint of how you are going to deliver the project, that will show stakeholder requirements every single conceptual thing why you are doing it, the policies, all of the overarching things, and the POE and the introduction of learning from other POE's should form a strong part of the PEP, and I am not sure that it does."</i>	4	Future research
3	<i>"Yes it is necessary to feed in, we have lessons learned, but Post-occupancy Evaluation when we get into them will be a part of that, so it is formalising what we found from other buildings, best practice, things which we need to avoid feeding that into the design stages."</i>	4	Sign-off
4	<i>"Yeah, well so for me in simple terms that sort of pre-planning application isn't it usually for a construction project, so I know that RIBA's 2013 plan of work starts to promote the thinking about handover strategies and so on, it tries to map them across the whole seven stages of the RIBA process which I think is useful."</i>	6	Sign-off
5	<i>"That really helpful, because as you picked up with the BCU approach, that did change significantly based on our maturity delivering projects, so as the organisation becomes more mature in how it delivers a project, then this feedback loop becomes more aligned rather than just what went wrong."</i>	6	Sign-off
Validation sign-off (%)		80.00%	

Table 27 offers the responses to the additional node requiring pre-contractual agreements for cooperation with POE at the conclusion of the construction phase of development. An 80.00% (four of five practitioners) validation score was found when presenting the additional node for pre-contractual agreement regarding development partner's cooperation with POE at the conclusion of the construction phase. Whilst four practitioners did agree, each gave a different rationale for their agreement, first, interviewee no.1 offered some concern to how pre-contractual agreements would work in practice, whilst agreeing that more attention to the POE process at the outset of a development would be beneficial. Responses from interviewee no.2 agreed and went further, suggesting this was an opportunity to outline the intended POE to development partners at an early stage. Interviewee no.3 similarly went further, suggesting this

would be a prime chance to develop the institutions ‘best practice’ approach, whilst interview no.4 offered complete and unreserved agreement, as that institution had also started to independently implement this idea in their own POE process. The only practitioner to disagree (interviewee no.5) suggested that this amendment to POE processes was more aligned with an institutions procurement strategy, hence requiring extra research.

Table 27 - A Table detailing the Validation Responses pertaining to Validation Question Two

Validation Point Additional node for pre-contractual POE agreements with development partners			
Interview No.	Comment(s)	Comment No.	Sign-off/ amend/ future research
1	<i>“I think it is definitely a good idea to focus it at the beginning, it’s the practicalities of implementing that could be quite arduous because they are going to be concentrating on actually designing the building rather than thinking about the people they are getting in, it a good idea but a lot of thought and cooperation with the partners to make it actually work at that level.”</i>	8	Sign-off
2	<i>“Yes, I see what you are saying, what else you could do there as well is you could set out at the early stage, set out the landscape of the POE’s you are going to do as well.”</i>	6	Sign-off
3	<i>“I think as we are developing... we have coped in the past with not having them, but the reason we wanted to have soft landings focus was because we weren’t learning from past mistakes, and potentially not building on best practice, a lot of the information would go with whoever had done the project, we got some churn, so I think it would be beneficial.”</i>	8	Sign-off
4	<i>“Well there you are you see, that’s terrific, you’ve just found a really good example which I have started to do on my projects, I have started to make sure that the duties for the professional team and contractor, there is a expectation that within the fee bid, they will contribute to a POE, so that’s great, there are things which clearly need to be done.”</i>	8	Sign-off
5	<i>“the one thing I would sort of question is contractual agreement with development partners, that is very much defined by procurement strategy, so you can definitely have that conversation around design partners, but certainly not the people delivering the scheme.”</i>	6	Future research
Validation sign-off (%)			80.00%

Table 28 offers the five responses from practitioners regarding the additional node stipulating that previous POE findings be reviewed at the outset of a new development. All five practitioners (100.00%) agreed with the addition of a node stipulating the requirement for the

review of previous POE findings. Interviewee no.2 again makes the case for using a PEP, of which the review of previous findings should be a part of. Interviewees no.3 and no.4 both make the point that their respective organisations do not do this at present. Interview no.5, whilst agreeing with the addition of the new node, suggests the development of a frameworks imbedded within the institution, as opposed to the project, ensuring consistency across all of the institutions developments. Whilst the interviewee suggested this as an amendment, it has been recorded as both a sign-off and a future research suggestion. The rationale being that the interviewee agrees with the requirement for the review of previous findings, however, sees this particular requirement being achieved as part of the institutions processes, as opposed to one achieved directly through the POE process.

Table 28 - A Table detailing the Validation Responses pertaining to Validation Question Three

Validation Point		Additional node for review of previous POE findings at outset of new development	
Interview No.	Comment(s)	Comment No.	Sign-off/ amend/ future research
1	<i>"If you don't do that, you don't learn."</i>	10	Sign-off
2	<i>"The only comment I have really is the fact it should be a contractual requirement or part of the PEP to review the POE's at a really early stage."</i>	12	Sign-off
3	<i>"Definitely something we would need to do."</i>	14	Sign-off
4	<i>"Yeah, absolutely, have never come across it done, and I am now having to say, why don't I ask that question at the beginning of a project."</i>	10	Sign-off
5	<i>"Yes, an amendment I'd say, where this would really work successfully from a process point of view, is if you are actually talking about establishing frameworks with contractual partners, so if this process is imbedded with the framework and not the project."</i>	12	Sign-off Future research suggestion
Validation sign-off (%)		80.00%	

Table 29 shows the five practitioner responses collected regarding an 'additional node for the inclusion of services'. Each of the five practitioners (100.00% validation) agreed and signed-off the additional node for the inclusion of services. Each of the participants commented that there is either a requirement to incorporate services into the process earlier, or that they are currently reviewing their processes to this end. The comment garnered from interviewee no.5 elucidated upon the differences between 'practical completion' and 'operational readiness'. The ICT and AV requirements of a HEI, based upon the activity of educating students, are

prime considerations which are often overlooked in HE buildings until after ‘practical completion’. Failure to consider these factors before this stage, inevitably require HEIs to outlay further resources to bring learning spaces up to required standards. Switching to an ‘operational readiness’ perspective moves all of these requirements into the initial construction cycle, as opposed to an annex considered during a building snagging phase.

Table 29 - A Table detailing the Validation Responses pertaining to Validation Question Four

Validation Point		Additional node for inclusion of services	
Interview No.	Comment(s)	Comment No.	Sign-off/ amend/ future research
1	<i>“At Aston the whole AV infrastructure is being totally reviewed bottom up and top down.”</i>	12	Sign-off
2	<i>“The comment I have for that is the fact that, well to reiterate what I’ve just said really, POE when we are taking previous learnt POE’s, there is no area within there that is really specific for complex IT, and the only information we have for IT, is the presentation we had from IT that we put into it, otherwise we’d have no feedback, no official feedback from an IT point of view or perspective, we’d have no knowledge of their problems.”</i>	18	Sign-off
3	<i>“Absolutely, but I would say, we have this with BIM as well, so we’ve got clash detection and things like that we are developing, but I would say that needs to run throughout.”</i>	18	Sign-off
4	<i>“Yeah, which come back to a point we touched on prior to this interview to starting, around a design guide, so whatever the IT equivalent is to that within the business, if the IT department is going to be the custodian of that element of the specification of the building, then maybe that sits outside the design guide but there is a reference, cross reference to it.”</i>	14	Sign-off
5	<i>“There are a couple of things we have done recently, a lot of it is learning off the back of BCU, we talk very much now about operational readiness, not practical completion, the industry still has the mind-set of practical completion, drop your tools, walk away.”</i>	20	Sign-off
Validation sign-off (%)			100.00%

8.3.2 Questions Referring to the Planning Phase of the Hybridised POE Model

Table 30 shows the five responses garnered regarding the ‘separation of theoretical and practical POE planning. The participant practitioners all agreed (100.00% validation) that the separation of theoretical and practical planning would be beneficial to the efficient and

consistent planning of POE's. Unless an institution has a well-defined internal POE strategy, POE are often undertaken by consultants working on behalf of HEIs. Utilisation of consultants can mask the planning requirements of a POE, as the service is essentially outsourced. In consideration of the requirement for POE processes to run simultaneously to the development cycle, a lack of understanding of the requirements for planning a POE can lead to inconsistency in approach as well as failure to recognise wider benefits of conducting such an evaluation.

Table 30 - A Table detailing the Validation Responses pertaining to Validation Question Five

Validation Point Separation of theoretical and practical POE planning			
Interview No.	Comment(s)	Comment No.	Sign-off/ amend/ future research
1	<i>"It the very similar set up to what we have at Aston, and formally at Brunel, it's part of the soft landings process, which we have done anyway."</i>	14	Sign-off
2	<i>"Yep, I understand that, and how that fits in there, so, you could specify who, when, and how, ultimately, that would feed into there, so you can design that out at the earlier stage, and then that would feed straight into there and deliver what you have already agreed. Yes, that makes sense."</i>	30	Sign-off
3	<i>"I think that is incredibly useful, you know, the HEFCE at the moment, because it is so sort of high level, and you can kind of pick out what you are doing, there is some freedom there, for a newbie who is just developing this."</i>	22	Sign-off
4	<i>"Yeah, good practice for me is to be preparing a briefing note for participants, to send it out to them, you know, a reasonable time before the review to explain what the purpose of the review is."</i>	16	Sign-off
5	<i>"No I think that is very good, if you align it with current approach to procurement, this sort of stuff means you can have the conversation with the main party involved which is the contractor, and once that strategy is set in, then it should be easier for these guys to take that forward."</i>	24	Sign-off
Validation sign-off (%)			100.00%

Table 31 shows the five responses garnered from practitioners regarding the 'reduction of choice within POE processes in favour of a more sequential approach. A validation score of 80.00% (four of five practitioners) was recorded regarding sequential approach within the POE process as opposed to multiple choice selection points. The practitioners interviewed in interview no.2 did not interpret the new model as representing a reduction of choice in favour of sequential pathways, stating that they still read the process diagram as offering the

practitioners multiple choices regarding which evaluation to utilise at which temporal junctures. As a result, this comment has been recorded as an amendment requiring clarification, as whilst they agreed with the concept, they did not interpret the model the same way. The other four practitioners (80.00%) did interpret the model as having reduced the choices to practitioners in favour of a more sequential approach.

Table 31 - A Table detailing the Validation Responses pertaining to Validation Question Six

Validation Point Reduction choices within POE processes in favour of more sequential approach			
Interview No.	Comment(s)	Comment No.	Sign-off/ amend/ future research
1	<i>"I think the definition blocks are good, I think it all depends who, on how you structure them in terms of who is going to form the party to do those."</i>	18	Sign-off
2	<i>"I still read that as different choices, rather than pathways, should the arrows not go from one phase directly to the next, previously it looked to me, that I had the option to go and do stage 1, the option to do stage 2, and there being no requirement to do this, it looks like I have choice, and I shouldn't have, there is no way to get to that third level without doing the previous ones. With things like this it needs to be that you have no choice. All roads must lead to Rome."</i>	32	Amendment
3	<i>"No, I think it makes more sense, again I suppose similar to what I said before, its nice to have flexibility, because you can do as much or as little as you can manage, but at the same time, if you're going through a process where you are doing POE's for every building, I think having all of this information done in a structured way is a lot more helpful, the danger is you do these different ways around, lacking consistency, and there will be a rationale to why these are done, these different points, so it is understanding the reasoning behind that as well."</i>	30	Sign-off
4	<i>"Yeah, I think generally I prefer what you have put down here as a clear sequential set of stages."</i>	18	Sign-off
5	<i>"Yep, if that still catches the same three things then that is fine, you've set you're structure at this stage, then that is fully articulated when you are having these conversations around the planning, that's in here, I think this is a much better approach."</i>	26	Sign-off
Validation sign-off (%)			80.00%

Table 32 shows the five practitioner responses pertaining to the 'replacement of review and evaluation selection points in favour of three stage pathway'. The validation findings for the replacement of the 'review' and 'evaluation' pathways in favour of a three stage pathway,

received a validation score of 80.00% (four of five practitioners). Again, the practitioner interviewed in interview no.2 felt that the planning phase of the hybridised POE model still required practitioners to make selections relating to ‘review’ and ‘evaluation’ selections. Furthermore, similar to the last point, the practitioner agreed with the concept suggested but did not interpret the model the same way, as such rendering the finding an amendment, requiring further clarification. The other four practitioners (80.00%), agreed with the modification removing ‘review’ and ‘evaluation’ selections in favour of a three stage approach.

Table 32 - A Table detailing the Validation Responses pertaining to Validation Question Seven

Validation Point		Replacement of ‘review’ and ‘evaluation’ selection points in favour of three stage pathway	
Interview No.	Comment(s)	Comment No.	Sign-off/ amend/ future research
1	<i>“I think that will probably be good because it will cut down a lot of probably be good because it will cut down a lot of questions.”</i>	26	Sign-off
2	<i>“That seems to me that there is a choice. That’s interesting (phase 3 - strategic evaluation pathway), that’s massive, I’ll tell you that now, this stuff you’ll get buy-in for (stage 1 and 2), that is an achievement (stage 3).”</i>	34	Amendment
3	<i>“No, I think it makes more sense, again I suppose similar to what I said before, it’s nice to have flexibility, because you can do as much or as little as you can manage, but at the same time, if you’re going through a process where you are doing POE’s for every building, I think having all of this information done in a structured way is a lot more helpful, the danger is you do these different ways around, lacking consistency, and there will be a rationale to why these are done, these different points, so it is understanding the reasoning behind that as well.”</i>	30	Sign-off
4	<i>“Yes, I prefer the staged approach to the flexibility pick and mix.”</i>	20	Sign-off
5	<i>“Yep, it makes perfect sense.”</i>	34	Sign-off
Validation sign-off (%)		80.00%	

8.3.3 Questions Referring to the Implementation phase of Hybridised POE Model

Table 33 offers the five collected responses from practitioners regarding the minimal modifications to existing POE processes regarding the implementation of a planned POE. The validation findings regarding the limited requirement for modification to the implementation phase of a POE were found to be at 80.00% (four out of five practitioners), indicating practitioners were in agreement on this point. Interviewee no.2, eludes to agreement with the

proposal of limited modification to the implementation of POE, but suggests further modifications based upon the provisions in the CIBSE log book *“that could fit in also.”* As such, the comment from interview no.2 has been assigned as ‘future research’ as opposed to a ‘sign-off’. The practitioners who did ‘sign-off’ this validation point, went on to reaffirm the importance of planning with regard to the successful implementation of POE.

Table 33 - A Table detailing the Validation Responses pertaining to Validation Question Eight

Validation Point		Implementation phase requires no amendment	
Interview No.	Comment(s)	Comment No.	Sign-off/ amend/ future research
1	<i>“Well, again its consistency, it the preparation of that in terms of who’s going to attend it, what questions are you going to ask in preparation for preparing that.”</i>	28	Sign-off
2	<i>“In the CIBSE log book, is interesting form a technical viewpoint, going back and logging readings after a year, that could fit in also, no one will want to do this though, the POE I have done however, has no technical information.”</i>	44	Future Research
3	<i>“I think going back to. Just taking a step back in terms of planning it ahead, this makes the implementation a lot more possible, so getting diaries, knowing when you are going to do something, if it is during the summer holidays, you are not going to get as many academics for example, so the actual doing of it really relies on cracking the planning stage right as well, little things like reminders having set text.”</i>	38	Sign-off
4	<i>“I think possibly, part of the reason for that is that I’ve never actually done anything between RIBA stage 4 completion of design and POE and the completion of the project, there have not been any interim during construction reviews, which is quite an interesting point in of itself I think.”</i>	22	Sign-off
5	<i>“It’s down to organisation isn’t it, it makes sense, this would be familiar to most people, the only thing I would question is, three is definitely too early I’d suggest, you are still licking your wounds from what is never an easy process.”</i>	36	Sign-off
Validation sign-off (%)			80.00%

8.3.4 Questions Referring to Augmented Knowledge Management Phase of Hybridised POE Model

Table 34 shows the practitioner validation responses to the requirement for ‘dissemination of findings to all applicable internal departments and personnel’. The validation score for

‘dissemination of findings to all applicable internal departments and personnel’ was found to be 100.00% (five of five practitioners). Notably, interview no.2, answers both this point and the next with their single comment, both agreeing with the proposed modification. Interviews no.1 and no.4 comments on the buy-in from internal departments and personnel, making the point that engagement with these internal departments and personnel will influence the quality and richness of feedback. Interview no.5 offers a sense of scepticism, commenting “*Great, do you see that happening?*”, then continuing on to share similar views to those expressed in interviews no.1 and no.4.

Table 34 - A Table detailing the Validation Responses pertaining to Validation Question Nine

Validation Point		Dissemination of findings to all applicable internal departments and personnel	
Interview No.	Comment(s)	Comment No.	Sign-off/ amend/ future research
1	<i>“I think that is important, you need buy in from the people, and by getting them to buy in, you probably get a lot of useful feedback from them, they’ll be quite motivated to do it, as opposed to just seeing a bit process and a map.”</i>	36	Sign-off
2	<i>“Dissemination to both internal and external, yep I agree that.”</i>	*48	Sign-off
3	<i>“Yes, absolutely, yes all of the managers, assistant directors, directors.”</i>	46	Sign-off
4	<i>“Yes, I think the first thing I would say, is it is really important to give the participants something back, and I am aware there have been occasions where that might have been promised and not delivered upon, on one occasion I have had to because sensitivities.”</i>	24	Sign-off
5	<i>“Great, do you see that happening?”</i>	40	Sign-off
	<i>“Yeah, it’s the best way to get your stakeholder engagement in the process, what I would say though, heads of departments.”</i>	42	
Validation sign-off (%)			100.00%
*comment answers two separate questions			

Table 35 offer the five validation comments offered by practitioners regarding ‘dissemination [of POE findings] to all external development partners - contractually agreed at outset of development.’ Again, similar to internal dissemination, regarding external dissemination a validation score of 100.00% (five of five practitioners) was recorded. Interviewee no.2 answers this point with the same comment which answered the previous point also. Interviewee no.1 comments that their institution utilises Design and Build (D&B) contractual frameworks for

certain elements of development, these cater for some of the requirement for feedback, although this still requires the internal processes to effectively manage the feedback. From the remaining interviews, an understanding that cooperation from development partners will require incentive, the feedback for them to improve their own processes and performance being an example.

Table 35 - A Table detailing the Validation Responses pertaining to Validation Question Ten

Validation Point		Dissemination to all external development partners - contractually agreed at outset of development	
Interview No.	Comment(s)	Comment No.	Sign-off/ amend/ future research
1	“Some of the AV provision in the new students union, the AV provision was done by the contractor under a D&B, but the key principles of the usage was obviously done by ourselves as part of the brief, and it worked.”	38	Sign-off
2	“Dissemination to both internal and external, yep I agree that.”	*48	Sign-off
3	“Yes... yes... yes so during the design meetings, there is a lessons learned process where we are bringing through, as I say, the last three or four projects, and they are talking about that, I haven’t attended one of those and I really want to, because I haven’t seen the level of conversation they have.”	50	Sign-off
4	“Yeah, architects would be more interested in elements of the design or products, I suppose project managers and so on will be more interested in whether they made the right judgements, whether they should have tackled an issue earlier and so on, so I think there is some sort of behavioural performance learning in that, should someone have called time on a project earlier, different parts of the POE probably mean more to different participants.”	30	Sign-off
5	“Yep, absolutely, they are the ones that will be delivering the next building that’s wrong... (laughter), but not as wrong as the last one.”	46	Sign-off
Validation sign-off (%)			100.00%
*comment answers two separate questions			

Table 36 depicts the validation responses from participating practitioners regarding 'transparency of findings increasing efficiency of 'action' implementation. Beyond simply disseminating findings to appropriate internal departments and personnel, if the findings of a POE are more widely democratised within the commissioning institution, the likelihood that 'actions and recommendations' being acted upon is increased. Anecdotally, it is not unusual to

hear of issues identified in POE reports never being resolved. As such, the validation findings for this intervention were found to be 80.00% (four of five practitioners). However, interviewee no.2 completely disagreed with the concept of ‘actions and recommendations’ emanating from a POE report. The practitioner in question was of the view, that POE is a hard technical feedback mechanism that helps inform future development, rather than an evaluation which can improve the functionality and efficiency of the newly developed HEI assets. It can be deduced, that reticence to feedback on current HEI assets is largely due to a recurring theme within well-established inhibitors to a progressive built environment sector, namely the mitigation of liability (c.f. Khosrowshahi and Arayici, 2012; Jiao *et al.*, 2013).

Table 36 - A Table detailing the Validation Responses pertaining to Validation Question Eleven

Validation Point		Transparency of findings, institutional knowledge of findings increasing efficiency of ‘action’ implementation	
Interview No.	Comment(s)	Comment No.	Sign-off/ amend/ future research
1	<i>“Yeah that makes sense, that’s logical, fundamentally check there own areas as opposed to the other way around, that’s logical.”</i>	40	Sign-off
2	<i>“I don’t see and implementation or recommendation from any of the POE’s, I don’t, I see the POE as being un-opinionated data, the recommendations need to be defined at this stage (preplanning), so implement and recommend, that’s for someone else to do.”</i>	50	Future research
3	<i>“I suppose it depends upon on what actions they are, I suppose, if it is that xyz about a certain feature, depending upon procurement rules.”</i>	52	Sign-off
4	<i>“Curiously, I put both in my POE reports, so I have a conclusion and recommendations, and then I have and actions, a follow on actions, why have both... I think it is useful to a series of actions, that the institution can actually do them or not, and you can see whether they have been done or not.”</i>	32	Sign-off
5	<i>“It goes back to stakeholders, because what we specifically did, because at that point the Estates and Facilities teams were separate, they weren’t combined under one function, there was a bit of a challenge there, as there were two very strong directors, which didn’t always have consensus of agreement on things - so this could be institutional.”</i>	52	Sign-off
Validation sign-off (%)		80.00%	

Table 37 identifies the five participant practitioner comments regarding the ‘preparation of POE findings for feed-forward to future developments completing the circularity of the

process.’ Interviewee no.1 confirms their agreement with the additional node regarding preparation of findings for feed-forward to future developments, but makes the additional point that within their organisation, this is very much driven internally as part of their Estates strategy. Interviewee no.2 continues along the line of no actions or recommendations, however in context to the question, this suggests they do not agree with feeding forward findings either. In consideration of the academic objectives of: i) facility benchmarking (Riley *et al.*, 2010); and ii) iterative improvement (Göçer *et al.*, 2015); failure to feedback on the development in question, or feed-forward to future developments would render the POE process essentially pointless. Practitioner fears regarding the concept of ‘mitigation of liability’ may offer a significant insight into an inhibitor of the POE process. As such, interview no.2 was recorded as a future research requirement, in keeping with practitioners fear regarding liability. Interviews no3 and no.4 both validate the process alteration, further establishing the importance of the RIBA stages to the development cycle in the process. Overall, the validation was found to have a score of 80.00% (four out of five practitioners).

Table 37 - A Table detailing the Validation Responses pertaining to Validation Question Twelve

Validation Point		Preparation of POE findings for feed-forward to future developments completing the circularity of the process	
Interview No.	Comment(s)	Comment No.	Sign-off/ amend/ future research
1	<i>"For this process to mean something it needs the full support of the Estates Director and possible the deputy, the senior, the COO, and then that will be driven internally by the Professors and Deans."</i>	42	Sign-off
2	<i>"I would make this whole process completely void of any advice or recommendations, its an evaluation, I'm just giving you pure data, I'm categorising it, I'm quantifying it, I'm putting some number on there, but what you make of them, is for you to do, anything you want to do with that information, I'm not going to tell you what to do what so ever, I would recommend reading the evaluation and digesting it."</i>	52	Future research
3	<i>"So we will have a plan of work which is basically RIBA, and it is sanitized a little for Coventry University, there will be part of this on here where they do do a schedule of lessons learned and then bring in information, again it is what that means exactly, how we go about doing it, so it's already in there that we do it."</i>	54	Sign-off
4	<i>"Okay, so the feedback would go back to RIBA 0 for me, if you are in the fortunate position of having... at the early briefing stage."</i>	34	Sign-off
5	<i>"What we are certainly trying to do here now, and we weren't very good doing it at BCU."</i>	54	Sign-off
Validation sign-off (%)			80.00%

8.3.5 Questions Referring to the Temporal Organisation of the Hybridised POE Model

Table 38 shows the five participant practitioner responses regarding the 'hybridised POE model [being] organised to coincide with the RIBA Plan of Work 2013'. Organisation of the POE model to coincide with the RIBA Plan of Work 2013 recorded a validation score of 100.00% (five of five practitioners). Each institution confirmed their own use of the RIBA stages as a starting point for development. As such, synthesis with the RIBA stages offers a host with which the hybridised POE model can run simultaneously, allowing practitioners to easily understand their requirements at each stage, and specifically when differing element of an evaluation should be organised temporally.

Table 38 - A Table detailing the Validation Responses pertaining to Validation Question Thirteen

Validation Point Hybridised POE model organised to coincide with the RIBA Plan of Work 2013			
Interview No.	Comment(s)	Comment No.	Sign-off/ amend/ future research
1	<i>"I think so, you've obviously studied the HEFCE guidance, and they've got a lot of experience, one hundred plus years, so there is a lot of knowledge base there, I think that will help the process."</i>	44	Sign-off
2	<i>"It will do for sure, yeah you can associate that with the RIBA stages, which makes sense."</i>	56	Sign-off
3	<i>"Absolutely, massively, we use RIBA."</i>	60	Sign-off
4	<i>"Yeah absolutely I do, if you get the RIBA to adopt it in there next plan of work update, that would be good, if you can't then it's a very good basis to have discussion with architects and engineers."</i>	42	Sign-off
5	<i>"Definitely, because then you can contract based on the RIBA stages, with all of your different partners and everybody in the industry... the construction industry will recognise that, less so with your client organisations, but they are not really the ones inputting into the significance of what it is going to cost, how long it going to take, it gives you clear responsibilities at each stage also."</i>	68	Sign-off
Validation sign-off (%)			100.00%

8.3.6 Word Frequency Analysis

A word frequency analysis is undertaken on each of the five transcripts pertaining to the five interviewees.

8.3.6.1 Validation Interview 1

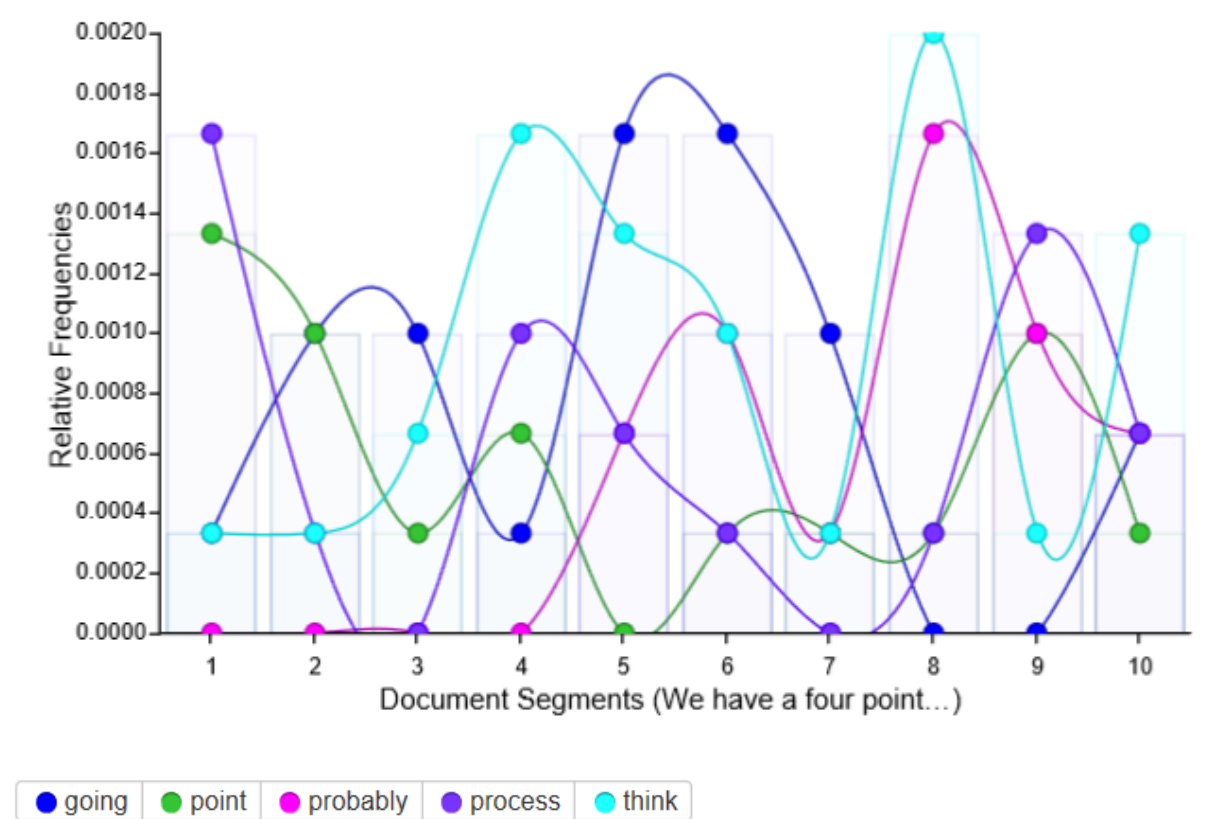
Figure 68 shows the word frequency visualisation developed utilising the interview transcript from interviewee no.1. The most frequent terms emanating from this transcript where, in descending order where: i) going; ii); point; iii) probably; iv) process; and v) think.

Figure 68 - A Word Frequency Visualisation for Interview Transcript no.1



Figure 69 shows a graph showing the frequencies of the five most frequently utilised words, in conjunction with the corresponding paragraphs they appeared in. Utilising the questionnaire developed for the validation of the hybridised model, an insight can be garnered into the language used in different paragraphs, and the corresponding area of the hybridised model. Notably, the word 'going' is utilised (particularly in the West Midlands vernacular) in the practitioner interviews to designate where an action or intervention is likely to produce a particular outcome, for example '*if you do x, you're going to get y*'. With the exception of paragraphs five and six, where the term 'going' arises, the term 'probably' does not. This gives an indication as to the certitude with which a practitioner is expressing their view on a specific element of the hybridised process. The terms 'point' and 'process' appear frequently throughout the transcript, with the exceptions of paragraph five for the word 'point', and paragraph seven for the word 'process'. These are not unexpected, the term 'point' is utilised in the interview transcript where the term 'node' could alternatively be utilised, and the research itself pertains to POE processes.

Figure 69 - A Word Frequency Evaluation Graph for Interview Transcript no.1 indicating Word Frequencies at Specific Temporal Points



8.3.6.2 Validation Interview 2

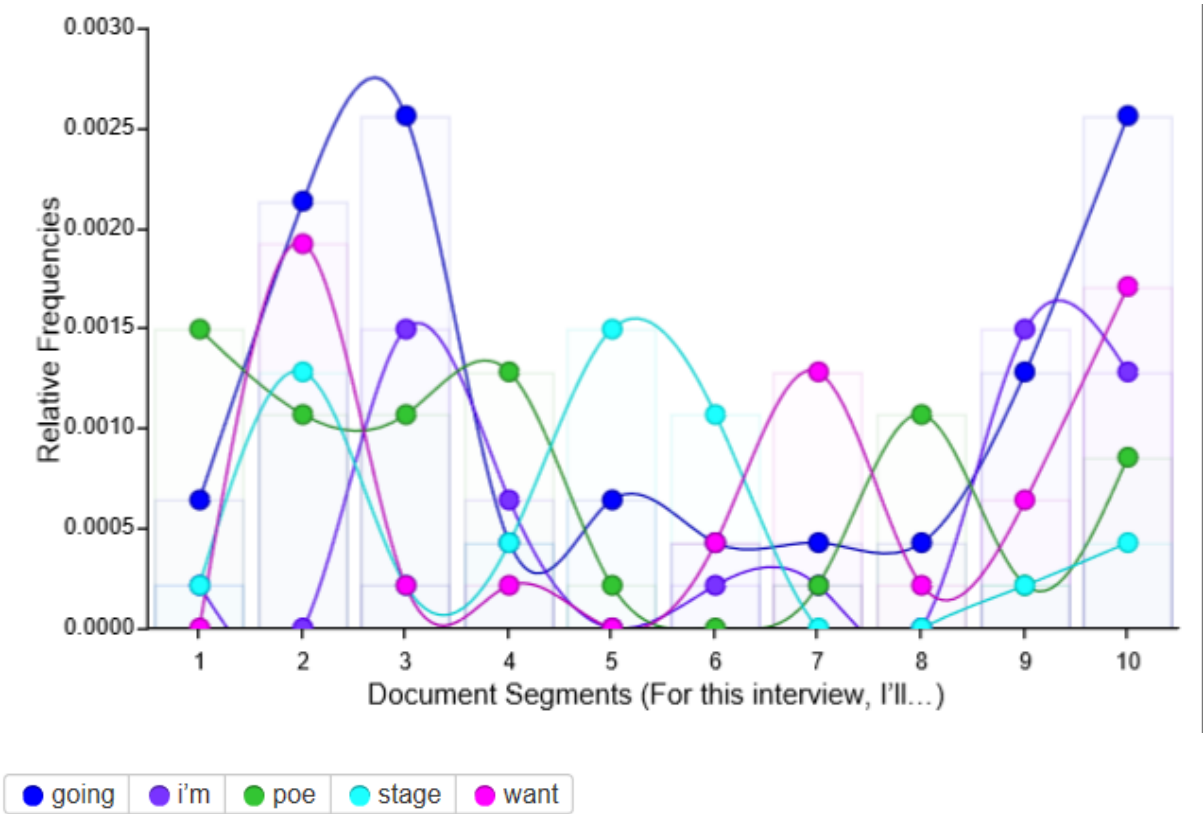
Figure 70 shows the word frequency visualisation for interview transcript no.2. The most frequent terms emanating from transcript no.2 were: i) ‘going’; ii) ‘I’m’; iii) ‘POE’; iv) ‘stage’; and v) ‘want’ in descending order. The term ‘going’ is utilised in much the same way as it was in the previous transcript, indicating where a practitioner states one action will lead to another.

Figure 70 - A Word Frequency Visualisation for Interview Transcript no.2



Figure 71 shows the frequencies of the five most frequently used terms, in conjunction with the corresponding paragraphs they appeared in. Notably, the term ‘going’ is utilised heavily at the beginning of the interview (particularly paragraphs two and three), and at the end of the interview (paragraphs nine and ten). This indicates the practitioner was prescriptive in their requirements for the preplanning phase, elements of the knowledge management phase, and the temporal organisation of the hybridised POE model, yet far less prescriptive when it came to the planning and implementation phases. Interview no.2 is the only transcript where ‘I’m’ is found to be one of the five most frequent terms. The term ‘want’ occurs throughout the transcript, but shows particular peaks around paragraphs two, seven and ten, paragraph two referring to the preplanning phase, paragraph three referring to the knowledge management phase, and paragraph ten referring to temporal organisation. The finding of the term ‘want’ indicates the practitioner in question was particularly prescriptive in what they were looking for from a POE investigation. The finding of ‘POE’ and ‘stage’ as two of the five most frequent terms is expected, whilst not particularly offering an insight, as both of these terms would be expected to occur frequently when conversing on the subject of POE processes.

Figure 71 - A Word Frequency Evaluation Graph for Interview Transcript no.2 indicating Word Frequencies at Specific Temporal Points



8.3.6.3 Validation Interview 3

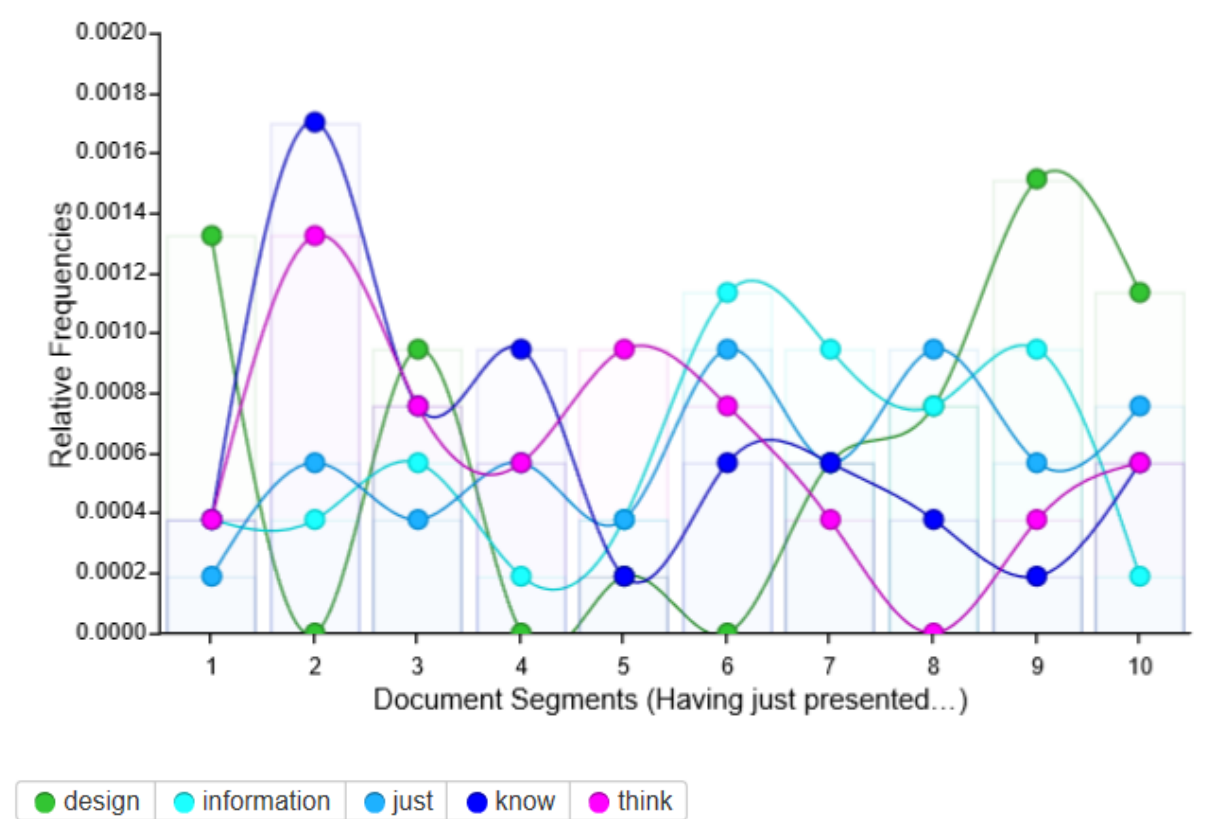
Figure 72 shows the word frequency visualisation for interview transcript no.3. The most frequent terms found in interview transcript no.3 were: i) design; ii) information; iii) just; iv) know; and v) think; in descending order.

Figure 72 - A Word Frequency Visualisation for Interview Transcript no.3



Figure 73 shows a graph depicting the frequencies of the most frequently utilised terms, temporally organised in conjunction with the corresponding paragraphs they appeared in. The most frequent term, 'design', is prominent at the beginning of the interview (paragraphs one and three) and at the end of the interview (paragraphs eight, nine and ten). Interviewee no.3 discussed the development of a design guide based upon the findings of POE. The use of an institution specific design guide, when interviewing practitioners on POE, will arise at the beginning of the POE process (by extension development process also) as the findings of previous POE's are informing the initial design phases. Similarly, the findings of a POE would also be fed into the continually updated institution specific design guide, explaining the high frequencies of the word 'design' at the beginning and end of the interview. The second most frequent term 'information', was found to be present in every paragraph. However, the frequencies of this term are increased later in the interview (paragraphs six, seven, eight and nine). The later stages of the interview discuss the 'knowledge management phase', the element of the hybridised process where POE findings are collated and disseminated. Notably, paragraph ten sees a drop in the frequency of the term 'information', coinciding with the interview discussing 'temporal organisation' as opposed to 'knowledge management'. The term 'know', again can be found in every paragraph. The largest peak in frequency of this term arises in paragraph two, when discussing the newly developed 'preplanning phase', the point at which previous POE findings should be reviewed.

Figure 73 - A Word Frequency Evaluation Graph for Interview Transcript no.3 indicating Word Frequencies at Specific Temporal Points



8.3.6.4 Validation Interview 4

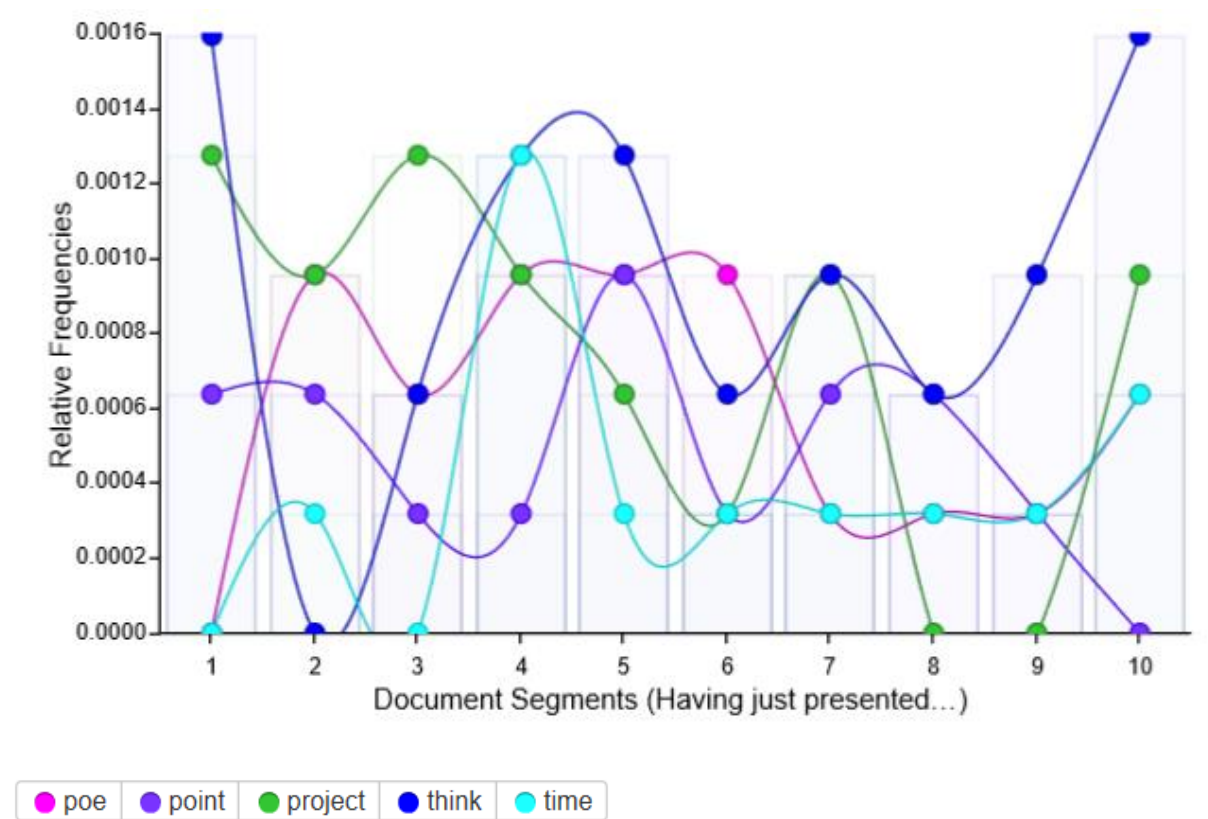
Figure 74 shows the word density visualisation for interview transcript no.4. The most frequent words in descending order were: i) POE; ii) point; iii) project; iv) think; and v) time.

Figure 74 - A Word Frequency Visualisation for Interview Transcript no.4



Figure 75 depicts a graph detailing the five most frequent words, in conjunction with the paragraphs in which they appeared. Immediately notable, is the high frequency of the term ‘think’ in paragraphs one, five and ten. Paragraphs one and ten correspond to the temporal organisation of the hybridised POE model with RIBA stages. Interview no.4 had a 100.00% validation score overall, indicating the use of this term was to support the validation point presented. The most frequent term ‘POE’ occurs throughout the interview, offering little insight being as this is the subject of the interview. Similarly, the use of ‘point’ (second most frequent term) and ‘project’ (third most frequent term), is a term which would be expected to arise in the context of the interview. However, the finding of ‘time’ as the fourth most frequent, suggest the practitioner in question is aware that timing and scheduling are critical in terms of garnering POE feedback data from stakeholders (construction through to end-users), at the applicable temporal points. Notably, interview no.4 is the only interview in which ‘time’ was found to be one of the five most frequent terms, despite the established importance of timing and scheduling.

Figure 75 - A Word Frequency Evaluation Graph for Interview Transcript no.4 indicating Word Frequencies at Specific Temporal Points

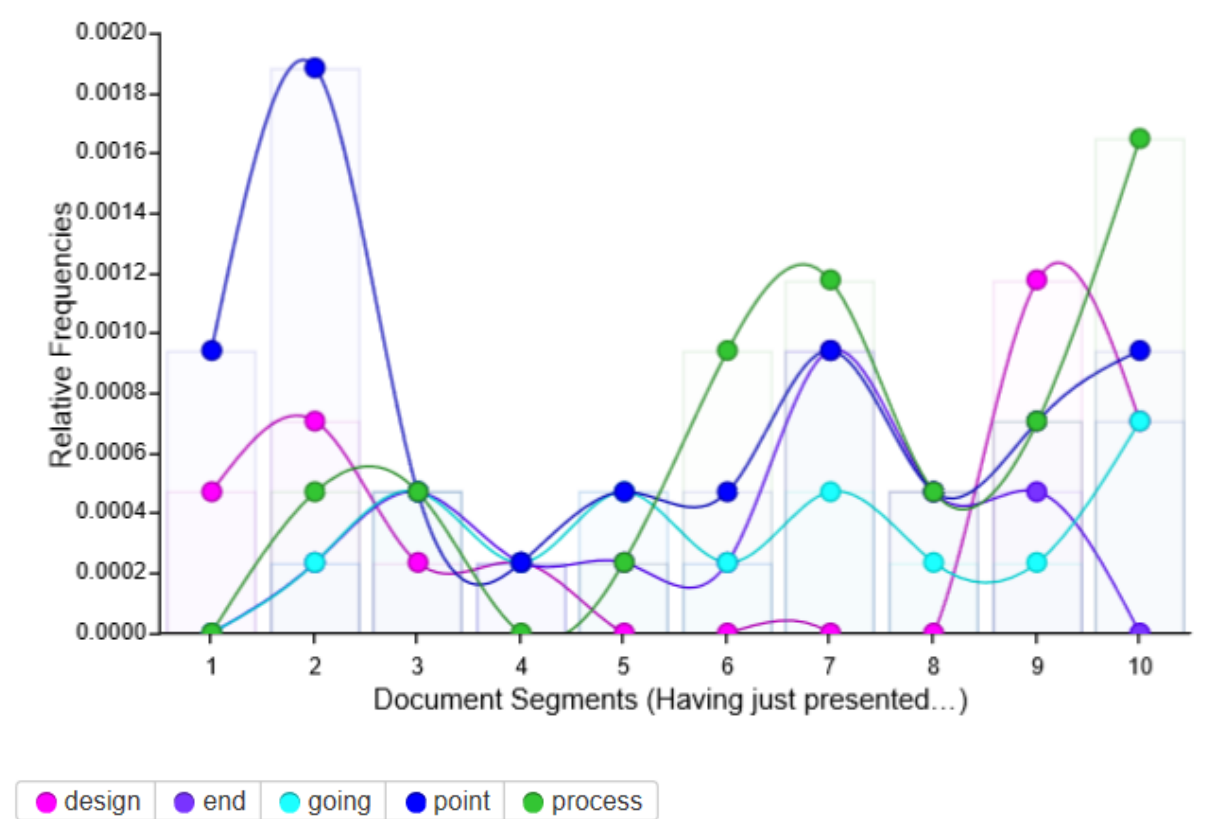


8.3.6.5 Validation Interview 5

Figure 76 depicts the word frequency visualisation emanating from interview no.5. The most frequent terms in descending order were: i) design; ii) end; iii) going; iv) point; and v) process.

[illegible]

Figure 77 - A Word Frequency Evaluation Graph for Interview Transcript no.5 indicating Word Frequencies at Specific Temporal Points



8.3.7 Validation Findings Overview

Table 39 offers an overview of all of the validation findings emanating from the five practitioner interviews, in addition to an overall validation score. Every question posed to practitioners garnered a score of at least 80.00%, the agreement of four of the five participating practitioners. The score for each question is reported in Table 36, and an overall validation score is derived from these findings by calculating the proportion of responses which were either a: i) sign-off; ii) amendment; or iii) future research requirement, and expressing them as a percentage.

Table 39 - An Overview of the Total Validation Findings for each Question posed to Participating Practitioners

Question No.	Validation Question	Sign-off (%)	Amend (%)	Future Research (%)
1	Process organised temporally to coincide with the RIBA Plan of Work 2013 Gateways 0-3	80.00%	0.00%	20.00%
2	Additional node for pre-contractual POE agreements with development partners	80.00%	0.00%	20.00%
3	Additional node for review of previous POE findings at outset of new development	80.00%	0.00%	20.00%
4	Additional node for inclusion of services	100.00%	0.00%	0.00%
5	Separation of theoretical and practical POE planning	100.00%	0.00%	0.00%
6	Reduction choices within POE processes in favour of more sequential approach	80.00%	20.00%	0.00%
7	Replacement of 'review' and 'evaluation' selection points in favour of three stage sequential pathway	80.00%	20.00%	0.00%
8	Implementation phase requires no amendment	80.00%	0.00%	20.00%
9	Dissemination of findings to all applicable internal departments and personnel	100.00%	0.00%	0.00%
10	Dissemination to all external development partners - contractually agreed at outset of development	100.00%	0.00%	0.00%
11	Transparency of findings, widespread institutional knowledge of findings increasing efficiency of 'action' implementation	80.00%	0.00%	20.00%
12	Preparation of POE findings for feed-forward to future developments completing the circularity of the process	80.00%	0.00%	20.00%
13	Hybridised POE model organised to coincide with the RIBA Plan of Work 2013	100.00%	0.00%	0.00%
Overall Validation of Hybridised POE Model (%)		87.69%	3.07%	9.23%

8.4 DISCUSSION

The overall validation scores for the hybridised POE model was found to be: i) 87.69% sign-off; ii) 3.07% amendment; and iii) 9.23% future research. As previously stated, 'sign-off' signifies a practitioners agreement with a validation point, 'amendment' was utilised by practitioners where they disagreed with a pre-prepared validation point, and future research was utilised by practitioners where they saw opportunity to further improve upon POE processes. The overall finding of 87.69% validation for the hybridised model for user-friendly POE planning in HEI buildings indicates practitioners participating in the validation focus group have indeed validated the model. The finding of 9.23% for 'future research' suggests

practitioners can see opportunities to further improve upon POE processes. Largely, the ‘future research’ opportunities centred around specific procedures implemented at the institution the practitioner represents, for instance the production of a design guide at both Coventry University (interviewee no.3) and the University of Birmingham (interviewee no.5), or the development of procurement frameworks, again at the University of Birmingham (interview no.5). The overall finding of 3.07% as ‘amendments’, in the context of this research indicating where practitioners did not agree with a validation point, roughly half of which, could be found where institutions utilised alternative guidance and documentation. For instance, BCU utilise PEP document at the outset of a development, before moving to the RIBA stages. The remaining ‘amendments’ centred on one practitioner’s disagreement with ‘actions and recommendations’ emanating from the POE process. As soon as the concept of ‘actions and recommendations’ arose, the practitioner in question immediately expressed their concerns regarding the apportioning of liability. Indeed, the practitioner in question stated:

“I would make this whole process completely void of any advice or recommendations, it’s an evaluation, I’m just giving you pure data, I’m categorising it, I’m quantifying it, I’m putting some numbers on there, but what you make of them, is for you to do, anything you want to do with that information, I’m not going to tell you what to do what so ever, I would recommend reading the evaluation and digesting it.” (Interviewee no.2, comment 53)

Fears around the mitigation of liability are well documented within the built environment (c.f. Khosrowshahi and Arayici, 2012; Jiao *et al.*, 2013). However, if concerns around the apportioning of liability are fundamentally stifling the feedback mechanism, then the academic objective of developing benchmark criteria will not be informed by actual facility feedback, rendering any target as purely aspirational as there will be no robust comparison data with which to develop benchmarks. Furthermore, this will knock on to the second overarching academic objective, the iterative improvement of HEI facilities, similarly having no previous findings to inform the ongoing cycle of iterative improvement operates.

8.5 CONCLUSIONS

The final hybrid model for user-friendly planning and implementation of POE has been validated at 87.69%. The ability to test the hybrid model in practice has not coincided with the development of one of BCU’s planned future developments. However, the validation score

recorded allows with some certainty, to assert that if the model were to be implemented, it would facilitate: i) a consistent of approach to POE; ii) the reviewing of previous POE reports at the outset of a development; iii) the consideration of services from the outset; iv) a sequential approach to POE engender a higher compliance rate; v) dissemination to external development partners; vi) dissemination to internal departments and personnel; and vii) the preparation of findings for feed-forward to future developments. The hybrid model, incorporating all of these considerations allows practitioners embarking upon a POE to implement a formalised process, allowing consistency across a series of developments from the outset. This engenders the ability to compare results across the entire series of POE's. Furthermore, consistency across the series allows the development of facility benchmarks based upon comparable findings, facilitating iterative improvement of both design and performance of HE facilities under evaluation.

CHAPTER 9

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

9.1 INTRODUCTION

The final chapter offers the: i) findings; ii) conclusions; and iii) recommendations emanating from the study. An overview is presented detailing the initial research questions, in conjunction with a matrix, detailing which elements of the study have answered which research questions. The chapter goes on to elucidate on the multiple contributions to knowledge emanating from the differing elements of the study, as well as developing a theory regarding the contemporary POE planning and implementation. Finally, conclusions, and limitations pertaining to the study are presented.

9.2 FINDINGS

Table 40 lists the research questions outlined at the commencement of the study. In conjunction with Table 41, an overview is presented of where each research question is answered and which chapter the answer can be found in.

Table 40 - A List of the Research Questions Outlined at the Outset of the Study

No.	Research Question
1	To what extent are existing POE processes utilised in HEIs within the UK?
2	What are the tangible benefits UK HEIs are gaining from implementing POE in its current form?
3	Are practitioners aware of the value adding implications of POE implementation?
4	What inhibitors discourage the use of POE in the UK HEI sector?
5	How can objectives set out in POE academic literature such as: i) iterative improvement of facilities; and ii) facility performance benchmarking, be realised in practice?

In consideration of Gilham's (2005) 'chain of evidence', and of Creswell's (2006) assertion that qualitative research requires the collection of 'as much reality as possible', the answer to each research question is not necessarily answered in its entirety by any single element of the study, although this is the case in the instances of research questions 2 and 3. Research questions 1, 4 and 5 require the input of two elements of the study to satisfactorily answer the initial research question (c.f. Table 41).

Table 41 - A Matrix Detailing which Chapters Answer which Research Questions

Chapter No.	Chapter Title	Research Question				
		1	2	3	4	5
3	Advancements in Asset Management					
4	Post-occupancy Evaluation	•	•			
5	Delineation of the POE process	•			•	•
6	Focus Group Transcript Data Analysis			•	•	
7	Hybrid Model Development					•

Notably, none of the research questions outlined at the outset of the study are answered in chapter three, however, the chapter does offer an overview of facilities and asset management, offering a contextual backdrop for the study. Both BIM and POE are covered under the remit of the Government Soft Landings, both requiring stringent management of data and processes. Put simply, POE and BIM are both intrinsic steps on the path to a digitalised built environment, industry 4.0, and future smart cities (c.f. Roberts *et al.*, 2019).

9.2.1 POE Utilisation in HEIs in the UK

The first research question posed in this study asked: ‘To what extent are existing POE processes utilised in HEIs within the UK?’ Despite the UK government mandating the application of the soft landings approach for all centrally funded capital projects, the implementation of POE is difficult to fully ascertain. However, where POE is implemented, it lacks consistency in its approach. Anecdotally, it is not unusual to hear of Estates departments, particularly in periods of upheaval or senior management personnel change, to suppress the findings of POE reports, or even cancel the undertaking of POE’s entirely. This raises questions around apportioning of enforcement responsibilities against organisations which fail to adhere to the government mandate. Exacerbating this, is the sensitivity practitioners perceive when reviewing facility performance post the construction phase, with fears of incurring liability resultant of the review process. The PROBE case studies, undertaken around the turn of the millennium by eminent POE researchers Dr Bill Bordass and Adrian Leaman, both from the Usable Buildings Trust, called for ‘democratisation’ of POE findings to facilitate greater knowledge exchange between practitioners and building operators alike (c.f. Bordass *et al.*, 2001; Cohen *et al.*, 2001; Bordass and Leaman, 2007). Despite this call for transparency, in reality only 21 POE reports have been made public since the millennium, the first of which was published in December 2008, and the last in December 2015. Notably only two HEIs have published POE findings, The University of Nottingham ($f = 20$) and The University of Sheffield ($f = 1$). Notably, the consultancy which undertook the evaluations filed for bankruptcy six

months after the completion of the final POE report (Companies House, 2019). BCU has been compliant with regards to its responsibilities to conduct POE's on its newly developed educational facilities.

9.2.2 *Value Adding Implications of POE Implementation in HEIs*

The third research question posed in this study asked 'Are practitioners aware of the value adding implications of POE implementation?' The value adding implications of planning and implementing POE are discussed in depth in chapter 4. The simple answer to this question, based upon the findings of the practitioner focus group would suggest they are not, or at least not all Estates practitioners are. Some of the practitioners whom participated in the focus group did refer to previous experiences of planning and implementing POE's - with alternative organisations. However, the main theme emanating from the focus group with regard to awareness of value (c.f. Zimmerman and Martin, 2001; Vischer, 2001), was the failure to disseminate POE findings to applicable personnel, both internal and external (Zimmerman and Martin, 2001; Jauzens *et al.*, 2003; Khosrowshahi and Arayici, 2012; Jiao *et al.*, 2013). This failure to feedback the feedback obtained in a POE, demonstrates that other considerations, sensitivity of findings and mitigation of liability as just two examples, may influence Estates perspective on the value of the feedback garnered in a Post-occupancy Evaluation.

9.2.3 *Inhibitors of POE*

The findings of the extensive literature review revealed a number of barriers to the widespread implementation of POE in practice, namely: i) ownership (Riley *et al.*, 2010); ii) cost, procurement and incentives (c.f. Zimmerman and Martin, 2001; Vischer, 2001); and iii) education and culture (c.f. Cooper, 2001; Bordass and Leaman, 2005) (c.f. chapter 4, p.90). Over the course of this study, further inhibiting factors to the implementation of POE in practice have been observed, namely: i) a small community of practice (Robert *et al.*, 2019); ii) inconsistent POE approaches (c.f. chapter 4); iii) lack of awareness of the innate value of POE (c.f. Zimmerman and Martin, 2001; Vischer, 2001); iv) mitigation of liability (c.f. Zimmerman and Martin, 2001; Jauzens *et al.*, 2003; Khosrowshahi and Arayici, 2012; Jiao *et al.*, 2013); and v) intellectual property and virtual property considerations (Olatunji and Akanmu, 2014). A number of these factors share rationale with the factors identified in the literature review, however, in the context of the case study of BCU's POE reports, a more in depth investigation of inhibiting factors was required.

Similar to the factors identified which inhibit wider digitalisation of asset management and the interconnection between them (c.f. chapter 3, Figure 8), the inhibiting factors affecting implementation of POE in practice also have a deleterious impact upon one another, with uncertainty emanating from one factor impacting upon others (c.f. Figure 78).

9.2.3.1 A Small Community of Practice

A bibliometric analysis was undertaken on extant POE literature as part of the study's literature review (c.f. chapter 4). Conducting a bibliometric analysis allows the establishment of key metrics emanating from the field of study, such as: i) first academic citation; ii) the total number of research items within subject area; and iii) the leading authors in a particular discipline. Beyond these initial statistics, bibliometric analysis allows for deeper analysis on the connections between academic authors expressed through complex visualisations.

The findings of the bibliometric analysis revealed a small community of practice (CoP). A three stage protocol was applied, further refining the search at each incremental stage. The search terms were as follows: i) 'post-occupancy evaluation'; ii) 'post-occupancy evaluation' and 'process'; and iii) 'post-occupancy evaluation', 'process', and 'benchmarking'. As of July 2017, a total of 516 research papers had been published on the topic of POE since 1981 (Roberts *et al.*, 2019). The refined search inclusive of 'process' returned 111 research items, and the final search also utilising benchmark returned 7 research items. Even at this cursory level, the research pertaining to process and benchmarking is remarkably low, particularly when compared to POE's companion under the umbrella of soft landings, BIM, which has had over 51,000 research items since its first citation in 1988. However, when these findings are analysed and visualised using the VOSviewer bibliometric analysis software package, and after the addition of specific criteria (two papers, two citations), these numbers drop significantly to 119, 12, and seven with respect to the three stage protocol. This indicated that many academics working in the field of POE had produced a single research item, or alternatively had not been subsequently cited from their research item(s). This remarkably finite amount research pertaining to the development of benchmark criteria realised through POE process (Wauters, 2005; Hassanain *et al.*, 2016), offers insight as to why this objective has not been achieved in practice, particularly when considered in conjunction POE guidance documentation aimed at offering practitioners the freedom and choice to pick and choose evaluation elements at their discretion.

9.2.3.2 Inconsistent POE Approaches

A case study of BCU's POE reports pertaining to its newly developed HE facilities was conducted in conjunction with an investigation of the aforementioned publically available POE reports. A delineated POE process map representing the guidance offered by the HEFCE Guide to Post-occupancy Evaluation (2006) was produced, and subsequently utilised as a comparative tool. Once the comparative tool was in place, the four BCU POE reports were plotted, as well as the twenty one publically available reports in efforts to ascertain the consistency of approach across the sample of POE reports.

Following analysis of the four POE reports pertaining to BCU HE facilities, it was observed that over the four POE reports, only two nodes selected by practitioners were found to be consistent in more than one report, and each of these common points of analysis were found in only two of the four reports. This leaves the four POE reports analysed in the BCU case study, as having very few common elements, and as a result can be considered an inconsistent approach to POE. These findings are somewhat exacerbated by the levels of compliance in each report - compliance denoting how many selections practitioners have made against the maximum number of selections. Two reports were found to have a compliance score of 37.50% (three of a possible eight selections), with the other two recording a compliance score of 25.00% (two of a possible eight selections). These relatively low compliance score against the maximum possible compliance score, mean in practice there are less common points of analysis to compare building performance data than there would be had the number of selections made by practitioners been higher.

Initially, investigation of the 21 publically available POE reports appeared to be revealing similar results in terms of limited compliance and significant inconsistency. However, upon closer analysis, all of the twenty one POE reports fell into four POE process permutations. In efforts to understand the reasons behind the finding of four specific permutations, the POE reports were organised into chronological order. Organising the POE reports in this way revealed that the four permutations had not arisen by chance, but actually formed part of a trend, with the POE process being refined as the practitioners undertaking these evaluations garnered more experience. If this is the case across the sector, then as a POE process is developed across a series of developments within the same estate, at the conclusion of that series of POE's the developed process ceases its own process of iterative improvement, with no more buildings with which to continue its development.

9.2.3.3 Lack of Awareness of Innate Value of POE

Anecdotally, it is said that POE reports often end up filed away, having never been reviewed. This sentiment was echoed in the practitioner focus group, with many practitioners stating they had never seen a completed POE report despite a number having been produced over the course of BCU's move from its Perry Barr Campus to its new City Centre Campus. This admission, offers an insight into why many issues identified in newly developed HEI facilities, are regularly repeated and encountered time and time again across a series of facilities. The utilisation of fire curtains across BCU estate is a prime example of this. Fire curtains were installed in Millennium Point, the first building BCU inhabited on their new City Centre Campus. Millennium Point was not commissioned by BCU, rather it was developed by Birmingham City Council as a millennium project. It was designed primarily to be a mixed use commercial and office development, with the inclusion of the Think Tank (the successor to Birmingham Science Museum) and Birmingham's first IMAX cinema. Millennium Point has a large atrium upon entry to the building, which in the case of a fire, utilises fire curtains to stop the spread of smoke whilst occupants evacuate. Fire curtains require regular testing and maintenance, and can often be found in there deployed state after a test due to difficulties resetting them. Fire curtains have subsequently been utilised across BCU new City Centre Campus, and rather intuitively, have experienced similar problems each time they have been installed in a new building. Had POE reports been reviewed at the outset of each new development across the estate, many of these ongoing issues relating to fire curtains could have been mitigated through designing out the requirement for such curtains, or increased scrutiny of the standards of installation. The Curzon building, the newest edition to BCU city centre estate, designed with a large atrium, has been cut in two by fire curtains undergoing maintenance.

9.2.3.4 Mitigation of Liability

Mitigation of liability is a well-established inhibiting factor to many contemporary processes and practices across the built environment (c.f. Khosrowshahi and Arayici, 2012; Jiao *et al.*, 2013). POE is particularly susceptible to this consideration, as it actively seeks to identify issues within a building, as opposed to those issues coming to light through the lifecycle of the building. Fears around the apportioning of liability (c.f. Zimmerman and Martin, 2001; Jauzens *et al.*, 2003; Khosrowshahi and Arayici, 2012; Jiao *et al.*, 2013) subsequent to a POE should be tempered against the feedback data received through the process. The dissemination of feedback data to development partners allow those parties to iteratively improve their own

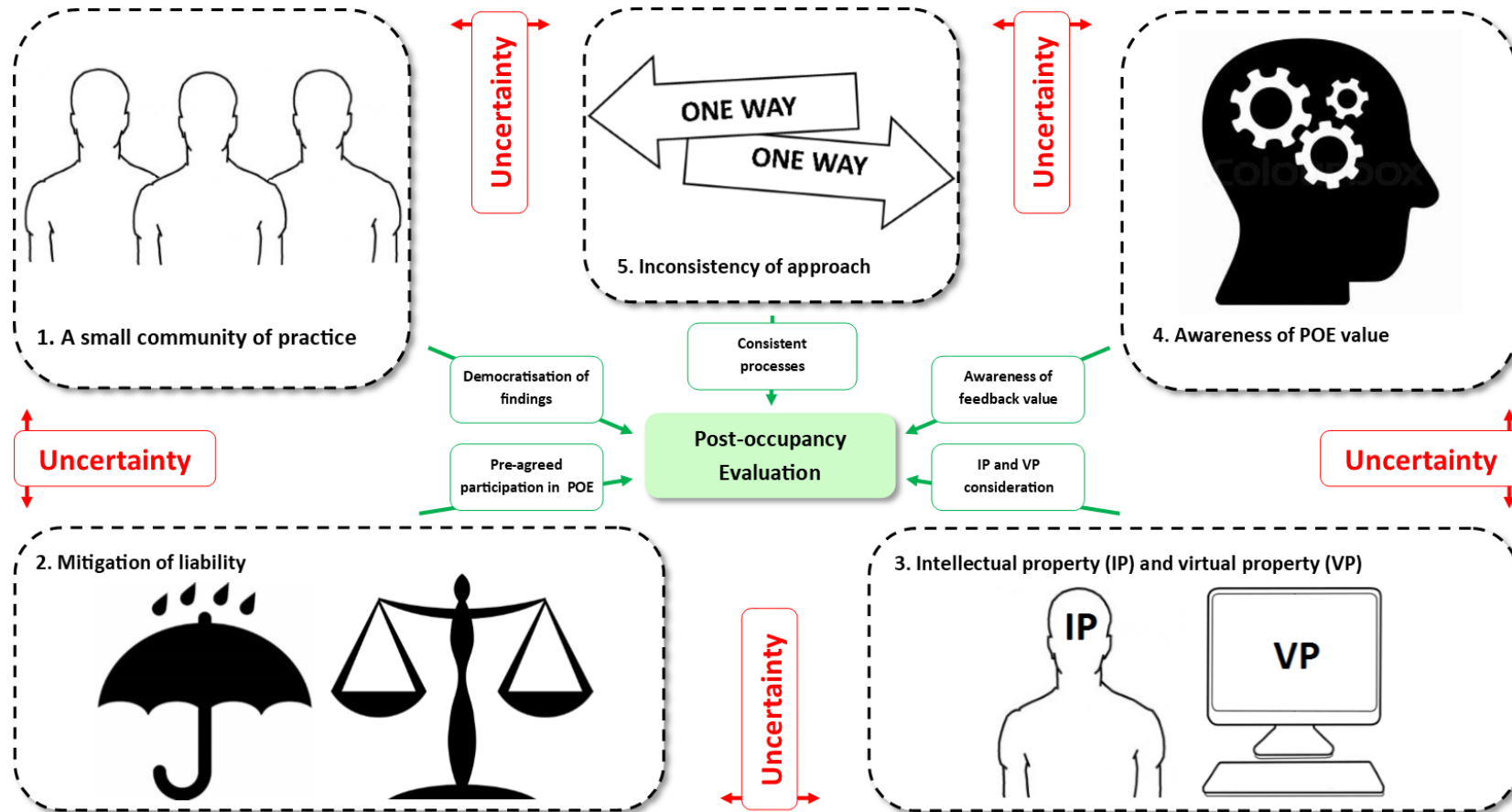
process, increasing efficiencies, and decreasing costs (c.f. García-Peñalvo and Conde, 2013). However, without either a formalised agreement for cooperation with POE processes, or participation on the basis of goodwill, there is no guarantee this cycle of iterative improvement will be initiated. In essence, cooperation with POE processes, and subsequent utilisation of the feedback cycle, will improve the performance of development partners, reducing their potential exposure to issues which may incur liability. Furthermore, failure to engage with POE processes may actually increase a development partner's exposure to liability issues, particularly if other development partners do utilise feedback to improve the process, practices, and performance.

9.2.3.5 IP and VP

IP and VP are significant considerations within an increasingly digitalised built environment sector (c.f. Olatunji and Akanmu, 2014). POE is a largely paper based activity at present, however, this does not preclude consideration around IP and VP. The feedback data collected during a POE, is by its very nature value adding, any information hailing from a POE which decreases costs and increases efficiency, has a direct impact upon an organisations profitability. Furthermore, increased efficiencies and decreased costs may indeed extend the commercial reach of an organisation, allowing: i) involvement with more developments; ii) increased revenue; iii) an increased capacity workforce; and iv) commercialisation of knowledge emanating from POE reports.

The focus group interrogating BCU's POE processes included a question regarding the 'consideration of IP and VP' with regard to POE. The response from the focus group dismissed the consideration of IP and VP, stating "*we're not the pharmaceutical sector.*" Whilst the consideration of IP and VP may not have been essential historically, with increasing digitalisation, the considerations is becoming more prominent within the built environment. Drawing comparisons with the engineering sector, IP and VP are crucial considerations protecting an organisation from IP theft. The increasing technical sophistication of contemporary buildings allows comparisons with engineering sector, contemporary buildings could be considered as large engineering projects. Notably, the reticence of built environment practitioner to democratise POE findings, has its origins in mitigation of liability, as opposed to the protection IP and VP rights.

Figure 78 - Obstacles to Industry-wide POE Implementation (adapted from Roberts *et al.*, 2018)



i. A small community of practice - A small community of practitioners undertaking Post-occupancy Evaluations often means practitioners are required to decipher POE processes with little experience, either their own or from fellow practitioners, to draw upon.

ii. Mitigation of liability - Fears regarding the apportioning of liability resultant from a POE impact upon the robustness of feedback. Practitioners often temper feedback for fear of incurring liability, likewise development partners may be reticent to cooperate with such evaluations.

iii. IP and VP rights - Undertaking a Post-occupancy Evaluation will generate large amounts of feedback regarding the built environment asset upon which the evaluation was conducted, all of which represents intellectual property aiding the organisation's business management.

iv. Awareness of value - Anecdotally, Post-occupancy Evaluation reports often end up filed away and not utilised for the feedback they offer. POEs can present significant value adding information for an organisation if utilised correctly.

v. Inconsistency of approach - The lack of a formalised sequential POE process leaves practitioners to decipher current POE processes, utilising their own interpretation. The inconsistency observed in POE implementation can render the findings of a POE report incomparable to the findings of other completed POE reports, subsequently rendering the academic objectives of 'benchmarking' and 'iterative improvement' unattainable.

9.2.4 *Benchmarking and Iterative Improvement realised through POE*

The innate inconsistency of approach observed regarding the planning and implementation of POE in practice, particularly with regards to the BCU case study, directly impede the development of benchmarking criteria (c.f. Wauters, 2005; Hassanain *et al.*, 2016), subsequently rendering the objective of iteratively improving HEI buildings a near impossibility. This situation is exacerbated by industry standard guidance documentation. The HEFCE Guide to Post-occupancy Evaluation (2006) is deliberately written to offer practitioners the freedom to select elements of evaluation as they see fit. The HEFCE guidance was drawn up by a group of Estates practitioners boasting over one hundred year of Estates experience cumulatively, however, this freedom of selection inhibits the creation of common points of comparison - effectively precluding the ability of practitioners to create facility benchmarks. However, contrary to this, when examining publically available POE report published from the University of Nottingham and the University of Sheffield, the POE processes can be observed undergoing its own iterative improvement until a standardised approach is developed which can then be applied to all future HEI facilities within the estate. However, this iterative improvement of the POE process itself requires a series of buildings to be constructed within the same estate. Isolated POE reports conducted on a single development will utilise the same guidance documentation, yet not have the benefit of an iterative improvement cycle facilitated by multiple developments, thus requiring a formalised sequential POE process in order to achieve the development of benchmark criteria and subsequent iterative improvement (c.f. Wauters, 2005; Hassanain *et al.*, 2016; Tookaloo and Smith, 2015).

9.3 LIMITATIONS

Using an interpretivist epistemological lens has several significant limitations. First, interpretivist researchers assume that access to reality is only through social constructs such as the prevailing academic discourse on POE (Antwi and Hamza, 2015). Second, and as a branch of positivism, the interpretivist philosophical position also emphasises qualitative vis-a-vis quantitative analysis (Symon *et al.*, 2016). The subjective nature of qualitative research can: introduce researcher bias into the study; be subject to literature searching practices that may omit significant research; and introduce translation errors (cf. Mallett *et al.*, 2012). Third, the interpretivist approach cannot be generalised because the data and findings elucidated upon are heavily influenced by the researcher's personal views and values (Kiernan and Hill, 2018).

These limitations apart, all research has a beginning and one significant benefit of an interpretivist approach is the generation of new theories that can signpost future research direction.

Case study research also has several limitations, namely: i) generalisability; ii) reliability; and iii) validity (c.f. Tight, 2017). Alternatively put, the main limitation of case study research is the ability to infer, or extrapolate from one particular case study to a wider context (c.f. Yin, 2009; Yin, 2012). In efforts to overcome this significant limitation, a validation process is crucial to ensure the contribution to knowledge emanating from case study research is applicable to the wider context in which it is being applied (Tight, 2017).

There are a number of practical limitations inherent in the research also. The first, regards the study's focus on HEI buildings, particularly in consideration that there are around 130 universities in the UK. Whilst this is a significant number of HEI's, when compared to the total number of buildings in other sectors within the built environment, commercial building for instance, this number is exceptionally small comparably. However, in consideration of this point, to design a POE model for application in commercial buildings may have been too large in scope to be achieved in a single PhD thesis.

The second regards a practical test of the model. While this was included in the methodology of this study, it was always contingent on a development on one of BCU's campuses requiring a POE within the final stages of the PhD study. Unfortunately this did not transpire. However, despite this limitation, the validation score for the model was recorded at nearly 90%, suggesting a significant level of practitioner agreement.

Finally, as highlighted in validation interview no.2 as well as the peer review process which the research paper: Post-occupancy Evaluation: A Review of Literature underwent, current POE processes require more technical information. This can include integration of energy performance metrics and building usage data. Whilst inclusion of more technical data is an intuitive next step in terms of POE development, a consistent approach engendering high compliance is crucial for the achievement of the academic objectives of developing benchmarking criteria and subsequent iterative improvement of HEI buildings.

9.4 FUTURE RESEARCH

A number of future research options have emerged over the course of the research. The first, and arguably most pressing, is further research into the decision making pathways located at: i) evaluation pathway one; ii) evaluation pathway two; and iii) evaluation pathway three. At present the hybrid model utilises existing methods and rationale, presented in the HEFCE Guide to Post-occupancy Evaluation (2006). As previously stated, the guidance is designed to offer the freedom for practitioners to choose evaluation approaches appropriate to the development project they are working on. As such, this extensive list of evaluation techniques have been organised into decision making pathways, based upon the rationale present in the HEFCE guidance. However, the process of organising these approaches into user friendly decision making aids, highlighted inconsistencies, which may not have been obvious previously. For example, evaluation pathway one offer a route to evaluating: i) the delivery of the project; and ii) the operational management of the project. However, despite this initial separation of intended evaluation subject, the rationale and suggested methods for these two evaluations are the same (c.f. HEFCE, 2006). Likewise, decision making pathway three interrogates the ‘organisational change and building response’ emanating from a HEI facility, but culminates in the approach ‘learning from experience’ (c.f. HEFCE, 2006). In efforts to further improve these decision making aids, more research is required to assign the most applicable method to the intended evaluation, indeed some instances may require the development of new methods to suit the particular need of a particular evaluation requirement.

9.4.1 *Emergent Concepts and Refinements*

A number of emergent themes were identified through the validation focus groups process. The observed emergent concepts offered an insight into further refinement of POE processes, increasing tangible benefits of conducting a POE, particularly in terms of tailoring the findings of a POE, and maximising the value adding implications of these findings. Table 42 details the four main emergent concepts emergent from the validation process, these were: i) procurement frameworks; ii) institutional design guides; ii) consideration of the CIBSE log book; and iv) contractor relationships.

Table 42 - A Table Listing the Emergent Concepts and Refinements identified from the Validation Interview Process

Theme No.	Emergent Concepts and Refinements	Supporting Quote	Interview No.	Comment No.
1	Procurement frameworks	<i>“if this process is imbedded with the framework and not the project, then everyone has a clear understanding from the outset that this is what needs to happen, irrespective of when you bring your contracting partner on board, it set out then as a procurement strategy, rather than just an activity picked up by a contractor at some point, and that’s where you get your feedback, if you have a framework, its inherent in the next project then.”</i>	5	12
2	Design guide	<i>“We are thinking of splitting our design guide, at the moment it is principle level, I’m suggesting that we have high level design guide, and one that is just about specifications, so all the teams feed in their particular specifications that they want to see.”</i> <i>“design guide can be built as a working document from the findings of the post-occupancy evaluation, so its constantly feeding through, and then when you’ve got the stage sign offs, what I’m proposing we do, where there is any deviation from the design guide, the consultants can then say why?”</i>	3	56
3	CIBSE log book	<i>“In the CIBSE log book, is interesting form a technical viewpoint, going back and logging readings after a year, that could fit in also, no one will want to do this though, the POE I have done however, has no technical information.”</i>	2	44
4	Contractor relationships - neo-liberal	<i>“contractors specifically are becoming more much sophisticated than designers, so when you think about asset management, when you think about the model environment, even to clash detection etcetera, it’s not your designers that do that, it’s actually your contractors.”</i>	5	8

Procurement Frameworks - arose in the validation interview conducted with the University of Birmingham’s Estates Department. Rather than seeking agreement with regard to POE participation, it was suggested that this requirement could be rolled up into a wider procurement framework. The development of a procurement framework would allow the commissioning

institution to imbue the requirements for cooperation with POE as well as other institutional requirements into the initial procurement phase of a HEI development. Not only would this approach ensure consistency with regard to feedback across all development partners, but would allow the standards

Design Guide - the development of a design guide resultant from the findings of a POE arose several times during the validation stages. It was suggested that the developing a design guide, kept as an evolving active document constantly being updated, could offer construction partners in particular with the precise standards required on the project they are working on. Furthermore this document can also be utilised for the purposes of holding development partners to account based upon deviations from the institutionally tailored design guide, whatever the reason for the deviations.

CIBSE log book - the CIBSE log book, in contrast to recognised POE processes, takes a more technical view of building performance. A critique of POE processes and procedure emanating from the validation phase of this research, suggested that the feedback generated from a POE lacked technical rigor with regard to facility performance. POE is largely based upon the collection of feedback from construction partners, end-users, as well as (at the strategic overview stage) the feedback of Estates practitioners. Whilst collecting feedback from these facility stakeholders offer invaluable insight into the day to day performance of a HE asset, there may be a gap looking at more technical performance related issues. Further investigation of the requirements for feedback emanating from the CIBSE log book may further improve POE processes, increasing the tangible benefits for conducting a POE, from both a contractor and commissioning institution perspective.

Contractual relationships - ever since the 1980s, a neoliberal approach to the operation of the construction sector can be observed. Whilst the basic rationale of a neoliberal environment dictates that increased competition between differing construction partners increases efficiency and drives up standards, in practice this can cause a disconnection between development partners. The example utilised within the validation interview suggested although many of the technical requirements within a HEI asset are designed by architects, the actual execution of these requirements is implemented by a contractor. Relating back to the first emergent concept ‘contractual frameworks’, a deeper understanding on behalf of practitioners to the roles and responsibilities of contractors, as well as increased communication between differing construction partners can help to alleviate many of the snagging issues which present during a

POE evaluation resultant of a lack of clarity where the remit of one contractor ends, and the responsibilities of another contractor begins.

9.5 CONTRIBUTIONS TO KNOWLEDGE

Over the course of the study, a number of contributions to knowledge have been identified. Table 43 details each of the contributions to knowledge, and where within the thesis these contributions are made. In consideration of Gillham's chain of evidence (2005), and of Creswell's (2006) assertion that qualitative research requires the collection of 'as much reality as possible', the study was required to make multiple contributions to knowledge associated with the various investigations which were undertaken.

Table 43 - A Table detailing each of the Contributions to Knowledge Emanating from the Study

Chapter No.	Chapter Title	Contribution to Knowledge
4	Post-occupancy Evaluation	<ul style="list-style-type: none"> The finding of a small CoP identified through the bibliometric analysis. A scarcity of literature pertaining to 'iterative improvement' and development of 'benchmarking' criteria realised through POE, despite these being prominent academic objectives. Identified through the bibliometric analysis.
5	Delineation of the POE Process	<ul style="list-style-type: none"> Inconsistent approaches to POE planning and implementation identified through process mapping and comparative analysis. Iterative improvement of the process itself identified through process mapping and comparative analysis. Institutions improve upon their POE processes as they garner more experience of doing such evaluations. Development stops when an estate or series of buildings is completed. Can create issues around comparable data points, as processes evolve and evaluations are either scheduled, or undertaken differently.
6	Focus Group Transcript Data Analysis	<ul style="list-style-type: none"> Requirement for a formal review of POE findings at the outset of a new development identified through case study. Scarce dissemination of POE findings, both: <ul style="list-style-type: none"> internally and; externally. Pre-agreement of POE participation identified through practitioner focus group. Crucial importance of appropriate scheduling of evaluation elements identified through practitioner focus group.
7	Hybrid Model Development	<ul style="list-style-type: none"> Requirement for a 'host' construction process for POE processes and procedure to run parallel and simultaneously - RIBA Plan of Work 2013. Identified through validation.

9.5.1.1 Chapter 4: Post-occupancy Evaluation

Two contributions to knowledge are found in chapter 4: i) a small community of practice (Roberts *et al.*, 2019); and ii) a brevity of academic work pertaining to developing benchmark criteria and facilitating iterative improvement (c.f. Göçer *et al.*, 2015). POE is a far more niche topic area than the similarly aligned fields of BIM and Digital Asset Management, with the number of research items falling in the hundreds (516 as of May 2018) as opposed to the tens of thousands in the case of the other two (51,937 and 36,583 as of May 2018) (Roberts *et al.*, 2019). This is also reflected in a relatively small number of academics publishing in the area of POE. The second contribution to knowledge regards the remarkably small amount of research pertaining to the academic objectives of facilitating: benchmark criteria; and ii) iterative improvement (c.f. Göçer *et al.*, 2015). Despite the importance of these considerations, it was observed that only seven papers had been published on this subject as of May 2018. This is particularly surprising in light of the built environments significant environmental footprint, and the opportunity to reduce this footprint utilising a formalised feedback mechanism such as POE.

9.5.1.2 Chapter 5: Delineation of the POE process

Chapter 5 makes two contributions to knowledge, namely: i) inconsistent approaches to POE; and ii) iterative improvement of POE process taking place as processes are implemented and learnt from. The inconsistent approach to POE currently observed in practice has direct implications on the usefulness of POE findings. POE's conducted early in a series of evaluations generally have a far less consistent approach than evaluations conducted later within a series, when experience of the requirements of POE have become more established. This can leave early POE reports incomparable to later reports, as selected evaluations and the scheduling of those evaluations can differ significantly to later reports. Furthermore, the efforts to develop these processes are often curtailed when an estate building a series of facilities completes their projects, meaning the developed POE process has no further facilities to be utilised on.

9.5.1.3 Chapter 6: Focus Group Transcript Data Analysis

The sixth chapter makes four contributions to knowledge, namely: i) the review of previous POE findings at the outset of a new development; ii) results require dissemination to appropriate personnel and external partners; iii) pre-agreement regarding development partner cooperation with the POE process; and iv) the importance of evaluation scheduling. Despite

POE findings offering tangible feedback on the performance of HEI facilities, the findings of such POE are, in practice, rarely reviewed. The practitioner focus group conducted for this study confirmed that no formal process was in place to ensure POE findings are reviewed at the outset of a project, in efforts to avoid previously identified issues in other HEI facilities. Without this formalised requirement, many of the issues from one HEI development, are repeated in subsequent developments. Dissemination of findings, or lack thereof, was also identified in the practitioner focus group with many practitioners stating that, despite the conducting of previous POE's, they had not seen the final reports. This included facilities management representatives whom find themselves on the 'front line' of building maintenance. Dissemination is crucial both to internal personnel and departments, but also external development partners, all of which can improve their process and procedures, improving their own business performance through a formalised feedback mechanism. However, to ensure external development partners cooperate with the conducting of POE's, pre-agreements should be put in place during the procurement phase, failure to do so leaves cooperation with POE's reliant on good will from development partners. Finally, the importance of scheduling of elements of evaluation also emanated from the focus group. Specific elements of the evaluation require specific temporal intervals to maximise the usefulness of feedback - for instance, conducting a review of the construction process at the strategic review point (5 years after building occupation) would yield few useful result as the construction team dispersed five years previously.

9.5.1.4 Chapter 7: Hybrid Model Development

Chapter 7 offers a single contribution to knowledge, namely the requirement for a 'host' process for POE processes to run parallel to. This contribution builds upon the findings of chapter 5, 6, 7, and 8, being identified in the focus group, developed in model development phase of the study, with the term 'host' arising in the validation stage. The prime document in the UK construction sector offering guidance on development processes, is the RIBA Plan of Work 2013. The RIBA plan offers a step by step guide to the exact requirements of a development, in conjunction with a temporal overview allowing practitioners to effectively schedule when elements of a development process should occur. POE has similar requirements, the process encompasses the entirety of the construction phase (continuing further into the lifecycle than the RIBA stages), and requiring precise scheduling to ensure maximum value from the process. As such the hybrid model has a second visualisation (c.f. Figure 53), utilising

all of the same elements as the first (c.f. Figure 39), but scheduled in appropriate temporal intervals coinciding with the RIBA plan of work.

9.6 CONCLUSIONS

POE is a significant organisational task, requiring cooperation from a multitude of development partners in conjunction with the required internal personnel. At present, the lack of a formalised sequential and rigorous process with which practitioners can consistently implement POE renders the planning and implementation of POE even more problematic, as practitioners are required to develop an approach to POE simultaneously to actually undertaking the evaluations. This has led to the observation that POE processes implemented in the UK HEI sector are continually becoming more and more sophisticated over the course of a series of POE's. Whilst this development in practice is desirable, it often renders the findings of POE undertaken early within a series of buildings within the same estate incomparable to the findings of later POE's which have utilised a more sophisticated approach. In the case of the University of Nottingham, the first seven POE reports utilised three different approaches, each process iterations increasing in sophistication. The thirteen reports which followed utilised the final process which had been iteratively improved, finally delivering a consistent approach. However, once the final thirteen reports had been completed, no more POE's were required, as the Estates new facilities had been evaluated. At this point the final process, having undergone development across the estate, has no more facilities with which to be applied to. Indeed, the consultancy which undertook the University of Nottingham's POE reports filed for bankruptcy six months after completion of the final POE report (Companies House, 2019). The POE process developed in this research, aims to offer practitioners a process which can be utilised from the first through to the last facility, delivering a consistent approach, facilitating comparison of results across an entire estate.

Contemporary buildings are subject to market forces, requiring: i) increased efficiency; ii) reduced costs; and iii) increased comfort and usability for end users; failing to meet these requirements places an organisation at a competitive disadvantage to developers and organisations which are achieving these aims. However, the increasingly neo-liberal approach to the built environment, rather than attaining the desired beneficial implications, can leave commissioning organisations, developers, and contractual partners alike more and more isolated. This isolation can be down to a number of reasons: i) fears of incurring liability (c.f. Zimmerman and Martin, 2001; Jauzens *et al.*, 2003; Khosrowshahi and Arayici, 2012; Jiao *et*

al., 2013); protection of IP and VP (c.f. Olatunji and Akanmu, 2014); iii) staff training and skill (c.f. Arayici and Coates, 2012; Abrishami *et al.*, 2015; Rahman *et al.*, 2016); and iv) accrual of value for competitors (c.f. Olivia and Christopher, 2014). Despite these reasonable fears, failure to engage with contemporary developments within the built environment is having a direct impact upon the outputs of the sector, namely its buildings.

The built environments environmental footprint is significant (c.f. Milutienė *et al.*, 2012; El shenawy and Zmeureanu, 2013; Motawa and Carter, 2013; Lui *et al.*, 2015). The development of a formalised, sequential and rigorous feedback mechanism within the built environment such as POE represents a real opportunity to mitigate the negative environmental effects of the built environment. If the UK is to meet its aspirations of zero carbon economy by 2050 (GOV.UK, 2019), the built environment must reduce its environmental footprint. To achieve this paradigm shift within the built environment, the requirement from change can only be achieved utilising both a ‘top down’ - governmental commitment to reducing the built environment environmental footprint, and a ‘bottom up’ approach (Miller *et al.*, 2012). Practitioners, developers and building end user can only have a limited impact upon the ‘top down’ considerations, they can, however, have a far greater impact upon the ‘bottom up’ considerations through interventions such as implementation of a feedback mechanism such as POE.

A major stumbling block with regard to industry wide implementation of POE has been practitioner fear regarding the accrual of value resultant of an evaluation (Olivia and Christopher, 2014). The PROBE case studies (c.f. Riley *et al.*, 2010), called for the democratisation of POE results to benefit the wider AECO sector (c.f. Bordass *et al.*, 2001; Cohen *et al.*, 2001; Bordass and Leaman, 2007). Democratisation of POE results, despite being counter intuitive from the perspective of IP and VP considerations (c.f. Olatunji and Akanmu, 2014), can counter this problem. If results are publically available, the improvements which are highlighted as a result of such evaluations can be beneficial to any and all interested parties, essentially accruing knowledge for the entire industry to benefit from. Furthermore, if a ground breaking environmental innovation is implemented, evaluated and found to have been successful, this innovation can be implemented further a field and at an significantly increased pace if it is publically available. Commercialisation of such innovations creates gate keepers to knowledge, which whilst desirable from an individual economic perspective, will do little to avert the climate crisis.

If all of the benefits of POE are to be realised, a consistent approach, facilitating benchmark criteria, and subsequent iterative improvement is essential. Inconsistency of approach engender incomparable results, replication of errors, and will begin to bring into question the value of conducting a POE in the first place. The model developed as the project of this research, aims to offer solutions to these entrenched problems. This is achieved through delivering: i) sequential process; ii) common points of analysis facilitating the development of benchmark criteria; iii) circular process engender iterative improvement; and iv) increased consideration of stakeholders (development partners and service providers for instance). However, whilst achievement of these objectives will greatly increase the performance and quality of HE facilities, POE is required across the built environment. Commercial residential buildings also require the implementation of a performance feedback mechanism.

POE represents an essential missing component from the contemporary built environment. Feedback mechanism facilitating iterative improvement are common place in other similarly related sectors such as engineering and manufacturing, after all, a built environment asset is essentially an engineering project on a significantly larger scale. Without such mechanisms, the ability of a sector to react to contemporary requirements: i) increased environmental sustainability; ii) increasing digitalisation of traditionally manual or paper based processes; and iii) increased efficiency and performance emanating from built environment assets, is severely hampered. If a built environment asset does not undergo a process of evaluation, it essentially remains an untested prototype (Cooper, 2001; Riley *et al.*, 2010). If the academic objectives of moving the sector toward smart buildings, smart cities, and industry 4.0 are to be realised (c.f. chapter four), an industry standard feedback mechanism is required. POE represents a route to greater digitalisation of the built environment, supplying that feedback mechanism (Roberts *et al.*, 2019).

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APPENDICES

Appendix 1 - Questionnaire for Focus Group Participants Detailing Ethical Statement

Post-occupancy Evaluation Questionnaire

Ethical statement

In order to help with my research, I would invite you to complete this questionnaire on the planning and implementation of POE at Birmingham City University. I appreciate your valuable time, so the questionnaire is designed to be completed within five minutes.

I would confirm that all responses will be treated as confidential and only used for the purpose of academic research. Responses will only be analysed or reported in aggregated form; so no one response will be identifiable and no personal or company names will be included in the research write-up.

1. Who is your employer?

.....

2. What is your job role?

.....

3. How many years of experience working with:

i) Estates

.....

ii) Post-occupancy Evaluation processes

.....

4. What are your direct experiences regarding the planning of a POE?

.....

.....

5. What are your direct experiences regarding the implementation of a POE?

.....

.....

6. What are your direct experiences regarding the post-POE (findings dissemination)?

.....

.....

7. Have you had any connection/involvement with the planning/implementation of POE?

.....

.....

8. How does the undertaking of POE impact your specific role?

.....

.....

Appendix 2 - Focus Group Questionnaire

1. Challenges

- a. What are the most significant challenges regarding the planning of a POE?
 - i. How are they overcome?
- b. What are the most significant challenges regarding the implementation of a POE?
 - i. How are they overcome?

2. Value

- a. Are the findings of a POE considered useful to ongoing Estates activities?
- b. Does the planning and implementation of POE impact day to day activities?
- c. Do the findings of a POE report influence Estates strategy?

3. Skills

- a. Are there any specific skills and training requirements for individuals involved in the POE process?
- b. What are those training requirements?
- c. What is the rationale for using a consultant for the university's POE?

4. Knowledge

- a. What use does the university make of historic POE reports when embarking upon a new development?
- b. Why is this approach chosen?
- c. How are the findings of POE disseminated?

5. POE Strategy options/ guidance documentation

- a. What POE guidance documentation are you aware of?
- b. Which POE guidance documentation is utilised by BCU Estates?
- c. What is the rationale for this approach?

6. IP & VP

- a. What IP and VP considerations are taken into account when planning a POE?
- b. What would be considered to be sensitive information within a POE report?

7. Stakeholder considerations

- a. Who do you believe is responsible for funding POE?
- b. Which project partners cooperate with the POE process?
- c. Which parties involved in the project ask for POE findings?

8. Mitigation of liability

- a. How is liability apportioned between multiple development partners?
- b. Are there any reasons why development partners would not cooperate with the POE process?
- c. What is the mode of procurement?

9. Benchmarking and Iterative improvement

- a. How do POE report findings impact upon perceived facility performance?
- b. What facility benchmarking metrics are utilised when comparing facility performance?

10. Space Survey

- a. Do you think the space survey is having an impact upon the ongoing POE process and subsequent findings?
- b. Why?

Appendix 3 - Focus Group Transcript

Comment no.	Speaker	Transcript
1	S1	What are the most significant challenges regarding the planning of Post-occupancy Evaluation?
2	S5	The point I made earlier when stood up about the timing of POE, with respect to assessing the performance of the delivery of the asset and the feedback of the users of the asset, there is a dichotomy between the personnel needed for the first part and the feedback in the second part, they have to have been in there for a while, just tackling that conundrum, I think doing the two part approach is the right way, otherwise I wouldn't be recommending it to [S2], but it is a challenge in planning POE generally.
3	S2	We've planned the second stage POE to be 12 - 18 months after occupation in order to get feedback that is what we are looking for as opposed to being potentially a sounding board for defects and localised issues which is not particularly what we are seeking, having that 12 month period, hopefully we have removed all the issues in the building and so doors that don't shut and painting and windows and things like that, we actually get a true reflection of the building and its impact in its uses, so that why our plan in that respect has been quite crucial to us.
4	S5	Sorry, another thing which we have debated long and hard is the mechanism for asking for end user feedback at the second stage, because you know, paper based questionnaires in this day of social media and so on, where is the balance and we've talked about using a number of students to help who are maybe incentivised in some way to go and gather data on a particular day or at a particular time versus sending out questionnaire, as it happens, we settled on an approach this time, but that is a big discussion isn't it.
5	S9	I think for my team, the facilities team who are out there doing the direct labour with customers and see them every day, they are the first touch point to share information of how they feel about their office space or any sort of space and have a lot of contact with students. So for me personally I get quite a lot of feedback from my team because there out there more so and are well known, so the experience for us is quite good, because we are out there, and being a facilities team, as soon as we walk down a corridor or as soon as somebody sees me, there like ooh [S9] did you know about this? Then I bring it to the table then direct it out to the Estates team we really need to go back on this, and that's my experience, but this is the first Post-occupancy I've ever been invited to since we've done the new builds.
6	S1	Is that generally peoples first Post-occupancy?
7	S9	The first one. I know there have been some in the past with the other project team, but I Never went along to any of those. I think some of them actually, with Curzon A there wasn't one at all, so, this is a good thing.

8	S2	I think one of the key things is within this one is to do the POE stage 1 while the project team is still around so you need to gather information from the constructors project team, professional services project team and the client project team. That was quite difficult actually because lots of people left, so [S5] was off interviewing people who worked for different organisations but still have that BCU knowledge, so, that has to be done very quickly while everything is fresh in the mind I think, so we were conscious of doing that on all occasions.
9	S9	For today's meeting, how did we go about getting feedback from staff and students, was it that presentation we looked at the other night?
10	S2	That's not gone out yet.
11	S9	That's not gone out, but it is part of the next stage?
12	S2	Stage 2 that is.
13	S1	The annex to that question was how are they overcome, which I think we've touched upon nicely. The next section regards 'Value'. Are the findings of the POE useful to ongoing Estates activities?
14	S4	Absolutely, I mean we are only, it's really important to say, we are only half way through the POE and certainly that second stage when we see the building in use and get that feedback that will be even more valuable but there are an awful lot of lessons learned to take away from this; three major builds; the repetitive nature of some of the feedback as well, so that's all feedback we can take back and build into future processes and procedures for the next project and indeed some of it already has been.
15	S1	And that has an impact upon the day to day activities of the Estates department?
16	S4	Yes
17	S1	Do the findings or POE investigations influence Estates strategy?
18	S4	Yes, in terms of the overall governance and our approach they absolutely do, we've talked about ensuring all stakeholders are engaged thoroughly throughout the process, so that will very much be a part of that moving forward.
19	S1	Are there any specific skills and training requirements for the individuals involved in the POE process?
20	S2	I wouldn't have thought so, I think you need to have an understanding of the grounding and I suppose understand what the POE output needs to be, but in this case because we've gone to [S5], and [S5]'s got a knowledge of BCU and a knowledge of POE's, very much over to [S5] to drive that forwards throughout the business, so internally [S5] knows more about, [S5] knows more than anyone does internally about POE's I would suggest, so we outsourced it in its entirety and the whole project, the whole POE process to me, I've been involved in it has been completely led by [S5] and been guided by [S5].
21	S7	Previously to this, unless I'm uninformed, I'm not aware of any structured POE's ever conducted, post a lot of the buildings that, starting from Parkside.
22	S9	No there wasn't any.
23	S2	There was - they've all been done.

24	S9	They may have been. I've never come across, prior to this.
25	S7	Prior to this.
26	S9	So from Parkside.
27	S7	Parkside
28	S4	You're aware of it for Parkside?
29	S7	Yes the work the new team has been doing, but before that - not really aware of that ever being done.
30	S9	No
31	S5	From my experience I suppose, I think I've done 2 for the university over a 6-7 year period
32	S9	Was that post Curzon A?
33	S5	No I think you might be right about Curzon A not having one
34	S9	There wasn't one. I remember I'd just started in the June, and the building went live for Curzon A around Sep... Oc... August/September 2015 and I remember my colleagues asking if there was going to be Post-occupancy, so don't know, there wasn't one for that.
35	S5	I think one was the sports hall at Perry Barr
36	S2	Mmmm
37	S5	and the other was possibly the Seacole
38	S2	Seacole
39	S7	10 years ago
40	S5	Yes, 10 years ago, longer than I remember
41	S9	Yes
42	S5	I think we might have it covered in another question but, I think the importance of disseminating the information and the findings, not just within the university team, but there is something about getting it back into the participants at stage 1, you know, the architects, engineers and contractors who've, you know, given their time, there should be something in it for them as well and I'm conscious of you give a commitment to the and say look we want you to participate it's a mutually beneficial thing and you'll get some useful information out and so we still need to work that out don't we as well
43	S2	We do
44	S5	How far, how much to share, how to do it and so on, I think that is an important thing
45	S9	And historically as well I don't think you are aware of this, maybe not I don't know, what used to happen is the Estates team were based at city north campus, we didn't have [S3] then, we didn't have [S4], and facilities and Estates were two separate, it was facilities management and Estates didn't have a lot to do with each other, and then when we came together as one department and we had a new director which is [S3], then it all changed, and I think that's when this is being led with the Post-occupancy that, people involved from the projects and facilities side, so I think going forward, I think it's only, its historic maybe they had their own post occupancy meetings or engagement with stakeholders in a different way, but along the way people like the facilities side weren't included in that stage to my knowledge, there was nothing that came out of Curzon A for a Post-occupancy, there

		was nothing from Parkside, but as we are now one department its changed as we are all sitting around a table as one department today
46	S3	I think POE offers trends, I read all of these 2 or 3 times, there is such a lot of wealth in them, and [S2] I've had several conversations with you haven't I about the importance of these I think, I've worked with POE's for over 15 years now in my previous institution, they are really the best way of doing business in relation to forming your policy strategy going forwards and these were three massive investments made, what they reveal for me was, I guess trends in the institution where there wasn't enough rigor and challenging at gateways 0-3, because some of the decisions going back that we are all living with and having to manage, I think were taken as a result of a lack of challenge/interrogation of gateways 0-3, and a lack of a full appreciation of some of the consequences of the decisions taken, and all three of these projects you can trace them back to a turning point, for me there is a turning point in each one, in Curzon it was the decision to steel frame instead of concrete, big turning point that, huge change, and really not fully understood the complexities, with each one there is a kind of turning point, but I think moving forward we've really got to get more rigorous, [S4] and I are working very hard with steam house to make sure they thoroughly kick around the brief at each stage and the institution is fully aware of the decisions taken, so when people take decisions and then leave the institution, what's useful for me is there is a record in here, and your about the only constant with all of this [S5], everybody has moved on, certainly from the Estates department, and we are lucky to still have some of the consultants round, but to see this history going back I think is massively useful and I'm really looking forward to seeing the stage 2, which will engage the wider community of users I think, which is important because its them that also live with the consequences of decisions taken 2 or 3 generations ago in a project, so that's kind of what they reveal to me, wealth of learning, and [S8] I spoke to you, the IT side as well, there is a massive level of learning in here for us isn't there, I know decisions were taken IT side about the design of systems that were, and the consequences of them now, there coming up to roost aren't they a lot
47	S8	They are
48	S3	I think for I and ICT there are huge learnings in here, we need to make sure they are disseminated and understood, so we don't make the same mistakes again, the millennium point work you did [S5] was very useful, that was a similar type of thing wasn't it, no rigor at gateways 0-3, and again the ICT stuff as well goes for that as well, MP project, no challenge, no rigor, just kind of merely pushing ahead without really understanding the consequences of the decisions and what being undertaken.
49	S5	Just responding to that, [S3], during the presentation of the individual POE's, I made the point that even the governance that we are usually really good at, around project governance and PEP, none of that seem to apply on millennium point at all, so I'd use the phrase 'blip' up there, it seemed to just be a blip.

50	S3	And also to be fair, at that time when the brief was being put together, the University didn't have a Vice-Chancellor, people in and out senior management, you know, it was a bit of a.... so we don't want any more of those happening really I think.
51	S5	No
52	S9	Some of the things that happened though I can see from Parkside to Curzon the new build, only a small thing, but if you look in Parkside all the sort of, I don't know what you want to call them, the ledges for the banisters round the atrium, they were all flat for instance, people used to put their laptop on them and their laptop used to fall off, so when we went over to Curzon A, they made them sort of slanted, so there was some improvements on feedback made, do you know what I mean, it wasn't all doom and gloom, there were some things that were taken on board from that build, and taken into Curzon and not repeated for instance.
53	S3	Oh no there is some fantastic practice in there,
54	S9	Yeah, there was some
55	S3	There's good and...
56	S9	But there was also, it was the change in projects, that's where, we had these three major, huge projects going on, and we had a change in the project management team, so erm, as I say going forward, I mean, all the people who are key sitting around a table, which is a real step forward in itself for me.
57	S1	Just to pick up on the use of consultants, I think you touched upon knowledge, what is the rationale for using consultants, as opposed to doing it in house, what was the decision, how did that come about?
58	S4	A degree of independence, you get that separation from the project team if you bring in... what I've seen elsewhere on POE's is that, whoever the project manager was for the project may take that through, but it is then very difficult for them to separate themselves from the nitty gritty, and the relationships on it, so it helps in that instance
59	S3	They're always better done independently, always better. I've never known a successful one without an experienced independent reviewer to come in, there always better for a whole host of reasons
60	S10	I think one of the big reasons as well, if the project manager is working on the project, people know he's finishing then people line him up for the next one, sometimes you have to be ready to go on to your next project, trying to drag back on to the other one makes it easier if you have an independent person who comes in and takes that on.
61	S3	It's resourcing as well isn't it
62	S1	What use does the University make of historic POE reports when embarking upon new developments?
63	S5	That's the \$64,000 question for me, I'll leave someone else to answer.
64	S4	I thought you were going to come in with a furl of wisdom. [laughter] I think it depends on the timing of it, so it think they were probably if [S6] mentioned the one back in Seacole in 2008, how much value

65	S6	can I ask a question, did anyone read it after it was completed? - because I don't think anyone did, because certainly a lot of the things which happened in 2008 reoccurred in 2018
66	S2	That's highly likely, that POE that was produced has not formed any part of the future briefing for anything, hence the reason for this meeting, because there is so much information that is gained from the POE's, particularly all three, all at the same time, a huge amount of spend, I think the opportunity is there isn't it, but I think, I just wonder whether with all three buildings, was that too much of a stretch for BCU to go for these three massive capital projects with a small projects team, was it just a case of overstretching, did all these issues which we found with all these issues that were found, were they endemic in the other buildings, I don't think they were, I don't think Parkside performs particularly badly, I don't think the Seacole building is particularly... same issues as these ones, is it the case that they were just overstretched and overreached
67	S8	I couldn't believe personally that that decision was taken, that we were running three big build schemes at the same time and certainly the delay on Curzon B and City South they came together, so all the problems compounded and then with restructures within the university as well so resourcing problems, capacity problems all added into this mix, which was very problematic, put it that way
68	S5	Just to take [S1]'s point, I've always felt that there is something missing between the POE conclusions and the briefing for subsequent projects, I'm not sure what it is, I don't know whether, I've called it a Bible in the past, or a design guide, is it something where you deposit the learning and the knowledge, so it becomes institutional knowledge rather than locked in an individual's head, but I've also felt that, I'm not sure, it doesn't feel instinctively the right thing to do to draw directly from the POE into the briefing for a future project, it feels as though there is something else important in between
69	S4	I don't think it's any one document, it's a whole suite of documents, from government procedures, to the PEP template, to does the university.... we don't have a design guide, you can really start building up a design guide as well with some of this. We already, [S10], [S11] and the team, have already done a complete rehash of all the template documents, so we've re-established change management procedures, PEP template, all of that is essentially shared and we have templates for it, and the next part we are looking at is what does the university design guide look like, so we are not asking ourselves the same questions every time, in terms of what does this brief look like, so we have something really robust to give to the designers
70	S1	How are the findings of the POE disseminated at the end of the process?
71	S3	Well, I think they probably need summarising don't they in a kind of a series of action points for us, ICT, a bit here for finance as well, and I'd like to go up, I don't know whether they go up UEG or somebody, because there are some earlier learning lessons on the challenges' and gateways 0-3, and clearer consequences, don't know what you think?

72	S6	I think the university is starting to get its act together in terms of project management, there has always been project management within the Estates function because there has to be given the nature of it, but I think if some of this had come forward to UEG 2 years ago, it would not have landed with them well, they wouldn't recognise it, they wouldn't recognise the function or indeed the value of it, and because we now have the university change board project management approach to large projects, after a building is complete they're implementing different systems within the building, that's done on a project management basis, I think it would be worthwhile as part of the 'post mortem', certainly post-project review if this sort of stuff was to come back it would give them some kind of assurance that there is a quality management process going on and it's not just a matter of put the building up and move on to the next building... it's about learning lessons
73	S3	I think also there is this idea of soft landings isn't it, that BCU never really bothered with soft landings in the past, I don't think [S5] has it
74	S5	It's tried, to be fair, it's tried, written them in, I think it feels....
75	S3	Got diluted, taken out
76	S5	It feels as though it's the first thing to go, a bit like maintenance is always.
77	S3	I know when I, when we picked up the budgets, there was no budgets for any of them, I had to get [X] to beef up the budgets, even that wasn't enough, we've had to revisit several times the budgets for soft landings and the scopes, the whole lot here, so I think there are some headline themes coming out of these which we can flag up, whether it is a change management board or whatever, there are some, and particularly coordination with the ICT stuff, and how that works and the briefing, you know the sort of the consequences of decisions and actions taken in those early gateways you know
78	S8	I suppose what these projects show, is the limitations within departments and shortfalls, so you take ICT or the IT department.... Ask for a Wi-Fi strategy... there isn't one. So how can we then inform the consultant and designers as to what we want, things like an AV strategy, it's not properly looked at, so some decisions are taken by default, and when the buildings are delivered, it comes back 'oh that's not what we wanted', but you didn't tell anybody what you wanted, which you didn't know yourself
79	S3	Yes there are some big gaps aren't there
80	S9	I echo that actually because I think as well, that when the university was at City North and you look at that building, I don't know whether it is historic, but automatically people thought 'oh well it will cost the same to run new buildings, it'll be AV, you know', its progressed so much, I think at City North there were still fax machines, I mean, nobody has looked into these new builds come with management of the AV equipment and all of this new technology that's gone into them comes at a cost of managing them and maintaining them, all of those kind of things, you know, City North is so historic that automatically, I don't know whether it is the board, or whoever the

		people are that look at that, think maybe it would run exactly the same, like for like, and that's not the case.
81	S8	Putting together an AV strategy together at the minute because one doesn't exist, so we've got 522 classrooms booked for teaching, we've probably got £4million of AV, and a lot of that is because we have expanded all of our buildings
82	S9	If you look, compared that what you've got now, compared with City North,
83	S3	You haven't got the skill base or the infrastructure
84	S9	...infrastructure to maintain it
85	S8	Then the budgets to refresh this equipment on say a 5-7 year basis, that needs to be accounted for because otherwise we are going to head towards a position where we have loads of old AV equipment which is critical for teaching, there is no support contract, there is no future investment program
86	S7	Doesn't that go a little wider as well, even with furniture, carpets, equipment's, there is no structured, what's the corporate image of the university, in terms of one classroom, or another lecture theatre, they all seem to be different.
87	S9	There is no room condition survey, as in, what point do we say that room is fit for purpose or not, do you know what I mean? With AV, with furniture, with lights, with all sorts of things, and also I think, even if you look at the bleacher seating in 087 Curzon, when that broke, it is like everything came to a standstill, at the time, when Curzon opened, it broke, it just brought everything to a standstill, it was like, well how much is a maintenance agreement, and the cost for that, to maintain that seating is costly, ...and some of the design things that were put in, nice to have, but actually in reality, do they work enough to maintain at a reasonable cost.
88	S5	I think that's a great point in terms of...
89	S9	Thank you
90	S5	...business case, again that's like a holy grail quest, trying to find a business case, that kicks off at the start of each project.
91	S3	They've never done them here, can't find them
92	S5	so, yeah
93	S3	I've never seen them, I've searched through the files, I've read every PEP, I've read every POE, or board reports... governors reports, can't find them, no MPV calculation: no cost in use calculation
94	S5	No consideration of the revenue
95	S3	No risk analysis
96	S5	that's what led me on from your point
97	S9	As far as I know, there was none of that, right up until when I got here in 2015, I asked some of the questions, like where's that, where's this, there wasn't any of that, so [S3]'s right there literally isn't anything, even anything on SharePoint that was maybe some minutes shared at the time, anything like that, I don't know whose responsibility it was to load all of that on there, or if they had them on their own desktop, but when you talk about sharing, back then, I couldn't see any of that when I got here

98	S5	I know local authorities are not always a great role model, but actually if you look at getting a decision, an investment decision signed off in Birmingham City Council, the revenue gets almost more focus on it from the finance team than capital...
99	S3	Some of that has started to creep in in the last reports I've done with [S10] in the last year, it's only at a very superficial, shallow level really, it's not really, its finance resources as well, the appropriate resources in the finance team, but you know, previous institutions we had revenue costers that said, you know, you've got a teaching room, then the revenue running cost of the AV is this, therefor the tariff should be that, you know and, so when we built a AV room of a certain... whatever grade it was, 1, 2, or 3...
100	S4	And we had standards
101	S3	So we grade the teaching rooms in terms of sophistication of AV, 1, 2, or 3, you know, so we basically knew which standard of infrastructure we were building to, where the Wi-Fi was, what level it was, what it should be, we accept it not going to perform because of you know, but, I think, that's a major question, what infrastructure standard should we be building to across the estate, both ICT and visible, then you can draw your plan of how are we going to maintain it and actually afford to build to this level, because I'm not sure the institution can afford to continue building everything at the level that is has built the three buildings to, I think it is going to have to prioritise
102	S9	I agree or increase the budget drastically, to maintain it
103	S1	What guidance documentation for POE are you aware of?
104	S3	Well the big one, there was one put together 15 years ago for the higher education sector by a friend of mine called Mel Barlex, who was head of Estates at Westminster, and became head of Estates for the Houses of Parliament, pretty good guide, you've seen this, you know this, it's a pretty good guide...
105	S4	Really detailed HEFCE POE
106	S3	Yep, you know this, so there are several versions of the HEFCE POE templates, which is quite good, your method is pretty much the same really.
107	S5	Yeah, the HEFCE is the definitive guide really, as [S3] said, it comes initially from authorship, at de Montfort
108	S3	It was, yeah we had input into it, yeah we did
109	S5	And that's sort of evolved, I mean it is quite a heavy duty, it's got some great templates and things within it, but from the outset, when I spoke to [S3]'s predecessor about how to introduce POE, we did debate that, we did say that this is the disadvantage of this... of doing it a bespoke way, is you haven't go' absolute compliance with HEFCE therefore you can't provide benchmark data that is absolutely reliable across all of the universities and so on, but, the decision was taken to do a lighter touch bespoke approach to POE, which is essentially what we were doing.
110	S3	I think that was the right decision, by the way, the HEFCE one is useful, and also, the state of the Estates management data, since then has become a little bit.... It was definitely the right decision to go the

		route on the POE's because I think you are hitting all of the essential buttons anyway with it, the key headlines are in it.
111	S1	What IP and VP considerations are taken into account when planning a POE?
112	S5	What was that, IP and....?
113	S1	Intellectual property and virtual property considerations.
114	S3	We're not the pharmaceutical sector [laughter].... I think is the answer, the only people, seriously, the only people that do the legal, they will look at those issues, but I don't think...
115	S4	I can't see, it's really a non-issue for us, I mean, we also think do we then share these reports across the wider sector, put them out in the public domain, it's more of, that's more the side we're coming from rather than trying to protect any IP.
116	S7	Yeah
117	S1	What would be considered sensitive information within a POE report?
118	S5	Well certainly opinions on performance of members of the supply chain.
119	S3	Well the big one is when you have live claims with contractors, if you've got big live claims with contractors, doing POE's is difficult, couple of schemes I've inherited in the past you can't, your barred because of the construction industry court, has got you at a certain stage, for me that is the big constraint if you've got a live claim on something, some of the stuff is evidence, you know.
120	S5	It is quite tricky when you're writing conclusions on the POE, because you've got to think well, if criticisms have been levelled at a member of the supply chain by maybe more than one quarter, then finding a way to express that, and having in mind where it is going, you know, because if it is going to, everybody who participates in the process, you know you have to be sensitive to that I think, there has been one occasion when there was open criticism of one of the contractors suppliers, sub-contractors, and finding a way to convey that, but actually making the point is... I think that kind of run through really, I think it is more about, its commentary on performance, that is sensitive I would suggest, it's the sharing of the information and the extent to which you do that
121	S9	I've had that in the past where you've been dealing with a contractor, but they have subcontracted it out, and your dealings with that contractor have been brilliant, but what they agreed with the sub-contractor, it sort of leaves a bit of a bad taste, and I think, it's kind of unfair to criticise the contractor you have great engagement with, and their subcontractor lets them down, but then ultimately that contractor is accountable, so I've come across that before in my last work place
122	S8	I think we have received the reverse of that haven't we from, so was it naming names, 'Briggs' with 'ProAV', because they said ProAV have a really good relationship with BCU so they will just BCU IT and talk to them, and we're left out of the loop, which wasn't the case, it was just divisive their part, how do you report back on that.
123	S5	Yeah
124	S1	Who do you believe is responsible for funding a POE?

125	S9	Anyone apart from Estates and Facilities.
126	S3	Typical answer.
127	S4	Building owner.
128	S1	Do all project partners cooperate with the POE process?
129	S11	I think it's what you get in their contracts really, if they haven't included it, then they won't want to do it.
130	S3	We just had an interesting debate with our partners about including a POE didn't we, as long as you have it visible upfront, everybody knows about it, then you'll get... it's no... and plus, and it's not like 10 years ago, it's quite common practice now, a lot of people doing it.
131	S5	I think that's right, as well write it into the terms and conditions of appointment, but generally my experience is you've relied on good will, with architects and so on.
132	S4	Yeah, and then there has also been opportunity for future work, business development opportunity for them so generally they will be quite keen to commit to it, obviously if relations a bit more fraught, then they might not be as keen.
133	S1	Do any project partners request POE findings for their own purposes?
134	S4	Yes
135	S5	That request has definitely been made by one of the architects on one of these three buildings, they were very keen, I think they had a Q&A section of their own, that is what I was told, that it would be very helpful for them to demonstrate they've got a process whereby they get feedback from their projects and their clients and they're acting upon it, I think that was the source of the request for that, but definitely yes, they are interested in the outcome.
136	S9	I've done that before, I've done builds like the university build, but a lot of major fit outs, and part of it is, if they didn't agree to be part of a process like this, as an aftercare, then they wouldn't be successful in the tender process, because it's part of the after care, I find that with the big contractors and stuff, they've handed over their building, wash their hands and they walk off, usually there is 10% outstanding payment, we used to make it 30%, it was worth them sticking around for their 30%, I worked for an American company and that is the way they used to work, and you know, if they weren't part of the feedback stage afterwards they would be penalised that money, I mean obviously we can't, the processes here, but that is how I have worked in the past, and it has worked, one other thing what I said was, they couldn't showcase their work in presentations or London magazines unless they were part of the post-occupancy, so you know, we want to take photographs, it's one of our best fit outs... blah blah blah, well that's all very well, but make sure you are at the meetings as that is where the staff feedback, and that is how it was done, a lot of days where we had lots of furniture brought in, loads of things brought in, show the staff how everything works, they'd put on big boards what they did like, what they didn't like, coach loads of them, can we have all this, and see where it goes, and then the feedback, they had to deliver all that the fit out companies, and see where they, they have big budgets for small office space, I mean sometimes the budgets could be like £15million on 19,541ft ² to be exact on one of them, so I

		don't know, it's different, that's just my experience, they sign up to that as part of the agreement, whether we can hold them like that here I don't know, [S3] I don't know... I think it is valuable for them to see what feedback is so when they go out there to perhaps do another university, and the universities all talk to be honest with you, you know, Estates probably talk to [S3] from all different universities, and I think that attending those meetings and taking some constructive feedback is key for [S4] and [S3] recommending them to another university, I think it is in their interest if I am honest.
137	S1	How is liability apportioned between multiple development partners?
138	S2	In respect of what?
139	S1	so if you were to be finding defects or if something was installed incorrectly found in the POE process, how is the liability around this finding apportioned?
140	S9	They usually say look in the spec
141	S4	Depends on the contractor arrangements, so you'd go take it back into the defect management program
142	S1	Are there any reasons why a development partner wouldn't cooperate with the POE process?
143	S2	It's what [S3] eluded to isn't it, if there are conflicts and claim/liability issues... legal, I suppose that is the only reason... yeah
144	S4	Or if they relationship has got so bad, it hasn't quite got to the claim, but still a broken relationship
145	S1	Is there a tangible impact from a POE report, on future performance of facilities, has that been found?
146	S3	N....
147	S4	N....
148	S9	Do you mean the facilities and buildings and how they work... It would be nice to have all that, at the moment it's just kind of word of mouth on how it works, and student feedback and those kind of things, I think it key for facilities people to get out there and talk to people, both during the process and afterwards, to get the feedback, and feed it back to groups that are managing the project, management doing the build, that has certainly been the case in the last year, that happens, sometimes it can be quite difficult because if you did let's say a staff survey, and opened it up to every man and his dog, it goes from being constructive to just criticism, a moaning spree rather than actually how many people actually want this, people start looking at it as their individual thing, but, one thing that they did do is, what has been done is champions in each.. you know when we've done moves and stuff like that, there have been move champions and things like that, so I think that is always key, then you find with those move champions they would drop off and then send somebody else, then they've dropped the ball, then that one comes back, don't know whether that is what has happened in the past.
149	S5	That was claimed to have worked very well on the JP building.
150	S9	Yeah it did work well on the JP building.
151	S5	Departmental champions

152	S9	When I first moved into the JP building, I had a building user group meeting, I got everybody together, key people in the whole building, saying what works well in here, what is not? Like I say, some people say can we have a tannoy system so when the sandwich man is turning up, well no not really, let's be honest about it, it comes where, I think people do need a user guide, a bit like what you are doing, these are the sort of questions, and not to make it too personal, then what they would like to see.
153	S2	I think it is evident, I don't see very much learning from the POE's that has been dragged through to future... anything, just anything, but I don't see any lessons learned... personally, the POE's from Parkside, Seacole....
154	S9	Nothing was shared.
155	S2	I haven't seen any reference to any POE, or PEP that I have read... anything at all, not reference to that lessons learned scenario, just not seen that, so that would be my point on that.
156	S1	Where performance is compared, are there any specific metrics which are used?
157	S8	There have been, so I know that, when we moved from Goster green into Parkside, [X] did a lot of work looking at energy management and savings, so he used various building management system software that they put into Parkside, think he used Veridium, which is an energy management tool, we produced a lot of reports around that, and it showed dramatic improvement
158	S9	one of the things we don't get a lot of is, I often wonder why, maybe it is a good thing, NSS results, you don't get a lot about the buildings or facilities, now whether it is drilled down in the questions, specific questions on buildings and facilities, you know, they don't really know what we mean by that, we don't actually get a lot of feedback whether it be positive or negative in facilities, we get more word of mouth facilities, for instance the other day people were saying how fantastic the facilities were, they were on the bus, it just goes to show, how we get that back, don't know how we go about that.
159	S5	You've just reminded me, there was a point in time, and I'm going back a few years, where there was a reluctance to go out with surveys to students for feedback, because of the National Student Survey going on, somewhere there was a concern that, we don't want to be going out every 5 minutes with surveys to students, so there was at one point there was a discussion to say could we integrate some of these questions we want to ask about facilities into the wider survey, I don't know what the outcome of that was
160	S9	But why does it...
161	S3	People don't really do it in HE, it's masked in the teaching and learning infrastructure, ICT questions and Library results, I think there are two questions masked in there - nobody does, in general.
162	S6	With learning resource questions, it tends to get confused in the students mind as to what are the learning resources are, it's the IT that falls over regular, as oppose to the AV works.
163	S9	With the facilities it's masked...

164	S6	You don't have the flexibility, some optional questions but, nothing specific in there
165	S12	I was just going to say, other institutions have been complying with the user-experience methodology where they've got students to do things like go take photos of things that they are picking up, and they've had a lot better feedback that way, and more detailed feedback, like taking a photo of why this table is broken, and that seems to be a better approach than a survey.
166	S1	I believe there has been a space survey in Curzon B in particular, how has that effected, having 2 evaluations underway simultaneously?
167	S4	They are totally different things, what you are taking about there is the space utilisation survey.
168	S1	Do you think there is any impact?
169	S4	There may be an interesting correlation when we do the second half of the POE, but not from this first stage of construction side I suspect.
170	S5	So testing the popularity of those social spaces, anecdotally are popular, would be aided by some harder evidence.
171	S4	Some harder evidence, yes, so you are in the second phase of the POE, you'll get the anecdotal about we love this space/we don't like this space, and we've got the hard data that shows what's the utilisation of those spaces
172	S1	So the two will work in conjunction?
173	S4	[nods]

Appendix 4 - Validation Interview Questionnaire

Procedure

1. Structured questionnaires - 5 participants (anonymised)
2. Present model to participants
3. Pose prepared questions
4. Validation - sign off/amend/note areas of future work

Points of discussion/questions

1. Preplanning Phase
 - a. Process organised temporally to coincide with RIBA gateways 0-3
 - b. Additional node for pre-contractual POE agreements with development partners
 - c. Additional node for review previous findings from completed POEs
 - d. Additional node for inclusion of services
2. Planning
 - a. Clear separation of theoretical planning and practical planning - complete rationale before scheduling
 - b. Reduction of choice - previous guidance written so practitioners can select components - new process more procedural contributing toward benchmarking and iterative improvement
 - c. Replacement of 'review' and 'evaluation' selections points with a three stage pathway
3. Implementation Phase
 - a. Largely unchanged
4. Augmented Knowledge Management Phase
 - a. Dissemination to all applicable internal departments and personnel
 - b. Dissemination to external development partners - contractually agreed during preplanning
 - c. Implementation of actions after dissemination - findings more likely acted upon if more widely shared
 - d. Preparation of previous findings for feed-forward
5. Circular Process - 'Ouroboros'
 - a. Final node 'prepare findings for feed-forward' leads directly to the preplanning phase 'review previous findings'

- b. Virtuous circles of improvement iterative improvement
 - c. Development of benchmark criteria from previous reports
- 6. Temporal organisation
 - a. The POE model organised to reflect where specific elements of the POE are scheduled in relation to the RIBA plan of work stages

Appendix 5 - Validation Interview Transcript 1

S1 - interviewer - Chris Roberts

S2 - interviewee - Estates representative - Aston University

Comment no.	Speaker	Transcript
1	S1	We have a four point structure interview, I'll present the model, then pose the questions, looking to either, signoff, amend or suggest future work. The first sheet is the process diagram relating to the HEFCE POE process, the second is the hybridised model made up of completed POE reports, industry standard guidance and a focus group of practitioners involved in the POE process here at BCU, the third shows a breakdown of the RIBA stages, and finally the fourth depicts the model adapted to follow the temporal points within the RIBA stages. There are an additional 3 decision making aids to aid practitioners creating a pathway for selecting the most appropriate methods at the recognised time intervals. Before starting on the questions, do you have any comments regarding the overview of the process?
2	S2	No it seems, you've taken the logical steps from the HEFCE which I have noticed, and you've also included a bit of practicality in terms of developing the brief which can hopefully be used in a practical sense either here or somewhere else, and getting Estates involved as well, which is very good from an experience point of view.
3	S1	Are you happy to move into the questions at this point?
4	S2	Yep
5	S1	The preplanning phase, the process organised temporally to coincide with RIBA gateways 0-3, as this has been a recurring theme from the focus group, particularly around not being rigorous enough?
6	S2	I think that, from of experience the success and occupation of a building starts from point zero in term of the RIBA stages, starts from the developed design, there are two phases really, in the brief, I suppose, does the brief effect A the fundamental about how the building is going to be used, its maintenance, and its fit for purpose, for its intension -future proofing. Yes it does. It goes back as far as that, because, if the brief, even if the brief is detailed, it's not aligned to what the function of the building is, you're going to get a mismatch, and certainly going to get a lot of discourse when people try to, when occupants try to move in, so it's absolutely fundamental that it starts from the very beginning as Mary Poppins sang.
7	S1	The second point here is an additional node detailing the requirement for pre-contractual agreement with development partners regarding cooperation with the POE process. Anecdotally it has been said ten percent of the fee is withheld until the POE is complete, however, if the relationship has been particularly acrimonious over the course of the development, it can be easier to write off the final ten percent.

8	S2	I think it is definitely a good idea to focus it at the beginning, it's the practicalities of implementing that could be quite arduous because they are going to be concentrating on actually designing the building rather than thinking about the people they are getting in, it a good idea but a lot of thought and cooperation with the partners to make it actually work at that level - an amendment maybe
9	S1	The next point is an additional node for reviewing previously completed POE's
10	S2	If you don't do that, you don't learn, case in point at... I've implemented at Aston where we rigorously do a 4 month/6 month occupancy review, which is part and parcel of the soft landings responsibilities of our engineer, so we've actually implemented that next year, an actually, particularly in a university setting, that is a precursor to getting, or obtaining information from the various parties as to how that functions which will obviously be feedback if say, developing new lecture theatres, then there are going to be certain people who will get accustomed to it, will not like it, will... some lecturers are still in the mode of I've got to be safe behind a lectern, whereas opposed to no, the way forward is to get tablets and be interactive, so all that I think is part of the learning, take I suppose to the next generation of construction building whether it be offices, whether it be labs, or whether it be specialist building facilities, or lecture theatres as I feel that, it is going a different way, there is more technology, more tablets, less of the boards on the wall but more of that, and you are only going to get anecdotal feedback if your record it over a certain period, over the evolution of the new build, to evaluate it then if that makes sense.
11	S1	The final point regards and additional node requiring the consideration of services
12	S2	At Aston the whole AV infrastructure is being totally reviewed bottom up and top down, because... I'm giving away secrets here, but it's no secret because your executive will know that one of the key selling points is to have good solid data and AV for the teaching and that has to be state of the art, over the last eight ten years the pupil or the graduate has become the client, they are a lot more savvy of what is happening, not just in this country, the States, Germany, Holland, where the AV is quite far advanced, I don't think we can afford to sit on our laurels if we want to attract the right people and get them in the courses than the AV has got to be state of the art or they will go somewhere else.
13	S1	The next section regards the planning phase, the planning phase has undergone reorganisation as opposed to augmentation, the theoretical planning has been separated from the practical planning as some elements of the implementation occur before the theoretical planning of later stages of evaluation.
14	S2	It the very similar set up to what we have at Aston, and formally at Brunel, it's part of the soft landings process, which we have done anyway. Stage 2 from a practical point of view, I think that is quite rigorous, the 9-18 month and the 3-5 years, I think get quite woolly in terms of documentation, because either they get forgotten about or

		they don't happen, how are you going to change... well unless you have a somebody dedicated to do post evaluation in the team, I think it depends on logistics and economics, and Estates Departments are quite lean these days, there is not a lot of because of financial constraints, there isn't anybody on a pay to.... The only thing I could think of doing, this is off the top of my head, is which when I was assistant director of Estates, that got put, those two stages got put into the exec paper, so when we presented an exec paper the notes were always at the bottom that you know, stage 2 stage 3 PO reviews are due, which gives me a reminder to get my project managers to go out and get it done, but it depends on how, on the Estates director view point, if the Estates director is process driven it may come up and may get recorded, but a lot of universities, I don't whether you found, it does get lost in practice regards.
15	S1	Absolutely this is what led to the more formalised process.
16	S2	I think the process is fine, it's just the economics of taking that through and decision by Estates director, deputy director as to well, are we going to carry that out or do we have three hundred other things to do to manage the estate, I'm afraid managing the estate will always come first, that's not an excuse, it just the world as it is, as I see it.
17	S1	One of the alterations to this phase has been to reduce the number of selectable options, this has led to the development of three decision pathways. The HEFCE guidance is written to offer a selection of choices to practitioners to choose from. This may be influencing the ability to develop benchmark criteria and implement a process of iterative improvement.
18	S2	I think the definition blocks are good, I think it all depends who, on how you structure them in terms of who is going to form the party to do those, if you are not careful and you get an array of people, you are going to get all sorts of diverse information that is going to be very hard, it'll be more or less impossible to benchmark, so I would think probably needs careful consideration of who is going to be the party to do that, in terms of.. I think somebody needs to decide who is best, to get the best out of that, in terms of, it would probably be like a selected steering group of people, if you got the wrong people it just wouldn't work.
19	S1	A focus group of applicable personnel was formed here for the purposes of dissemination, it seems as though those same people need to be included in the planning
20	S2	For instance say on a... engineering services, if like us you've got a very good senior engineer, who knows his stuff, it will be valuable in terms of that, combined with focusing any part of that to say the end user, in terms of, how did it feel, did the lighting okay? Specific questions like how was the lighting, how was the acoustics, do we have any air conditioning, did we have any breakdowns, what was it like in the winter, what was it like in the summer, they're all questions that I think are very very important to benchmarking, it's that sort of thing
21	S1	Beyond the process itself, we almost need specific points with specific methods at which to benchmark

22	S2	And key end users as well, key end users being anyone from academics staff, Estates, and students
23	S1	So the questionnaire put out to end-users requires the same benchmarking overview
24	S2	It shows a consistency then, otherwise you will get such a diverse range of answers it's going to be very very difficult to.
25	S1	The final point is the replacement of the evaluation and review selections with more formalised pathways.
26	S2	I think that will probably be good because it will cut down a lot of probably be good because it will cut down a lot of questions, answers to questions that either aren't relevant, the trouble is you are always going to get, and it's very difficult to sift them out, you are always going to get, you are always going to get answers from I would think mainly academics who are pretty stayed in their views and are probably going to give fairly negative answers because the facility might not be right for them rather than actually the facility has been discussed through umpteen end-user groups in terms of, you now the idea is that you go out there and interact, whereas, so there may be negative comments that aren't, to the individual and not the function of the room if that makes sense
27	S1	On to the next point. The implementation phase in the original model was a single node, it is now dived into three representing the three temporal implementation points, other than that the implementation phase remains largely unchanged...
28	S2	Well, again its consistency, it the preparation of that in terms of who's going to attend it, what questions are you going to ask in preparation for preparing that.
29	S1	This is why an additional node was added requiring the development of questionnaires and focus groups once the strategy has been selected
30	S2	If that is prepared, then its making sure, the focus has got to be on getting the right chair for that implementation phase, and making sure that it happens, because sometimes people might not come, they might have excuses, I think you have to factor in that sometimes, but what you don't want to do is implement it and find that the people who've done that, half are missing, there has to be continuity or else you are going to dilute the results, from one to the other
31	S1	Our POE's a conducted by an external consultant, does Aston operate in the same way?
32	S2	No we do it in house. We've done it in house with a workshop, if there have been issues outside of the normal soft landings, director of Estates would probably get the lead on space planning manager, Claire, the services manager, and myself the project manager, and that would be really the key group to lead that.
33	S1	With regard to Aston conducting their own POE's, is there any consideration of IP and VP when making that decision?
34	S2	We feel that its, because of the main player whom form part of... from there to there in terms of taking it through, its I think its fundamentally important that they continue through, in terms of the probably I think, of somebody external, they're not part of Aston university, you could say it his bread and butter and he doesn't have to be, I think we are

		quite passionate about our... probably because we are a smaller university, we are quite passionate about efficiencies of our lecturers, in fact the deputy VC Helen gets involved with them, she actually goes around when I've been round with her, when we did new lecture theatre, we go in and stop them and asked the lecturer what you think, ask the students, getting some feedback just like that, and if problems occur like there has been, we'll then have a meeting with the Estates Director, IT or whoever, oh yes we probably need to move the lectern here, move the screen on the other wall, we are quite, its quite handy, probably because of the size of the university, but it is quite proactive in terms of getting things done like that.
35	S1	The next section regards the augmented knowledge management section, anecdotally its not uncommon to here of practitioners never having seen a completed POE report. This point regards the dissemination of POE findings to internal departments and personnel.
36	S2	I think that is important, you need buy in from the people, and by getting them to buy in, you probably get a lot of useful feedback from them, they'll be quite motivated to do it, as opposed to just seeing a bit process and a map, and wording... its attitude really, they've got to be motivated in the first place to get decent feedback, and I think we are reasonably successful at Aston, it a bit of a culture really, I suppose you probably couldn't do on a bigger university. A bit like a best practice approach, it down to the size, we only facilitate ten thousand students, whereas BCU I'm not sure... and we did something similar at Brunel, again ten to fifteen thousand students, whereas this is 25, probably double, so it would be interesting I would think, and say a university in London, and that's probably twice the size of... be interesting to see their process as well, UCLs process, it would be interesting to see how well its implemented, driving down to the key players.
37	S1	The next point regards the dissemination of findings to development partners, this brings into play the node requiring contractual agreement in the preplanning phase.
38	S2	Some of the AV provision in the new students union, the AV provision was done by the contractor under a D&B, but the key principles of the usage was obviously done by ourselves as part of the brief.. and it worked, well you've seen the results, the proof is on the pudding.
39	S1	The next point regards the ordering, dissemination before actions and recommendations - rationale being it is easier to ensure all actions and recommendations are acted upon if they are widely known
40	S2	Yeah that makes sense, that's logical, fundamentally check there own areas as opposed to the other way around, that's logical
41	S1	The next point regards the preparation of findings for feed-forward, to complete the circular process.
42	S2	For this process to mean something it needs the full support of the Estates Director and possible the deputy, the senior, the COO, and then that will be driven internally by the professors and deans, that's what happened, because Helen is quite focussed, that's why it happened, she got the last say of all the professors and deans, then it

		gets focused down to the end users, that best practice approach, it needs to be drilled down, top to bottom and bottom up, but its got to start, if the COO or ProVC haven't got ownership and are doing it as a tick box exercise, it not worth it is it, I'm not saying people do, I'm just saying, I can only go on the experience of the two universities I've worked at, it could be an advantage of a smaller university, that it is probably a little easier to do, in terms of smaller university, smaller staff, but the principles I think could still be done on a bigger.... I feel I could probably implement it on a bigger university, the principles are solid and laid down, I think it could be facilitated in a large university... that's my personal opinion based upon experience and knowledge really
43	S1	The final point refers to the temporal organisation of the process to coincide with the 7 stages of the RIBA Plan of Work as well as three additional in use stages
44	S2	I think so, you've obviously studied the HEFCE guidance, and they've got a lot of experience, one hundred plus years, so there is a lot of knowledge base there, I think that will help the process, but just to make sure it isn't top heavy in administration, on resource and how it's going to be implemented, what you don't want to do, is to say you're going to do it when you haven't got the resource to do it, then it gets watered down... and it won't work, there has to be a passion, and it has to be driven from the top down, less politics than you'd get at a larger institution like Nottingham for instance

Appendix 6 - Validation Interview Transcript 2

S1 - interviewer - Chris Roberts

S2 - interviewee - BSRIA Soft Landings Group representative (formerly)

Comment no.	Speaker	Transcript
1	S1	For this interview, I'll begin with presenting the model, then pose of pre-prepared questions, looking for your feedback to assign each point as either signed off, need for amendment, or a requirement for future work. So to begin with, do you have any general comments regarding the model?
2	S2	So, taking this comparison with the HEFCE model, the HEFCE model is quite generic, the word I'm looking for, so it doesn't seem massively detailed, but I suppose at the time this was created, and given the weight of importance given to POE's, I get why that is, that makes sense to me, however, I completely see how you have derived your model. I understand the complexities and why this was required.
3	S1	The first point regards the preplanning phase, do you have any comments regarding the temporal arrangement of the POE around gateways 0-3 of the RIBA plan of work
4	S2	BCU uses a PEP, a project execution plan, that PEP document is the DNA and blueprint of how you are going to deliver this project, that will show stakeholders requirement, every single conceptual thing, why you are doing it, the policies, all of the overarching things and the POE and the introduction of learning from other POE's should form a strong part of the PEP, and I am not sure that it does. In the PEP document there should be a requirement to have all of these elements included, very early in the document actually, not at the end, the thing is I suppose, it a bit tricky, you're using post-occupancy before prebuild, if that makes sense, so there is a bit of a contradiction isn't there, if that makes sense, so we are looking at something before we have started and we are using the term post, I know that makes sense to me and you, but it can be contradictory, what I think will happen with the POE stuff, the POE stuff will slip to the back of the PEP, 'ah we will do this', we actually it should be at the beginning, right at the beginning, if you have access to POE data, then that should be right at the beginning of the PEP document, that document is the key document for this university, and many others as well because it will show everything that is in there.
5	S1	The next additional node regards the contractual arrangement with development partners regarding cooperation with the POE
6	S2	Yes, I see what you are saying, what else you could do there as well is you could set out at the early stage, set out the landscape of the POE's you are going to do as well, because the POE testing that we did actually was kind of, I made the decision with [S5] as to what we were going to do, it was do we do this, do we do that, we are making all of these decisions at the end of the process, whereas if you were to

		set out the POE mechanics early, we are going to do this because you can either have meetings, structured meetings, you can have one to one, I went for the one to one process, but if you are to identify that early and set out how you are actually going to commission your POE's later, or in this stage, if you can contractually do that then that would be a benefit, because in this part we are going to commit to individual assessments, you're going to commit to two days of POE evaluation, rather than going to a bit of kind of good natured, trying to hep and all the rest of it, you could create your POE specification at this stage, and how you are going to do that later, because that was only developed at this stage
7	S1	The strategic considerations belong in the preplanning phase as opposed to the planning phase
8	S2	Because what you are saying at the early stage is, this is how we are going to deliver the POE's, and this is what we expect of you if you sign up, we are going to ask you to sign up six focus groups... whatever you decide, that can be done and costed early, because if there is a cost associated to the contractors, you know a lot of it is goodwill, if you fall out then they will be like 'we don't want to do that', and you won't get any information, where as if they are contractually bound to do that, at that stage, you can we want three days of, well what ever you want to do, and it gets cemented in there. It might be that you have a one size fit all POE standard, but you want X,Y, and Z so that is what you do, or you make it... the trouble is if you make it specific to each job, its difficult in terms of data comparison, me personally I would try to identify a standard approach to POE specification, you know, we want one to one meetings, we want focus groups, we want such and such, and we want this, if you do that every single time, and everybody is the same
9	S1	With regards the decision making pathways, most institutions will have their chosen route through the decision making pathways anyway
10	S2	Yes, so what you want to do is take out any potential decision making further on in the process, because you have defined it and agreed it at this stage, so its not 'we aren't going to show up to your meetings', 'we are not going to do this', 'we are not going to do that', because when you are trying to define your POE of what you are going to do, because that was done very late in the process here, 'we will do this, we will do this', if it is contractually tight on that and specified we are going to do... that's my opinion.
11	S1	The next additional node regards the review of previous findings, we've covered some of this already, do you have any comments regarding the cyclical approach at this point.
12	S2	The only comment I have really is the fact it should be a contractual requirement or part of the PEP to review the POE's at a really early stage, the PEP, if you are going to go for feasibility, reviewing the information in previous POE's must form part of that feasibility study
13	S1	Business case
14	S2	Absolutely yes, because it comes, it becomes quite simple actually, say if you have a building and you have an issue with lighting and

		then you don't take notice of that issue, you then go through all of this, and then you start to change these lighting issues later, what are you doing? What are you doing? You've gone through all this process, spent a fortune, with the lighting issue for example, you're are going to continue and do it again? It doesn't make any sense what so ever. The more you do this and the more concise and the more control you have over the management of it, the stronger the position you are in for the future, so economically, fantastic, you are going to just deliver things people want, so there is no problem with paying for itself, we've discussed this before, if you were in an engineering or manufacturing process, it completely bizarre! This is massive manufacturing, it's just on-sight manufacturing and yet you don't take any notice of your previous work
15	S1	They are essentially untested prototypes
16	S2	You see also, the POE's, the POE is not expansive enough, the Poe if we are, and I'm talking form my perspective, which is not great, I've only done POE's here, it's not expansive enough, I asked thirty questions to building users, you know, I'm going to get the building users information, I'm not actually, there is no section going to the technical teams, there is no section for going to other departments, student allocations or whatever, I'm not getting that information, I'm getting really small information, my POE is not big enough, I'm trying to keep it small for samples, because people are not going to answer questions, I should be doing a POE ultimately for the technical engineering side, 'how do you find these buildings?' - there going to come back and say, 'we're not happy', what I'm going to get then is lots more technical information, so like the IT as well, I've not asked IT, 'what's your problem?', I've not, I've not done that, 'Engineering what is your problem?', with building users, it's not the same, it's not the same because the POE information that I am getting from building users is 'how's the lighting?' - 'its alright', technically I'm not getting any information at all its relatively weak information
17	S1	The final point regarding the preplanning phase is the addition of a node for the inclusion of services, ICT, AV etc
18	S2	The comment I have for that is the fact that, well to reiterate what I've just said really, POE when we are taking previous learnt POE's, there is no area within there that is really specific for complex IT, and the only information we have for IT, is the presentation we had from IT that we put into it, otherwise we'd have no feedback, no official feedback from an IT point of view or perspective, we'd have no knowledge of their problems, the problems I've got I can tell you about IT problems, anecdotal issues that building users have raised - 'there are no computer' - this is not infrastructure, its not brought to my attention that it is an IT infrastructure problem - that been brought to my attention from an unhappy It team who want to jump on and do anything they can, but the Poe is not expansive enough to do that, it seems to me you need multiple POE's if I'm honest with you, you need a building user one, and a technical one, and may also need a finance one as well, the building user one is great, you know, 84% of people are happy with security, what that going to tell me? Not a great

		deal, it's a flavour, when I'm at this stage I need to know what not to do - and because someone is unhappy with IT, that is not enough, what actually are the issues, was the server too small, I need to be really really precise
19	S1	So we need the more feed-forward regarding services, particularly in a technical sense
20	S2	I think so mate, I think looking at this you need more POE's, a user POE, a technical POE, and the potential for a finance one as well, because it all comes down to money, it's okay, the feedback we got, the predictive spend was £37 million, the actual spend was £38 million, but why, where is the devil in the detail, and if you've not got detail at this stage, your POE is not, it's not going to have the impact it need ultimately, merely a flavour, so what can we avoid, you've also got in the finance one, you've got value engineering part of all of these, every single one of these projects is full of value engineering, so we set out to get something which actually meets the universities requirements, it comes out at £40 million and you've got £37 million, all you do is reduce your requirements, this is not a good move, it's not a good move, actually you wanted this, you can't afford it, so now you are taking something else, really? Massively opportunistic. If it doesn't sit in there, if I think of the POE stuff I have got, useful as it is, it's not going to provide me with hard data for me to make decisions on in the preplanning phase on a massive project, because IT are unhappy, people are unhappy with IT, but I need to know whether they are unhappy with the builders cut out the wrong holes, is it sequencing, programming, what is the issue, so that we can resolve that at an early stage, it could be the situation from technical, you know we've used the wrong, heating system, we've not got air conditioning, we've not got this, we've not got that, saying it too hot or too warm, that doesn't do what I need it to do.
21	S1	The next question refers to the planning phase, and in particular the designation between strategic planning and practical planning, or what is going to be done, and how it will be achieved, across the three evaluation stages
22	S2	There is a lot of information to consider, so when you have the requirement for lots of information and you are trying to build up a picture, to try and go back in time and pick that information up, would be quite difficult, you know maintenance reports and things like that, what are you looking for?
23	S1	Following the three stage structure, stage one evaluates the design and construction, stage two evaluates end-user feedback, stage three holistically considers the previous two stages, with the addition of supplementary information such as maintenance reports, in what could be described as a desktop study. The process is designed so that the evaluation pathway is considered from a strategic view point, with a view to what the information is being collected for, before the practical planning - organisation of focus groups, development of questionnaires and so on
24	S2	So this phase is to define the strategy of how you are going to do this?
25	S1	Essentially yes

26	S2	So where is the point at which the stakeholders are identified?
27	S1	This feeds through from the initial contractual agreements in the preplanning phase, as well as identifying end-users at Stage 2 where end-users perspectives are evaluated
28	S2	So the detail in there is fundamentally driven by the previous stage
29	S1	The incorporation of the cyclical process, it has to be seen as a continuous loop
30	S2	Yep, I understand that, and how that fits in there, so, you could specify who, when, and how, ultimately, that would feed into there, so you can design that out at the earlier stage, and then that would feed straight into there and deliver what you have already agreed. Yes, that makes sense.
31	S1	The next point regards the reduction of choice within the planning phase, essentially replacing a vast and variable set of choices, into pathways easing
32	S2	I still read that as different choices, rather than pathways, should the arrows not go from one phase directly to the next, previously it looked to me, that I had the option to go and do stage 1, the option to do stage 2, and there being no requirement to do this, it looks like I have choice, and I shouldn't have, there is no way to get to that third level without doing the previous ones. With things like this it needs to be that you have no choice. All roads must lead to Rome.
33	S1	The next point regards the review and evaluation selections, replacing them with pathways
34	S2	That seems to me that there is a choice. That's interesting (phase 3 - strategic evaluation pathway), that's massive, I'll tell you that now, this stuff you'll get buy-in for (stage 1 and 2), that is an achievement (stage 3), if anybody does that, anybody, that's impressive, what I would say, in my limited experience, if you do that you've got it, this is all okay, no problem, a building is going to be there for 50 years, this what you want, this data is what you want, this is real fact, a lot of this anecdotal, I thought this, and I thought that blah blah, what's actually happened, you know, if an organisation is committed to learning from that, they would need to put in processes and systems in order for this data to be collected continually as soon as operation ticks on, as soon as the building is switched on, you need to start collecting this money straight away, because to go back and collect it later on is going to be massively difficult, in here you could have energy as well, in one building we had a prediction of £300,000 energy consumption, it was £1,000,000, so really, has that information fed back? I'm not sure it has this is the one that after five years, absolute... if it's done properly, you've really got it, because you've got all of the anecdotal information, the contract information for the developers and design team, you know, we wanted this, we wanted that, actually all of that is one thing, but actually, how does it actually work in real life, what's our performance, how are we doing with this, so we know all of these issues, you know you had an IT problem, you know the front end, I get that, but actually it's the five years of building use really, what has happened, that's the one that if you can get five year document that says okay, we do x, y and z, we've got the

		results a, b and c, but actually these performed brilliantly, these performed badly, because at the end of the day it's all going to be about data, it's about numbers, you need to transfer qualitative into quantitative, I know that's not all ways possible, for me, I'd want to sit there and say right, give me a number show me, give me a number on this building, show me a colour, I want to see something, I need something form a previous learning of a same previous building type, internal areas and whatnot, how do we think our buildings have performed
35	S1	So summary statistics are important to make the business case
36	S2	Absolutely, you need some figures, because unless you've got figures nobody is going to take it seriously, again this is just my personal view, but we can sit there and discuss, the light quality was this and so on and so forth, actually, I'd want to see some numbers, I want to see, how much have we wasted, and I'd want to look at the value engineering. The value engineering is a key one as well, because what you have with that is you have, maybe you will save £3,000,000 on your original contact costs, I bet over five years you will spend £6,000,000 putting that back in, if you could pick that up, I mean, this is big, because you can pick up everything that was value engineered out, so we don't want a super-fast lift, I bet you put one back in, if you could learn, we value engineered 3, but we actually spent 6, let's not do that again, that kind of information
37	S1	So POE findings are essentially a key feedback mechanism for managerial decision making, formulating Estates strategy
38	S2	Absolutely, now when you are funding these buildings, when you are raising capital, you will go out to the markets, you'll get loans, complex finance, your better to do that than spend revenue costs later on, and further capital sums, trying to put something right which you could of put it all in one nice package, it's like a debt consolidation thing, put all of your debts in one place to manage it, your much better doing that, that one finance vehicle, because at the time you are doing that, you've got control over that, the more you borrow the better your rates are, I don't know how BU's finances are but I'm sure they have access to.. you know, you get some complex stuff, you're better off to do that, and I know from experience here, all the stuff that is value engineered out, is going back in, and at two or three times the cost, and it's an absolute nightmare, all it is, we shouldn't have done it in the first place, again that's my view, but that's the feedback you need in here surely.
39	S1	It's key to financial decision making
40	S2	The POE stuff we have done here, as good as it is, even if it is a little disjointed, what decisions could you make form it, I mean Health and Safety weren't included, and they had a lot to input, you have Health and Safety, IT, they were all missed form the POE ultimately, we've got no technical feedback, if I was to get the POE work we did since I've been here and take it into this preplanning phase, and say this what we have learned, there is not a lot of substance to that in real terms, I know I have done this work and I undermining my own achievements, but actually when I think about it, its good, but it is

		anecdotal, its like, this does not work... and I'll tell you why, and here are some numbers because that is what I need, I need numbers, to be able to quantify my decisions moving forward, now also as well you've got risk, where is the risk map on all of this, again its not there, and the key to all of this after seeing this today is strategic review, this is the one, this is massive
41	S1	The next question refers to the implementation phase of the POE, and the relatively limited modification
42	S2	Where do the time frames come from?
43	S1	The model being a hybrid, they are originally identified within the Higher Education Funding Council for England's Guide to Post-occupancy Evaluation, the primary higher education guidance document first developed by practitioners in 2006
44	S2	In the CIBSE log book, is interesting form a technical viewpoint, going back and logging readings after a year, that could fit in also, no one will want to do this though, the POE I have done however, has no technical information
45	S1	A customer service exercise over a feedback mechanism
46	S2	It is, when I think of the data I got, and I was proud to get that data, did well to get it, well actually its anecdotal, 80% of people are unhappy with security, what aspect of that, well we can drill down into, but again it's not really... what does it tell me, how do I make a decision on that, all it will do is point me in the direction of further investigation, so if it came back and said the lighting was unsatisfactory, but I need to go and understand what that means, that's a further thing for me to go and do, if I've got to that, it going to takes months and months, we're not asking the right questions to the right people, building users not building managers, I never asked a technical question to a technical manager here, now I think of it, if there aren't enough parking spaces for a bike, what does that mean, it means well stick a few more... but really if I want to look at financing a massive £50,000,000 building its not telling me a lot, its not telling me how the heating performed, I've got really complex issues in some of these buildings because we haven't learned, and because of value engineering as well, and this is taking a long time, and I won't go into it, but I've got serious problems and complexities, but if we don't learn form that, we'll do just the same
47	S1	The next question regards the knowledge management phase, the dissemination of findings to internal and external stakeholders and implementation of actions
48	S2	Dissemination to both internal and external, yep I agree that, what are you implementing? Post construction implementation... any changes
49	S1	Yes
50	S2	I don't see and implementation or recommendation from any of the POE's, I don't, I see the POE as being un-opinionated data, the recommendations need to be defined at this stage (preplanning), so implement and recommend, that's for someone else to do, I'm not interested what IT want to do, problem with IT you need to go and fix it, but the issue is, its an understanding of issues identified feeding back into here (preplanning), so if there is an ICT issue, say a server

		issue, whatever, action and implantations to rectify that are well out of the scope of this project, because they might never, I don't care whether they do, this is the thing, I don't care whether they fix it or they don't, I just don't want to make the same mistake again, it goes off into facilities, its about the lessons learned and not repeating mistakes, its all about lessons learned, implementation, I have no concern with that, all I'm trying to do is stop you doing it again, I'm not trying to fix what you have done, that's a dangerous place to go, if you start suggesting changes to servers, that's not what you are looking for, as soon as you step into the world of recommending something you are taking on responsibility, what I would do, issue found, I'm not going to start telling you what to do about it, I'm not going to go in to that, because if I start making recommendations in there, its never going to stop, all I'm going to do is what happened, who am I to recommend anything, I'm not going to recommend what to do about it, it's a reporting of what happened, its not giving you advice on what not to do, because that is a different thing, its about the early stages, strategic definition
51	S1	The final point refers to the cyclical process, feed-forward to future developments
52	S2	I would make this whole process completely void of any advice or recommendations, its an evaluation, I'm just giving you pure data, I'm categorising it, I'm quantifying it, I'm putting some number on there, but what you make of them, is for you to do, anything you want to do with that information, I'm not going to tell you what to do what so ever, I would recommend reading the evaluation and digesting it
53	S1	Purely to avoid repeating mistakes
54	S2	The POE doesn't guarantee you won't make mistakes, doesn't guarantee you are going to learn any lessons either, doesn't, because you can get to this stage and they can completely ignore it, and if has not got facts and figure and quantifiable data, that not going to pay attention to it, at this stage for instance, you are going to have architects I the room, and they are not going to want to be led, they are going to want to fit glass everywhere, your POE says we don't want glass everywhere, they are going to use every reason in the world to fit glass because they won an award for fitting glass, that what you are going to have ultimately, now if your POE is anecdotally we don't want glass, well why not? We don't like glass because we have had 67 breaks, spent £45,000 doing it, so this why we are not going to do it, you are going to have that issue, all the way through, you are going to have resistance from people who just want to go and do their own thing, and its particularly the architects and the designers, and they are not going to want to do it, so they will railroad the client quite quickly.. oh no no no, this is alright, this what we do, we've done it elsewhere, well our data says we don't want to do that
55	S1	Final point refers to the organisation of the process to coincide with the stages of the RIBA plan of work, will this aid uptake
56	S2	It will do for sure, yeah you can associate that with the RIBA stages, which makes sense, you've also got the soft-landings stages as well which are quite key, who would run this POE, would it be an internal,

		or an external consultant, it quite a tricky one, but to align those with that makes total sense to me if I'm honest to you, that would make sense, you need to link the process on to something, it needs a host
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Appendix 7 - Validation Interview 3

S1 - interviewer - Chris Roberts

S2 - interviewee - BSRIA Soft Landings Group representative - Coventry University

Comment no.	Speaker	Transcript
1	S1	Having just presented the model, do you have any general comments?
2	S2	I suppose the first comments I had is it seems so straight forward to have it laid out in that sequential way, that made absolute sense to me, I suppose I would have questions as to the selection of stakeholders, and where that information goes, when we are looking at the pathways where you are breaking down the different evaluations, you've got more detail about the planning, maybe that would be quite useful, because that is one of the questions I'm always thinking is, who do we consult, how and when? For example, with students we might have a focus group and not a survey, for staff you'd have a survey, for some staff you might want to have a focus group for those that were involved in the design stage at the beginning, so you might have technicians who were really involved in the design, speaking to them individually or in a small group about how it has met the design spec, so I think different methods for different types of people might be useful.
3	S1	The first point regards the preplanning phase and the organisation of the preplanning phase around the initial three stages of the RIBA plan for work
4	S2	Yes it is necessary to feed in, we have lessons learned, but Post-occupancy evaluation when we get into them will be part of that, so its formalising what we found from other buildings, best practice, things which we need to avoid, feeding that into the design stages, I mean, I would want to see highlighted areas coming through in our design guide which would then go to contractors, so you could start to build a working document after each Post-occupancy Evaluation where you got things which are coming through, I suppose its how its done again, you know, there is going to be a lot of information over time with buildings upon buildings
5	S1	A design guide
6	S2	I think it is necessary, because what you are doing there, we are thinking of updating ours at the moment, at the moment we've got, more principles, although all teams across Estates have fed into that, some in more details than others, and actually, I'm thinking we need to put a bit more specification about, well you have to pick your battles, but some are very particular about light fittings for example, so its making sure everyone is aware what works for us, and the things that don't work, and putting them into a guide that contractors and consultants, so that the architects will be able to see at the early stages, and we could feed all of this lessons learned, Post-occupancy Evaluation into the design guide as a working document so you are

		constantly documenting what works in very specific way, otherwise its quite high level, why does it work in that way, you know actually starting to specify in what way does that not work, what does work, in a document that we are then actually giving to architects and contractors to say, this is what we want for our buildings, if you deviate we need to know, if it is value engineered out, we need to know so that we are preparing ourselves throughout the lifecycle of the RIBA stages
7	S1	The next point within the preplanning phase was the addition of a node requiring contractual agreements with development partner regarding cooperation with the POE
8	S2	I think as we are developing... we have coped in the past with not having them, but the reason we wanted to have soft landings focus was because we weren't learning for past mistakes, and potentially not building on best practice, a lot of the information would go with whoever had done the project, we got some churn, so I think it would be beneficial, how you apportion the value of that retention if it doesn't get done, I don't know, certainly for a POE, we have other areas that if they don't finish, the construction or something like that, that's going to have a higher impact on occupation, because that is the main thing, business as usual in making it work, I'm not sure we would be able to justify being on an equal par to that but it might be part of it
9	S1	Not the key consideration in light of that relationship
10	S2	You know, I think in our experience, it depends on the contractor, but they can waive off 10% quite easily if they want to get off to another project and not bother, so it can help, more often than not we have found that it's the pride in the building that will drive them, so it is a positive motivation rather than the money at the end, actually having their name against the building that's worked
11	S1	More reputational
12	S2	Its reputational, I think it really makes a big difference, and you know, winning bids for subsequent projects, you know Coventry is growing exponentially, its really really growing, it means more to us. As soft landings develops, hopefully that kudos and reputation with doing it properly, all the way through, not just with Post-occupancy but all of it, they would want to be part of that
13	S1	The next point is the addition of a node detailing the requirement for reviewing previous POE reports
14	S2	Because we are just going through our first one at the moment we haven't, even the process we have started I don't think we gone back through lessons learned, I had a look at other POE's, to get a sense of not just the methodology, but the focus in certain areas that they wanted to look at, but I think it is definitely something we would need to do, I don't know how that would look at the moment, I think if we are clear what the key areas are that we want to focus on, and we are reflecting on what information we've got from those previously, my only concern, and don't know if I've misunderstood the purpose of reviewing your previous post occupancy evaluations at the beginning of the next one, would it bias the outcomes, you know if you are

		looking at previous ones, would that make you... because its done isn't it, the building is built, they've occupied it, so the information they have got is the information they've got, whatever you are bringing from previous, I don't know if I've misunderstood
15	S1	This node is supposed to represent the reviewing of POE reports at the outset of a development, with the cyclical POE process happening simultaneously to the development, across the different development gateways
16	S2	Oh I see, I've misunderstood, yeah, oh no definitely, I thought you meant before actually planning your post occupancy evaluation at the beginning stages, no definitely, that the point isn't it, for designing better buildings, learn from mistakes, it crucial, as I say our design guide, I think it would be a working document based on some of the information we've got out of our lessons learned doing post occupancy evaluation we would put into that, and that would be shared with perspective consultants and contractors, so they know in terms of the detailed specifications, you know, what we expect, and then we've got the rationale with the post occupancy evaluation of why, so we can challenge if they decide not to go for certain design or...
17	S1	The next point regards the additional node for the inclusion of services, ICT or AV strategies
18	S2	Absolutely, but I would say, we have this with BIM as well, so we've got clash detection and things like that we are developing, but I would say that needs to run throughout, because we can get to a stage down here, where we've got furniture, and we are constantly finding that we're just not aligned with how we install furniture, so this sort of thing, we haven't planned, you know, who's actually going to be plugging them in, IT don't do it, the suppliers of the furniture don't do it, they assume someone else is doing it, so I think that all the way through we may not have talked about FF & E at that stage, we won't have furniture potentially at that stage, so those conversations need to be had throughout, and even when we are talking about the client later on, the people who are going to be occupying the building need to still think, because they may have strategy of how they are using laptops, they might all of a sudden be thinking actually we are going to have a lot more laptops, we are going to have people doing agile working, they've started to think about using the building differently, we have different Wi-Fi needs, or something like that, so yes, I would say the IT and AV strategy are important throughout
19	S1	So it's key to delivering anticipated performance to end users?
20	S2	Yes because it doesn't start and stop at the design stages with IT and AV, there are just so many different people who will be accessing that, its not a static.... So some of it will be static design, but you have so many bits that are coming in later, that may not be part of the building design itself, but will be a user, key to the user, certainly you would review the AV and IT early on
21	S1	The next question refers to the planning phase, with the first point regarding the separation of the theoretical and practical planning, essentially developing the overarching strategy for the POE before the

		developing, for example, specific questions for surveys and focus groups?
22	S2	I think that is incredibly useful, you know, the HEFCE at the moment, because it is so sort of high level, and you can kind of pick out what you are doing, there is some freedom there, for a newbie who is just developing this, I feel I've not gone wrong because we are developing our own, but I feel more structure would have been useful as we were developing our strategy, especially if it is something we are learning from best practice, if other people have done it, and they are finding... actually one of the questions I had is, when we are doing a post occupancy evaluation, when is the best time later, is it twelve months, is it thirty six months, you know, so things like that, just having a bit more information for what works for that would be good, but yes planning ahead, the only issue with this I find, if you are too prescriptive with dates, even months, is that building projects shift, so it is good to be prepared and know what you are going to do, and set it up and know who's doing what
23	S1	A little more leniency on the time spectrums
24	S2	Yeah maybe, but then you've got that haven't you - 9-18 months after handover, so its all about handover isn't it
25	S1	Yes
26	S2	The other thing is what we mean by handover and PC, we've had buildings where people have occupied them but technically, some of the aspects like heating and cooling haven't been, we've had problems with how to get people in there and using the building, I don't know how that would fit with that technically, but in terms of our building performance, it hasn't functioned in the way we expected it to, so we've had to delay the post occupancy evaluation to get the right.... It will depend on each building because they are all different aren't they and you have a different set of circumstances, but I would say for this as I'm applying it, I would think about the relevance for each building, so we've delayed slightly one of them because we didn't have included that it was commissioned at the same time as the use of the building, so we have had to park some of that data, and just rely on occupants views of how they are using the building
27	S1	Is there opportunity if there are delays, to collect richer data?
28	S2	Yes there is that, but if you leave it too late you've lost a whole year of students, what they knew before, and if that was helpful, and people do forget as well, they get used to it
29	S1	The nest point refers to the reduction of choices permeating from the POE process
30	S2	No, I think it makes more sense, again I suppose similar to what I said before, its nice to have flexibility, because you can do as much or as little as you can manage, but at the same time, if you're going through a process where you are doing POE's for every building, I think having all of this information done in a structured way is a lot more helpful, the danger is you do these different ways around, lacking consistency, and there will be a rationale to why these are done, these different points, so it is understanding the reasoning behind that as well

31	S1	The third stage certainly requires a structure to review previous findings and supplementary information
32	S2	That would be really useful, and I hope that we do do this, it might be down to resource, if we don't, in terms of can we? I think it would be useful because it that future, buildings are around for twenty or thirty years, so why wouldn't we want to continue to understand how future proof they are, we design them to be future proofed for flexibility, its one of our big aims for spaces, so we've got to test that, and feed that in, I think that would be really good
33	S1	The next point regards the removal of review and evaluation selections and replaced with three pathways
34	S2	It would help, I think it would be enormously helpful, for me, coordinating with that would be my soft landings plan in terms of when I'm doing that, if I've got several building that I am having to manage, I'm having to make sure I manage my resource, and potentially the contractors in terms of, you know, this month we are doing this for this building and doing that for that building, but actually the danger is with a selection where I don't have that planned out, that it gets forgotten
35	S1	The next points regards the implementation phase, as in particular the relatively few modifications
36	S2	Could you remind me what that means (implementation phase), is that actually doing it?
37	S1	Yes, conducting focus groups, dispersing questionnaires and so forth
38	S2	I think going back to. Just taking a step back in terms of planning it ahead, this makes the implementation a lot more possible, so getting diaries, knowing when you are going to do something, if it is during the summer holidays, you are not going to get as many academics for example, so the actual doing of it really relies on cracking the planning stage right as well, little things like reminders having set text, to send, for whoever is sending out the survey or reminders, so what we did recently was tell people that 50% had completed the survey, which is great, if you haven't already, please do so by this time, so little things like that to just really reinforce that that is happening, that people need to take part in that, its about engagement isn't it, its making sure people, because there is a danger of planning and sending out invites, and then everyone has forgotten or don't really care or whatever, to make this happen you need as much engagement as possible, so maybe some tips
39	S1	There is something around the interaction with participants
40	S2	Its contextualising what they are taking part in, but again as I say, a lot of that could be done here when you are checking, making sure everyone is still available, that you've planned it at the right stages, that suite staff, possibly students, I mean you are getting your data from people, you are making sure those people are available to give you that information, so just re-contextualising, people will have forgotten what you are asking them to do, so some sort of reminders, I don't think there is much more, its what you are doing... its all about the planning, always isn't it, finding the spaces - maybe something after, to thank them or acknowledge the importance of engaging, it

		just that kind of client relationship bit, I think we have to be clear when you are getting the information from people again what it is that you are asking, are you asking so you can develop better buildings in the future, or do people think you are asking because you are going to fix the issues in that building, and that is one of the things I'm finding, people are really happy to moan about a building that they are in, and they will tell you because you are in Estates, but actually in my mind, I'm thinking next time we'll do it differently, and this is how I'm going to feed it back to the development team blah blah blah, but in their mind they are thinking, I'm giving her all of this information, you know, how do I know that in 1 week, 2 weeks, 3 weeks, that heating I've been moaning about, or lighting, what is going to feedback now, so it's making clear why you are getting that information, its what you are doing, and not making false promises
41	S1	So end-user need to understand the purpose of the investigation, so not to unnecessarily raise expectations
42	S2	I think so, because the danger is that, you know, I'm just used to this from talking to people and asking generally about how they are getting on in buildings, they will rant, if they have an issue and there will be some positives of course, but where you have a few people who just want to rant about the experience of the building, that's great, that really good information, but what do they want out of that, it's almost like a transactional relationship, you're getting information out of them, but what do they need back after telling you all of that? Is it just a thank you that will avoid all of that in the future, is that sufficient, or is I'll see what I can do with the issues have at the moment and I'll take that back, so its making sure you are ready if you are making promises to people, to help them or it's a relationship you have lost, there is a reputational risk within Estates, on subsequent building projects they may be part of. You can't promise you are going to solve everything, I've made it clear in focus groups when I have met with staff, I met with staff quiet close to handover, maybe six months I had a meeting to see how it was going, everything was still really fresh, and what came, what I learned from that, yes I'm understanding how this building operates and what we could have avoided from migration, for the next project but what came out of it was people wanting to know what was going to be fixed for them now for that building, so I had to kind of do a bit at the end to say, right I've highlighted the issues you're having currently and I'll pass those on to whoever, and make sure that I did that, and I would do the same thing again when either doing a survey or a focus group, to say ill pass this on to people, see what we can do, but it is not making promises as well - snagging for end users regarding design, not how well it is being managed
43	S1	So all snagging activities have to have been dealt with before phase two, if not phase two will simply report on the ongoing snagging issues
44	S2	Yes, it should over time, you should reduce that snagging more and more and more, you might just get a couple of bits but it depends upon

		what it is, if its things like lifts it has a massive impact even if it is only one snag
45	S1	The next question refers to the augmented knowledge management phase, the first point regards the dissemination of POE findings to applicable internal personnel
46	S2	Yes, absolutely, yes all of the managers, assistant directors, directors, what I'm getting a headache over at the moment is some kind of matrix to get all of the summary information into a spreadsheet or something where people can select for themselves over time, they can go into this document and think, right let's have a look at the post-occupancy evaluation report on M & E, they may wish to look at a specific strand type of design, they don't want to go into every single report to read that, it needs a matrix for all of the important information, I don't know whether to do that for lessons learned, probably just sufficient to have it for lessons learned, or to have it for post-occupancy evaluation, I don't know yet, its causing a headache wondering how to bring all of that information together, so people can select based upon what type of question, rather than the specific project
47	S1	So as opposed to an executive summary?
48	S2	Yes because, if you say this is for the director of ops and maintenance, and you wanted to feed into the development stages of a new building, and you wanted to draw upon all of the different experiences, even new or relatively new, you want to draw upon all of the experiences from other projects, where do you get all of that information, you aren't going to read every report that goes back, you want to draw out your bits that are relevant to you, so for me, it's kind of, how do we harness the information and feed it back, at the moment its very iterative, we are just thinking about the last two, and that gets fed into the design stages, so if it is student accommodation, we think of the last two and the mistakes, building on what we did for the last ones, but for me we are not thinking of the ones we did a few years ago, there is almost too much information, how do we get it right, so that key people who are feeding in are able to extract that information and use it in a targeted way, I don't yet have the answer for that, so yes the key people who get the report, at the end, but I would want to see that fed into some kind of matrix, that can then be used later
49	S1	The nest point regards the dissemination to external development partners
50	S2	Yes... yes... yes so during the design meetings, there is a lessons learned process where we are bringing through, as I say, the last three or four projects, and they are talking about that, I haven't attended one of those and I really want to, because I haven't seen the level of conversation they have, and whether it is just anecdotal, because we don't have anything to draw upon yet, I am just starting to develop all of that, so I would be interested to know what level of conversation they are having and the specific details, because it depends upon the project manager as well, and their memory and what they have chosen to cherry pick out of what we learn from... whose experience, its great if you have people who have been around for a couple of decades,

		<p>who are really good at casting forward that information, or who talk to other project managers in their team, who all have a joint understanding, but what happens if you had churn, you've got people who aren't experienced in that project, or they're bringing experience from another project, which could be useful, it's just tracking it I suppose and making it consistent, also making sure that in those design meetings, its recorded and that is what I would like to see, and those are the questions I am asking at the moment, in our design guide, the information that we are using says this is what makes a good building and what helps work for us, if they are not doing those why are they not, so its just bringing to life the design guide based upon experience</p>
51	S1	<p>The next point refers to scheduling the dissemination of findings before actions and recommendation</p>
52	S2	<p>I suppose it depends upon on what actions they are, I suppose if it is that xyz about a certain feature, depending upon procurement rules, if we can actually specify certain types of lighting we are avoiding, so I don't know what actions there would be, you might have actions as you say from building users on that particular building that you are doing, I guess one of the things at the moment I am really trying to fish for is a senior director buy in, just to make sure everybody is actually taking it seriously, with the lessons learned and post-occupancy evaluation, because the danger is as soon as we get into the swing of feasibility studies, we've had sign off for the budget and the design, it starts picking up speed really quickly, so one of the things I would like to see, I haven't seen it on here but it might be on the RIBA, is Estates sign off, so at each of these stages, there will be, we are doing a formal stage sign off, as part of soft-landings where we have got key stakeholders who come to a presentation meeting, they have received a copy of the report, they should take responsibility to read the report, even if it is just their bit, and to formally sign off that they are okay with the design at each of those stages, so I'm not sure if maybe if some of the information from a post-occupancy evaluation comes through that, remind them, we have done this because that was what was said at the initial stages when we were talking about lessons learned, that's why we have chosen this design and not that, maybe that could come through, and maybe talk about stakeholder engagement - the design changes, it can change really quickly, we get design value engineering, which can impact all sorts of people and is often communicated, people late down the line are angry about that, so I think there is an action where everyone starts to interact with the design in a formal way, and understanding why the design is the design, but feeding back to lessons learned and post-occupancy evaluation in the first place, so you have that thread running all the way through, understanding why we are doing what we are doing, why we are avoiding certain things, but it is running all the way through, not just at the beginning</p>
53	S1	<p>The final point of the augmented knowledge management phase is the preparation of findings for feed forward to other projects</p>

54	S2	So we will have a plan of work which is basically RIBA, and it is sanitized a little for Coventry University, there will be part of this on here where they do do a schedule of lessons learned and then bring in information, again it is what that means exactly, how we go about doing it, so it's already in there that we do it, I'm just not quite sure how, and to what degree, but I think what would be useful for me, I'm not suggesting, what would be useful would be some way to bring it all together for reference, so a document or a matrix, something that you can get all of that information that you can feed it in from the reports, the key information, and access it much more easily in those sessions where you are reflecting otherwise you have like twenty reports, are you going to read every single one of those before you go in every single, that doesn't work that easily, you've got condensed information, you know, the learning from experience bit, that needs to be harnessed, in a palatable way, so I am struggling at the moment.
55	S1	Not to mention project team changes over the course of those reports
56	S2	Absolutely, you might have had 50 project managers over that time or more, it's about harnessing that experience in a way that you can select easily. We are thinking of splitting our design guide, at the moment it is principle level, I'm suggesting that we have high level design guide, and one that is just about specifications, so all the teams feed in their particular specifications that they want to see, you know picking their battles and not being too prescriptive with everything... you know because you could just go nuts, our procurement wouldn't like that, but having two documents where you can just start to apply it the more that you are going through design, when they start to look lighting, or heating, or cooling, they can refer to the design guide to say they are saying about lifts, heating, or cooling, this is what we need to do, this what we need to avoid, does it fit with the budget, is that suitable to this building, and that design guide can be built as a working document from the findings of the post-occupancy evaluation, so its constantly feeding through, and then when you've got the stage sign offs, what I'm proposing we do, where there is any deviation from the design guide, the consultants can then say why? It a lot easier than reading the final report, and saying, right, where did they deviate, furthermore how does this impact? - applying the knowledge.
57	S1	The next point regards iterative improvement and benchmarking, do you see the changes to the process making these objectives more or less achievable?
58	S2	Ye, simply because it is more prescribed, with the HEFCE process you could, you know, there are a lot more options, you could choose not to go own some of those routes, or ignore some of it entirely, this is more prescriptive, so you have to follow it, you are more likely to get consistent information - the only danger I suppose, and it depends upon each individual organisation and how it is resourced and constructed, it may seem more onerous, so you would have to think beforehand, are we going to be able to do this, within the contract if we ask someone else to do this, or are we doing it ourselves, I think unless that in its self, if that's not consistent, then the process may not

		work, so you almost have to say from the outset, if it is an external organisation that is doing the POE, you have to kind of give them this and make sure that is in the contract from the beginning to say, you are following our process, but I think that would help, if you were to say 'just follow HEFCE guidance', we are less likely to get the consistency. It also depends on the relationship, but having something a little more prescribed, yeah you are going to get that consistency, but if you pass it on to someone else...
59	S1	The final pint regards the overall synthesis of the process with the RIBA work stages
60	S2	Absolutely, massively, we use RIBA... my soft landings plan of work I'm fitting into the RIBA stages in terms of what Estates do as well, it's all consistent, it's got to be.

Appendix 8 - Validation Interview Transcript 4

S1 - interviewer - Chris Roberts

S2 - interviewee - Invigour (POE Consultancy) representative

Comment no.	Speaker	Transcript
1	S1	Having just presented the model, do you have any general comments?
2	S2	Yep, well I think that all makes sense, you've taken me through, useful to start with the HEFCE process map like that because, you know, its always useful to try and crystallise that, and then I get what you have done with splitting it down into phases, and I really like the fact you've put it into the RIBA plan of work, that's all good, yeah.
3	S1	The first four bullet points refer to the planning phase, the first bullet point refers to the organisation of the preplanning phase specifically to the first three 'gateways' within the RIBA plan of work
4	S2	So you are taking about the RIBA gateways one to three?
5	S1	Specifically, yes
6	S2	Yeah, well so for me in simple terms that sort of pre-planning application isn't it usually for a construction project, so I know that RIBA's 2013 plan of work starts to promote the thinking about handover strategies and so on, it tries to map them across the whole seven stages of the RIBA process which I think is useful, I haven't used that to any great degree, but in a project recently that I was working on, I have to hold my hand up, I didn't actually get very far trying to populate a handover strategy at the early stages of the project, and with hindsight probably should have pushed the architect and the design team a bit more to think about it, but I didn't see it as an absolute must have at that point, so I think it educating people like me and project managers and so on about the benefits of doing something early on, but in terms of, I'm just trying to think what one might do at the early stages on... it's a bit like planning for soft landings, so planning for soft landings early.... I can see your principle works for planning of your post-occupancy early, so I suppose it means working out what it is that's going to be important to you ultimately to evaluate, but it is a long way off at that point usually, at stage 0, 1 and 2 in particular, so I suppose my comment is, I don't readily see what you would do at those very early stages, but I'm sure there is something, if I spent some time thinking about it a bit more.
7	S1	The next point is the addition of a node in the preplanning phase requiring contractual agreements with development partners regarding the undertaking of a POE, and their cooperation to it
8	S2	Well there you are you see, that's terrific, you've just found a really good example which I have started to do on my projects, I have started to make sure that the duties for the professional team and contractor, there is a expectation that within the fee bid, they will contribute to a POE, so that's great, there are things which clearly need to be done

9	S1	The next additional node requires practitioners to review pervious POE findings at the outset of a new development cycle
10	S2	Yeah, absolutely, have never come across it done, and I am now having to say, why don't I ask that question at the beginning of a project, so I am working on something at the moment where the client has just got to the end of a fairly meaty construction project, and I'm now appointed to do the next one, and I'm saying to the client, who's in the middle of handover issues and all of that, at least it has been a good learning curve for you and chance apply it, but actually, if I said to them, can we please review and evaluation findings from the project that you are finishing now, I don't think there would be any other than starting from scratch and going and interviewing the team, almost doing the POE, does that make sense?
11	S1	Yes absolutely. The next additional node pertaining to the inclusion of services at the preplanning phase of the POE
12	S2	I'm not one hundred percent certain I've understood that question, is it about problems with the AV installation, its taken too long, there has been poor feedback, then are asking?
13	S1	The services, ICT and AV for instance are crucial to the operation of a university building, as such, service feedback is included with the objective of minimising any potential snags or delays for example
14	S2	Yeah, which come back to a point we touched on prior to this interview to starting, around a design guide, so whatever the IT equivalent is to that within the business, if the IT department is going to be the custodian of that element of the specification of the building, then maybe that sits outside the design guide but there is a reference, cross reference to it, or should it be the same design guide as the IT section of it, to use the example we were talking about before, before we started the formal interview, if a window has been installed that is too heavy for member of staff to actually operate or something, then where do you capture that, so that if the next project... I mean if you have the same architect, project after project then you would hope that they would learn, but there is no guarantee of that either, different individuals, so it is the repository is suppose where that knowledge resides, so the process sign posts the project manager to actually look at that, and I think that probably applies to the AV as well.
15	S1	The next few bullet points refer to the planning phase, firstly, do you have any comments regarding the separation of theoretical POE planning, or a strategy for the POE, form practical POE planning, what will actually transpire?
16	S2	Yeah, good practice for me is to be preparing a briefing note for participants, to send it out to them, you know, a reasonable time before the review to explain what the purpose of the review is, what you have been asked to do by the university, and to just put them on notice essentially, and if there are any inputs required, to ask for them. Generally I find I'm asked when the project manager has a fair degree of confidence that they are going to have the output of the stage gateway, so either a design report at stage three or whatever it is, and I receive that, so I need some time to assimilate that, think about questions which need to be asked during the review itself, so that

		element of planning definitely, then there are the more practical considerations of, you know , where is going to be, can someone organise the sandwiches
17	S1	The next bullet point refers to the reduction in choices presented to the practitioners through the model, do you have any comments?
18	S2	Yeah, I think generally I prefer what you have put down here as a clear sequential set of stages, which is... I think you need to do this first stage 3-6 months after handover, and that's more about timing... the sensitivity around the timing is more about delivery process than it is about the performance of the building, the risk if you don't get in there and do it at the right time is you've lost the key project personnel, they've moved on to their next project, they've forgotten all of the issues, so I think there is a right time to catch that, whether that is quite so sensitive to glean information on the performance of the building, probably still into testing and commissioning of services at that point, so whereas later the building has had time to go through a full annual cycle and so on, so it more about... its less important to collar the people who were there, more important to collar the people who are using the building if that make sense... so I like that - I'm not familiar enough with the HEFCE pick and mix to do a compare and contrast but I'm comfortable with that
19	S1	The next point refers to the removal of the review and evaluation selection points, and replacement with sequential pathways
20	S2	Yes, I prefer the staged approach to the flexibility pick and mix.
21	S1	The next question refers to the implementation phase of the model, and the deliberate lack of alteration
22	S2	I think possibly, part of the reason for that is that I've never actually done anything between RIBA stage 4 completion of design and POE and the completion of the project, there have not been any interim during construction reviews, which is quite an interesting point in of itself I think, so the one exception to that is where the contractor has only ever been... no I think twice in probably seven or eight POE's I've done for the University, and two of them have involved conversations with the contractor, but those have tended to be gateway reviews about the other stages, so I think it is about... is there an argument for thinking about combining interim POE with a gateway review through the process... if that makes sense - a live feedback mechanism as opposed to feeding back at the conclusion of a project, actually I'm sorry, I may have confused your implementation phase for the POE with the existing implementation phase within the RIBA stages, is there a method structure - use of focus groups over one to ones, I find one to one conversations with key participants, the key players in the project is really helpful to try and get people a bit comfortable beforehand, identify the issues, make it clear that it isn't a persecution, this about knowledge gathering and so on, and then by the time you get into the room together, if indeed you do, because I have done some POE's purely relying on one to ones
23	S1	The next question refers to the augmented knowledge management phase, the first point regards the dissemination of POE findings to all applicable internal personnel

24	S2	Yes, I think the first thing I would say, is it is really important to give the participants something back, and I am aware there have been occasions where that might have been promised and not delivered upon, on one occasion I have had to because sensitivities, I have had to do an executive summary for that particular purpose, to be shared with some of the participants, so I think one of the big first questions is, how open are we going to be with the dissemination, does it contain sensitivities that mean it shouldn't be widely shared, and dependent upon the answer of that question, it probably would influence the way the POE is written up, I suppose I write mine on the assumption that its likely to remain internal, but it may be disseminated further, it a bit of a cop out really, neither one thing or another, the cautious part of me would say, if I was trying to write a process for this, I'd probably be more comfortable saying the POE is produced and disseminated to those who have commissioned it, they then make a judgement about how it is used, where it is shared, I would have an extra step in the process, which is the feedback to the participants, and if that needs a bit more work to tailor that, or take some things out, or do some redacting or whatever it is then...
25	S1	Do you see any linkage between information that is considered sensitive, and information that is considered to be value adding?
26	S2	Yeah, so for example if there is some criticism being picked up on the performance of a key sub-contractor on the project then the recommendation might say, as it has in the past, the recommendation might say arrange a supplier performance discussion with that, which is all fine, but to actually send that out to the full design team, contractors and so on, is I think not necessarily the right thing to do
27	S1	If they had signed up at the outset, could it not be argued they were aware that this oversight would occur?
28	S2	I'm not sure, when do you get into defamation and all of that sort of thing, yeah I'd be a bit cautious about that
29	S1	The next point regards the dissemination of findings to external development partners
30	S2	Yeah, architects would be more interested in elements of the design or products, I suppose project managers and so on will be more interested in whether they made the right judgements, whether they should have tackled an issue earlier and so on, so I think there is some sort of behavioural performance learning in that, should someone have called time on a project earlier, different parts of the POE probably mean more to different participants, so again I'm not suggesting you tailor it, tailor the feedback to that extent, but I think for me, one feedback to design team and contractors who have given commitment to it is probably... feels like the right level
31	S1	The next point refers to dissemination of results as a mechanism for insuring compliance with the actions and recommendations, if indeed you agree with actions and recommendations?
32	S2	Curiously, I put both in mine POE reports, so I have a conclusion and recommendations, and then I have and actions, a follow on actions, why have both... I think it is useful to a series of actions, that the institution can actually do them or not, and you can see whether they

		have been done or not, whereas the conclusions and recommendations might just suggest why something went wrong, or might have been better. I think it only becomes obvious if someone is given time to go back and questions whether all of the actions have been implemented or not, that's a great question, unless somebody within the institution is charged with that responsibility, the likelihood is it probably won't happen unless it is such a compelling thing that it makes sense for someone who's going to benefit from it, that they grab it and do it because it is fantastically useful and beneficial, its something that involves them in a little bit of work and effort and so on, then you might find they are disinclined necessarily to prioritise it, from the institutions point of view, it might be really beneficial, but maybe not for the.. otherwise you are just relying on... I suppose the other thing is the actions are not necessarily attributed in my reports, they are just a series of actions for the institution to work out what to do with and who to... is there an institution wide QA system that actually requires somebody to look at conclusions of POE's and make sure actions have been addressed, even if they haven't been implemented
33	S1	The next point simply regards the preparation of findings for feed-forward to future developments
34	S2	Okay, so the feedback would go back to RIBA 0 for me, if you are in the fortunate position of having... at the early briefing stage, you might be doing reference visits to other institutions that are being built, or buildings, or facilities to try and get a feel for what is in the clients mind as a vision, so equally if you are in a happy position of having some evidential stuff from a POE then that's the time to pick it up I think, so I'd have a feedback straight back to RIBA 0
35	S1	The next point regards the impact the cyclical process will have on the academic objective of iteratively improving future developments
36	S2	Yes in so far as its used... if the same institution is closing there and opening there, yes, but the question is, is it with one estate, or separate developments, otherwise you would have to rely on whatever feedback you've given to participants to take on to other clients and other projects and so on, I suppose there is... by osmosis or whatever the term is...
37	S1	Do you think the democratisation of findings would help, making them publically available?
38	S2	I don't see why not, is that the sort of thing that former Office for Government and Commerce, the OGC might have done for example, I don't know whether there is a new equivalent of that in central government, but why wouldn't the west midlands combined authority do that for public sector projects across the west midlands, clearly there is some effort involved, I can see the benefit, I don't see that sensitive information would make up anywhere near the majority of the findings, so yea I would have thought that learning would be really good
39	S1	Do you think the model will aid in the development of benchmark criteria across differing developments for direct comparison
40	S2	Well its difficult for me to comment comparing one to the other, only lack of familiarity with the key process, because from the beginning

		<p>working with the university we agreed we would do a bespoke POE, which I know doesn't help in terms of organisation and benchmarking- I think the challenge there, and I found it when trying to do three POE's for three major assets that came together more or less in the same window of time, the challenges is exactly how to express the KPI, so are you looking at total project cost, or are you looking at overrun, or are you looking at overrun that is contractor, an overrun for which the contractor got an extension of time so you are going to disregard some of that, so I think deciding exactly what it is your expressing and getting some commonality across that is probably challenging, I just remember having to make some quite tricky judgements about how to show the comparison data even for three projects within the same institution if that makes sense- to give an example of that one project was delivered inclusive of all the FFE fixtures, furniture and equipment, and the IT, with some exceptions of end use... applications and so on, that was all in the contract cost, on another project a lot of those things sat separately so weren't necessarily easy to get at, but I think you can imagine trying to write a guidance note for that, by cost we mean x, y, and z.</p>
41	S1	<p>The final question refers to the temporal organisation around the RIBA stages, do you think this will aid in increasing uptake of the POE process in practice?</p>
42	S2	<p>Yeah absolutely I do, if you get the RIBA to adopt it in there next plan of work update, that would be good, if you can't then it's a very good basis to have discussion with architects and engineers, for whom that it their lifeblood, yeah without a doubt I think it is really neat to put it in there.</p>

Appendix 9 - Validation Interview 5

S1 - interviewer - Chris Roberts

S2 - interviewee - Estates representative - University of Birmingham

Comment no.	Speaker	Transcript
1	S1	Having just presented the model, do you have any general comments?
2	S2
3	S1	The first question regards to the preplanning phase, the first point refers to the organisation of the pre-planning phase in line with the first three gateways of the RIBA plan of work, do you have any comments?
4	S2	So the definition of feed-forward from previous POE's, is that specific to the organisation, or is that specific to the sector, there are quite a wide range of focuses
5	S1	It would relate to the findings of post-occupancy evaluation within the institution itself
6	S2	That really helpful, because as you picked up with the BCU approach, that did change significantly based on our maturity delivering projects, so as the organisation becomes more mature in how it delivers a project, then this feedback loop becomes more aligned rather than just what went wrong, as you've picked up, there are a lot of activities around weaknesses, but not positives, and it was because of exactly that reason, we were learning how to do it, so having a structure like this is fantastic, that just gives us... we can just draw into that sector experience, rather than just organisational, it gives a head start, the stage you are doing it I think definitely there, the one thing I would sort of question is contractual agreement with development partners, that is very much defined by procurement strategy, so you can definitely have that conversation around design partners, but certainly not the people delivering the scheme
7	S1	So there would need to be a second point of pre-agreement
8	S2	Yes, which is more around stage 3-4, because what you will find is contractors specifically are becoming more much sophisticated than designers, so when you think about asset management, when you think about the model environment, even to clash detection etcetera, it's not your designers that do that, it's actually your contractors, you may have a novated service, but there is a split there at some point where some of that activity does very much need to come into the contractors world, rather than the design and client world. Services coordination, I don't know what experience you've had of working with consultants, they will do very high level strategies at this point, its probably not something that can come back in a feedback loop, unless you are talking about cost etcetera, technical solutions don't happen until you get the contractor involved, because what you will find, I do find particularly MEP consultants can be quite lazy, they will take it to the point of schematic, but the actual detailed design...

		<p>this is where you get a bit frustrated with the model environment, particularly around BIM, is you get designers that will take a model to a certain stage of maturity, they'll get slightly nervous about any PI associated with that, so a contractor will try to adopt that model, but the consultant is not willing to release the full detail, so you end up with a contractor having to rework all of the design models at the point we get to contractor award, so stage four, so there is a bit of... I mean if we can balance that out somehow so that its from learning at this point that allows us not to have to redesign or reproduce information at this point, it two very much distinct and separate activities, so you get to the point where you think you can articulate exactly what you want, and the a contractor telling you what its going to do</p>
9	S1	Its almost a repeat
10	S2	<p>Yep, I think the themes are correct, its just how we split that between what is a client led conversation with designers and getting into a client led conversation with the contractor.</p>
11	S1	<p>The next point is the specifically regards pre-contractual agreements with contractors which I think we have covered, to summarise, a second instance of contractual agreement may be required, one for design partners, one for construction partners</p>
12	S2	<p>Yes, an amendment I'd say, where this would really work successfully from a process point of view, is if you are actually talking about establishing frameworks with contractual partners, so if this process is imbedded with the framework and not the project, then everyone has a clear understanding from the outset that this is what needs to happen, irrespective of when you bring your contracting partner on board, it set out then as a procurement strategy, rather than just an activity picked up by a contractor at some point, and that's where you get your feedback, if you have a framework, its inherent in the next project then, you are working with the same people, that is what we are doing here at the moment, trying to establish a new framework relationship with all of our designers and practitioners, to very much reset what we want to do, not what we have done, within that we are embedding soft landings, which include post-occupancy evaluations, but also BIM strategies, its very much driven by what the operational needs are rather than, as you picked up before, these purist views that its there to operate the building, or its there to build the building, what we have certainly found working on various projects both at BCU and here, is that it is probably less effective to influence contractual aspects of delivering a project, its more about the outputs at the end, and information at the end, we talk about clash detection, the contract model still sees that as a non-cost, because you talk about a different way of doing it, but historically they have had to do it anyway, because otherwise buildings don't get built. So, having this clearly defined process they have to follow from the outset, and having it established in an almost pre-stage zero, that is the power of where this is really going to be positive.</p>
13	S1	<p>The next question refers to the preplanning phase, the first point regards a node stipulating the review of previous POE findings at the outset of a new development</p>

14	S2	Yep, so the key observation is, if you've done them before, its how you can feed off others that have done them, its sector related, take Coventry for example, if Coventry have been through this loop before, if BCU have, then its getting a knowledge base that you can start sharing, so it becomes a HE type POE, you can always follow that DNA through to other sectors, Government etcetera etcetera. In terms of framework relationships, I'm a big fan f building framework relationships, is that if you have partners in the framework with relevant experience from elsewhere, they can do that feedback, its what we are looking to do with all of our contractors is at the pint of project inception, almost before project stage zero, get them all involved at that stage, so keeping as a small group of contractors, only four on the framework, so they can feed in from there experience, because they aren't going to be able to get on the framework without the relative HE experience, what has works better
15	S1	So rather than a race to the bottom in terms of getting the best financial deal, its more about working relationships and previous experience, a best practice approach
16	S2	And then your commercial aspects come back in at stages three and four, that's where you can run a mini con off the frame work, but once those people have had the opportunity to input into the process, or input into the design
17	S1	The final point refers to the additional node requiring the inclusion of service considerations at the early stages
18	S2	Physical services?
19	S1	Due to the nature of HE, more along the lines of ICT and AV provision
20	S2	There are a couple of things we have done recently, a lot of it is learning off the back of BCU, we talk very much now about operational readiness, not practical completion, the industry still has the mind-set of practical completion, drop your tools, walk away, and it is was quite odd here, that was very much the language, we've got practical completion, walk away, but what that meant here, is that you have a building without furniture in it, you have a building without AV, you have some IT infrastructure, but certainly no network switches.
21	S1	A husk
22	S2	(laughs) what we talk about now is operational readiness, and the whole language around, okay, what gets us operationally ready, only part of that, sits on this journey, the extra bits are outside of that, so the what we are doing again through establishing frameworks, things like AV, IT and furniture all sit within the main contractors deliverable, so we've got scope for all of those things which get you operationally ready, and that's through that feedback loop of what went wrong last time, the things which are always going to throw you out are things like IT, just so fluid in what the technology is, its constantly changing, AV becomes an afterthought, and its so obvious when you walk into a room, like that (points at non-operational AV equipment), no coordination, this is where it goes back into the design cycle, if you can coordinate your AV and IT, you get a much better

		polished product at the end of it, rather than something that looks like 'yeah its great, you've got some architectural shots', but go back six months later, and all of the kit has been installed, you've got cable runs running across ceilings etcetera, you can avoid all of that pain, it becomes much more efficient as a conversation here
23	S1	The next set of points refer to the planning phase, firstly the clear separation between theoretical planning and practical planning, developing the strategy separate from inviting participants to focus groups
24	S2	No I think that is very good, if you align it with current approach to procurement, this sort of stuff means you can have the conversation with the main party involved which is the contractor, and once that strategy is set in, then it should be easier for these guys to take that forward.
25	S1	The point regards the reduction of choices at the planning phase, replacing choices available to practitioners with structured pathways
26	S2	Yep, if that still catches the same three things then that is fine, you've set you're structure at this stage, then that is fully articulated when you are having these conversations around the planning, that's in here, I think this is a much better approach. Would you be looking to standardise the approaches to these pathways
27	S1	Absolutely, there will be separate flow diagrams for evaluation pathways 1, 2, and 3, allowing practitioners a consistent approach to evaluations
28	S2	So would it make sense to combine these three diagrams to make one approach?
29	S1	There is a different focus at each of the integers, the first focusing in project delivery, the second focuses on end-user feedback, and the final concerns a strategic overview of all findings and supplementary information
30	S2	Well that standardises it, which will make benchmarking much easier, so it gives you much more useable data, which very much stretches the feedback loop. So as a client organisation you need to be clear on what you are after from the outset
31	S1	Also its unlikely contractors would still be around for the third stage of the evaluation
32	S2	Urm... well actually it comes back to this partner arrangement, and having a partnership in place, because what we are going to do here is run our frameworks for ten years, because what historically happens is you get framework, you establish a process that last four years, by the time you've gone through any serious development, you've probably got one project with one contractor, in that period, so you aren't really going to get any benefit from that, so if you retain them for ten years, and they are still working on other projects, they will be quite happily involved in this type of conversation, because they will always be brought into the conversation at this point on a new project, so that whole feedback loop becomes more energised, so there is a constantly moving element of improvement, with the same group of people. If there is an expectation from the contractor that they will be doing that, then there shouldn't be any issue with not being around

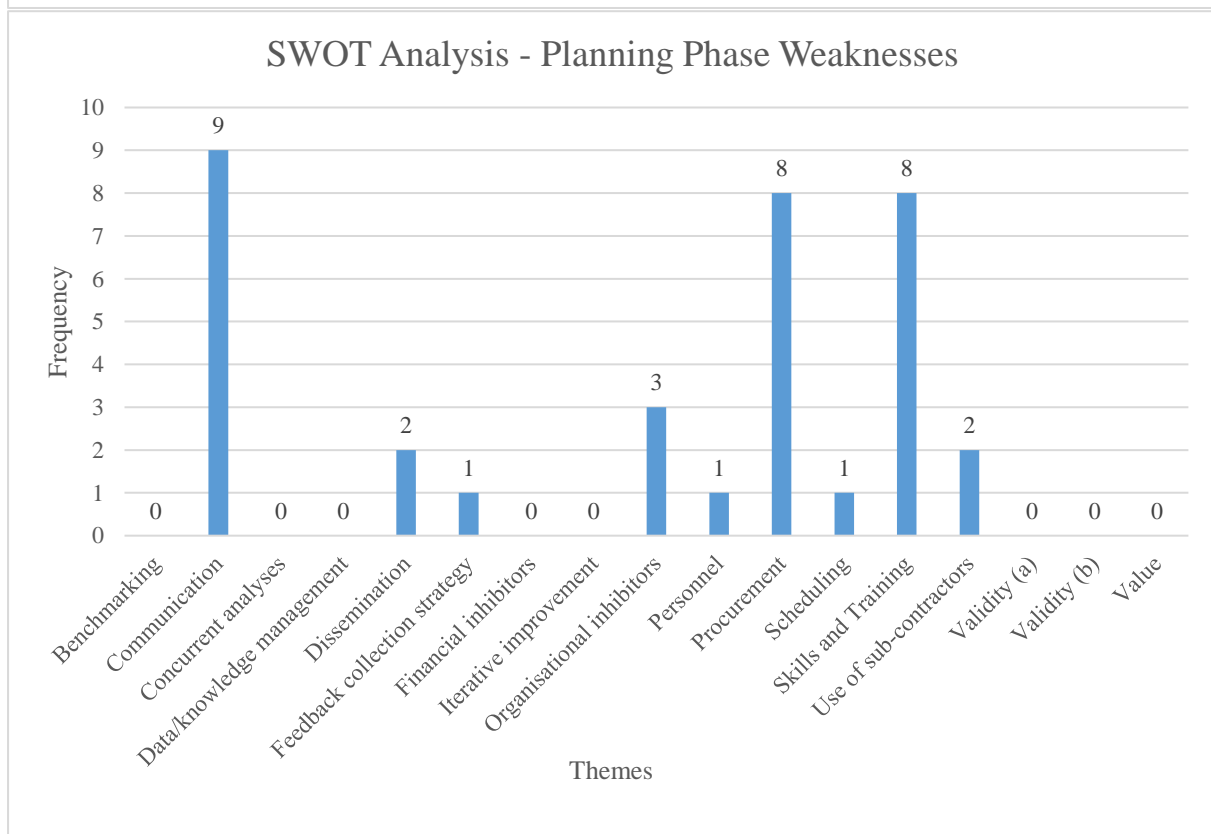
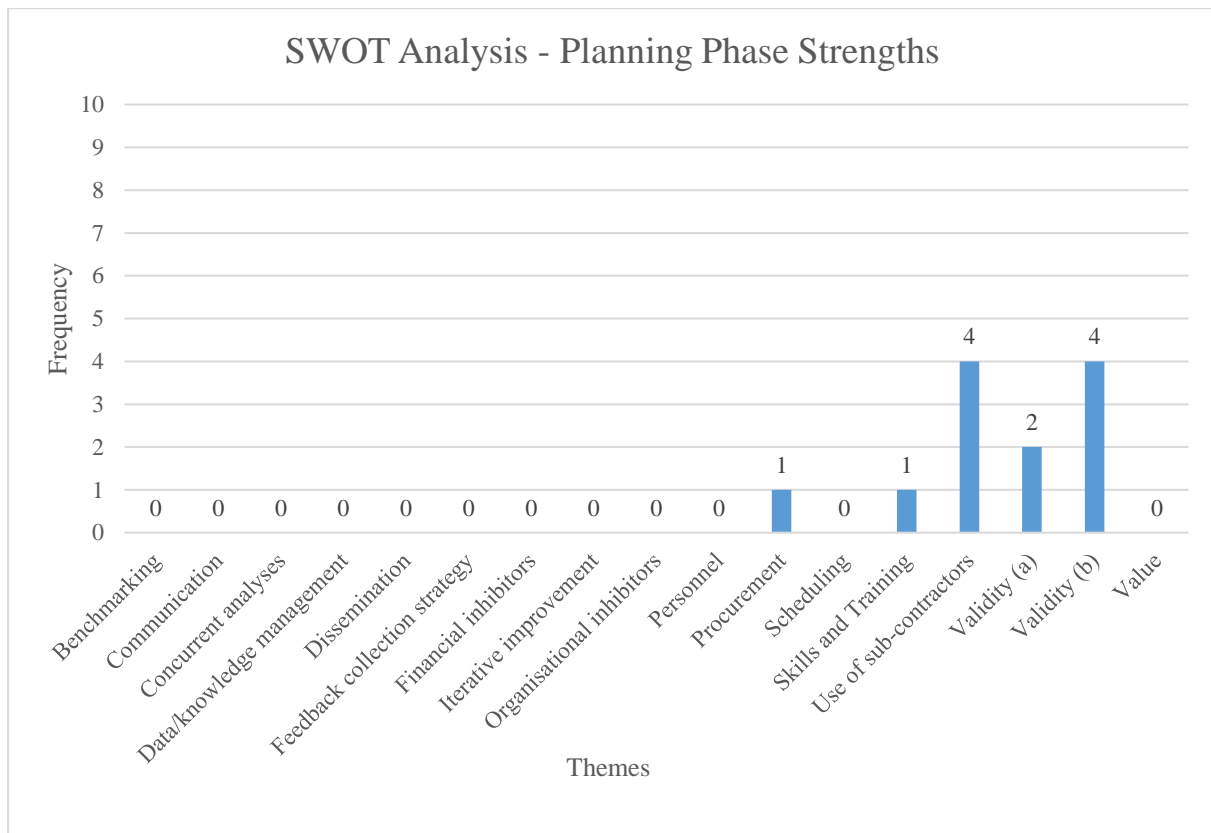
33	S1	The next point refers to the removal of the review and evaluation selections in favour of more sequential evaluation pathways
34	S2	Yep, it makes perfect sense
35	S1	The next question refers to the implementation phase, and the relatively limited alterations to it
36	S2	Its down to organisation isn't it, it makes sense, this would be familiar to most people, the only thing I would question is, three is definitely too early I'd suggest, you are still licking your wounds from what is never an easy process, so it doesn't matter how many times you've been through the process you will always have tensions and issues within that first three months, so to get the emotion out of the feedback you get, it probably leave it until that six month point, a bit of time to reflect and almost calm down, you do get a lot of tension within that three months, particularly where there is money involved and you are talking about retention, defect periods, etcetera, that's when you aren't going to get honesty from the team, so taking it back to the six month plus, you get a much better, balanced feedback, in all stages a process is needed for the generation of honest feedback, not just a group of people sitting patting each other on the back, because they feel that is what they have to do, because again you are talking about a contractual relationship with someone, an ongoing relationship, particularly with contractors and consultants will never really be honest in that environment, especially in that kind of environment, fear of exposure
37	S1	Mitigation of liability
38	S2	Yep, and then at the other end I would probably say five years is a bit too long, I'd try and keep that to a maximum of three years, because after three cycles of activity within the building... after five the building is no longer doing what it was originally designed to do anyway, everything changes in a building, it's a five year lifecycle, look at Millennium Point, it was never designed to do what it does now, even after three years it had changed significantly, now look at after twelve, sixteen years, even when we moved in, look at it now, its unrecognisable
39	S1	The next points refer to the augmented knowledge management phase, the first regards the dissemination of POE findings to all applicable internal personnel
40	S2	Great, do you see that happening?
41	S1	A newly developed mechanism is now in place
42	S2	Yeah, it's the best way to get your stakeholder engagement in the process, what I would say though, heads of departments, these aren't the people whom have the detailed understanding of what the issues are, so what you need to do is disseminate through not just the heads of departments, but the individuals who are likely to be involved in the next project, so its not he head of FM, it's the building manager, its not the head of IT, its the network designers you'd be talking to, so its how you bring the right level of stakeholder in, they are the ones who really influence the next building, not the head of IT,
43	S1	So its not as simple as disseminating out to department heads, it's a continual process disseminating down to the correct level

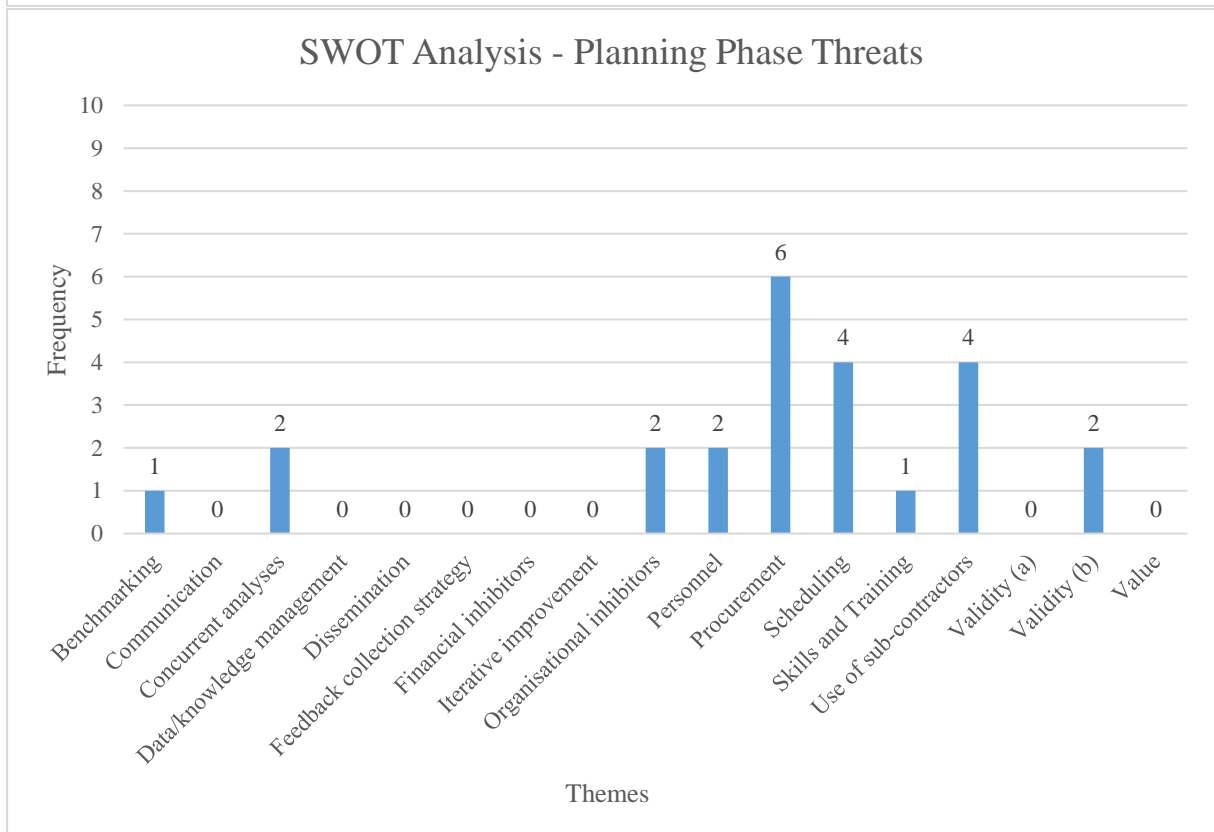
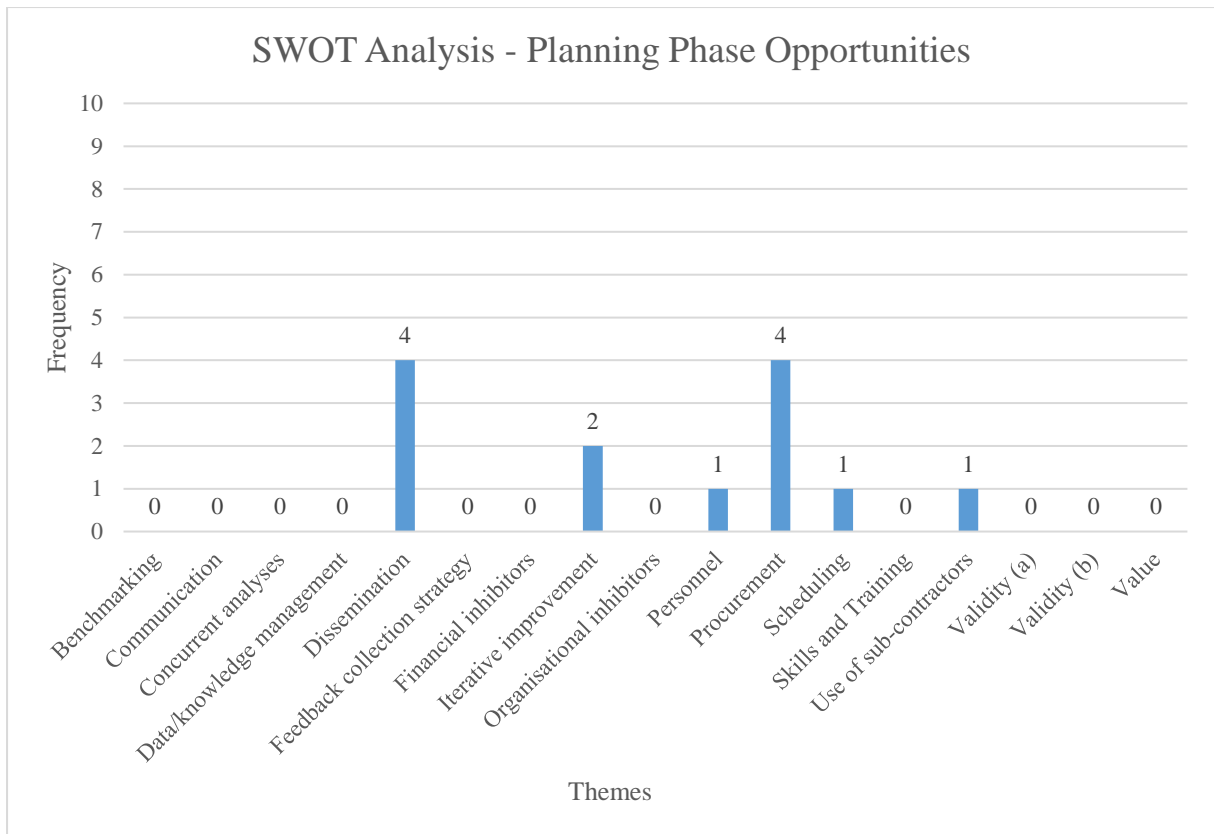
44	S2	Yes, making sure those people are actually involved in the POE process
45	S1	The next point refer to the dissemination to external development partners, those with which the initial contractual arrangement was established
46	S2	Yep, absolutely, they are the ones that will be delivering the next building that's wrong... [laughter], but not as wrong as the last one.
47	S1	Iterative improvement being the point
48	S2	Absolutely, the more you can guide them, the more recognisable the project will be at the end of it, the more you leave them to interpret expectations, the more disappointed you are going to be at the end of it, so it does need a strong client lead in that conversation to make sure that's not just the POE side of expectations that come through from where you want to be, rather than what the industry is likely to give you. To me this is more important than internal stakeholders, because internal stakeholders change quite a lot, strategies change quite a lot, so what you need to be doing is what the industry is currently delivering, which at least gives you something that is recognisable then. Look at Parkside as an example, the whole senior management team changed from the start to the end, same with the conservatoire, the whole team changed from start to end, so as part of the POE process, you need to make sure at each of these stages, you do get a structured process of signoff, so if things do change in the direction that the strategy changes, you've got a point you can bring it back to, you have a choice then, you either implement a change or you don't, depending upon where you are in the process, its either going to be a point of frustration or a massive cost, that was certainly one of the fears with the conservatoire, when Julian started, nice guy, but I think the team that were in before were quite challenging, it was quite refreshing having [X] come in, he could just be left to it, I think also got much better results off the back of that, kept the relationships quite strong
49	S1	To avoid identifying issues and failing to amend them, the dissemination of findings to internal personnel may act as a control mechanism, if it done before the actions and recommendations point in the process
50	S2	Do you have an example that sounds quite specific?
51	S1	FM managers, anecdotally hear of building issues as they are reported, despite in some instances the same issues having been identified in feedback reports
52	S2	It goes back to stakeholders, because what we specifically did, because at that point the Estates and facilities teams were separate, they weren't combined under one function, there was a bit of a challenge there, as there were two very strong directors, which didn't always have consensus of agreement on things - so this could be institutional. Getting back to the stakeholder, we'd get a named representative from the FM team as a sponsor for all FM related issues, and that worked really well, particularly for Parkside and Curzon, that person left at the end of conservatoire, and didn't get that continuity, so what I can guarantee is that all of those discussions did

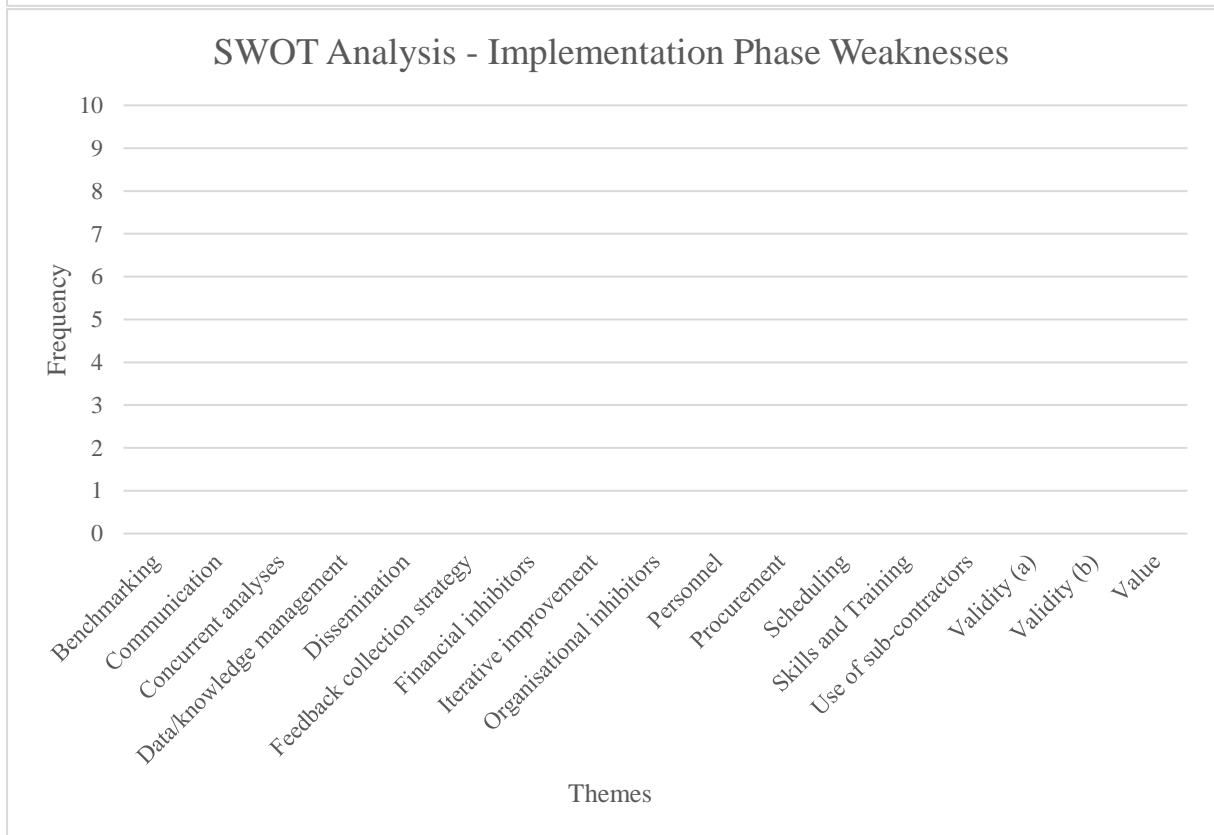
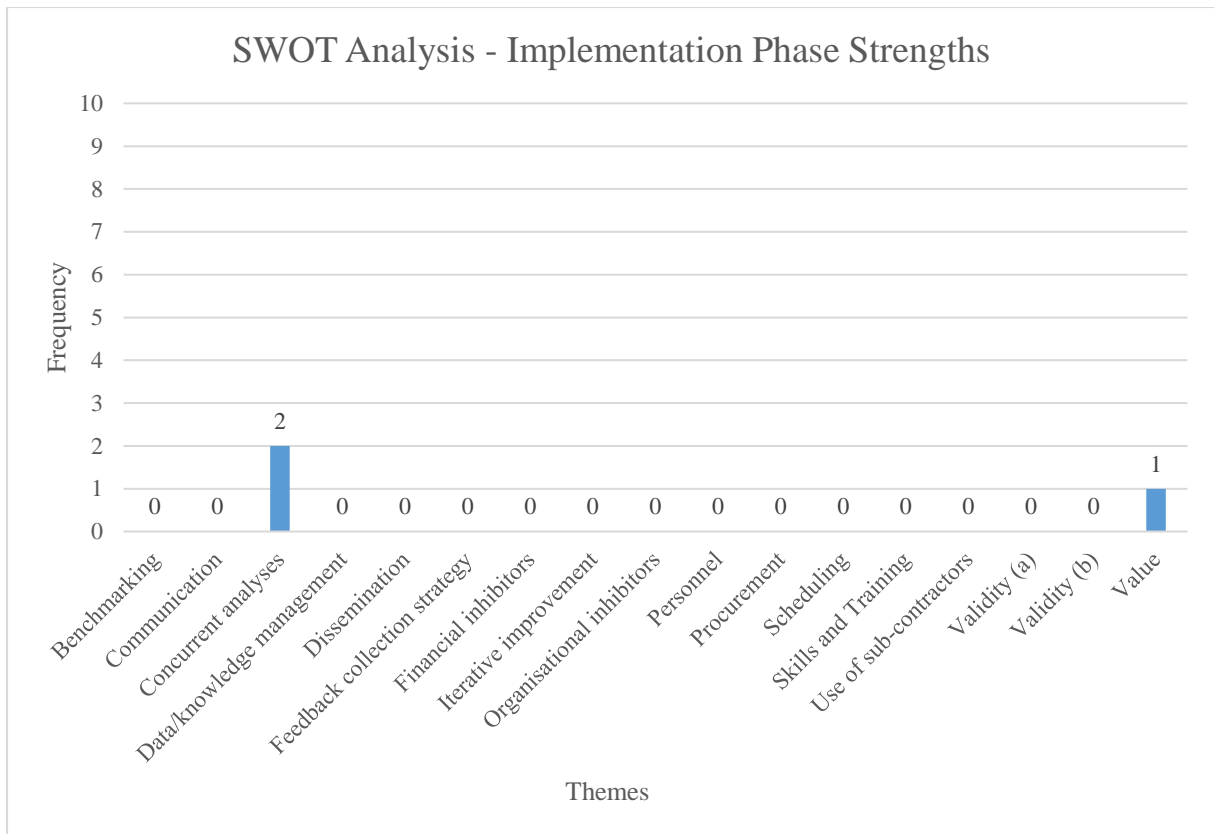
		<p>happen, what you probably describing now, is people not understanding what they had signed up to - at each stage a proper signoff is required. I think that is a very valid thing, we just need to understand as a client what it is we are asking for, and understand that if that is not right then we are being clear about what we are asking for, its half an FM person to understand that, because they will come in at the end of it and pick up all of the issues that aren't right, even though it may have been someone else with the input at the start of the process, a lot of it is generally driven by affordability, a lot of the issue that come out of POE's are driven by either a value engineered solution or something where we are getting to the position where we are balancing capital outlay against capX (capital expenditure), so its getting that operational understanding of what the cost impact is, got inevitably a very challenging budget from the outset, what we are bad at doing as an industry and a sector, is we will set a budget, based on the last scheme we did, and the last scheme was always over budget and value engineered, we are not good at resetting that position to say, okay this is what we actually want, and this is what it is going to cost, we tend to get what we can afford, on an assumption it will cost the same as the last one. Consider floor covering, the FM team will want the most robust floor covering, which tends to be the most expensive, whereas the cost plan will get you what you bought last time, so there is a balance between what the ask is, and what the institution can deliver, but I think the key thing is for this process, as long as that conversation has happened, its understood, rather than someone at the end picking it up and asking, well why didn't you do it this way</p>
53	S1	The next point refers to the preparation of findings from a POE for feed-forward to future projects
54	S2	<p>What we are certainly trying to do here now, and we weren't very good doing it at BCU, is having design guides, and everything is discussed here is fed into an updated design guide, there is a danger in that that becomes a very cumbersome document that nobody can understand, because historically here, as soon as there are issue become apparent from the opps and engineering teams, they will bolster the specifications to the point where it a very large specification that's conflicting in a lot of respects, and almost impossible to deliver, the market then costs it against that, its impossible, so they'll put a percentage cost increase on it, so its getting that position where you can have a more lean approach to a design guide, but agile enough for that to be updated at the end of each project, so you almost want to have a design guide that starts there, follow it through, track all of the changes on it, update it there, bring it back to the start of the process. That will bring out what is important to the organisation, is it the choice of flooring, is it the choice of bleacher seating, or the colour of the walls</p>
55	S1	So the development if a design guide informed by the POE
56	S2	<p>Again, it can be quite generic, because people at the start of this major capital project, won't have a starting point will they, so what you could do is bring it back to the generic position of do it as HE wide, people who are mature enough not to need it, don't need it, new</p>

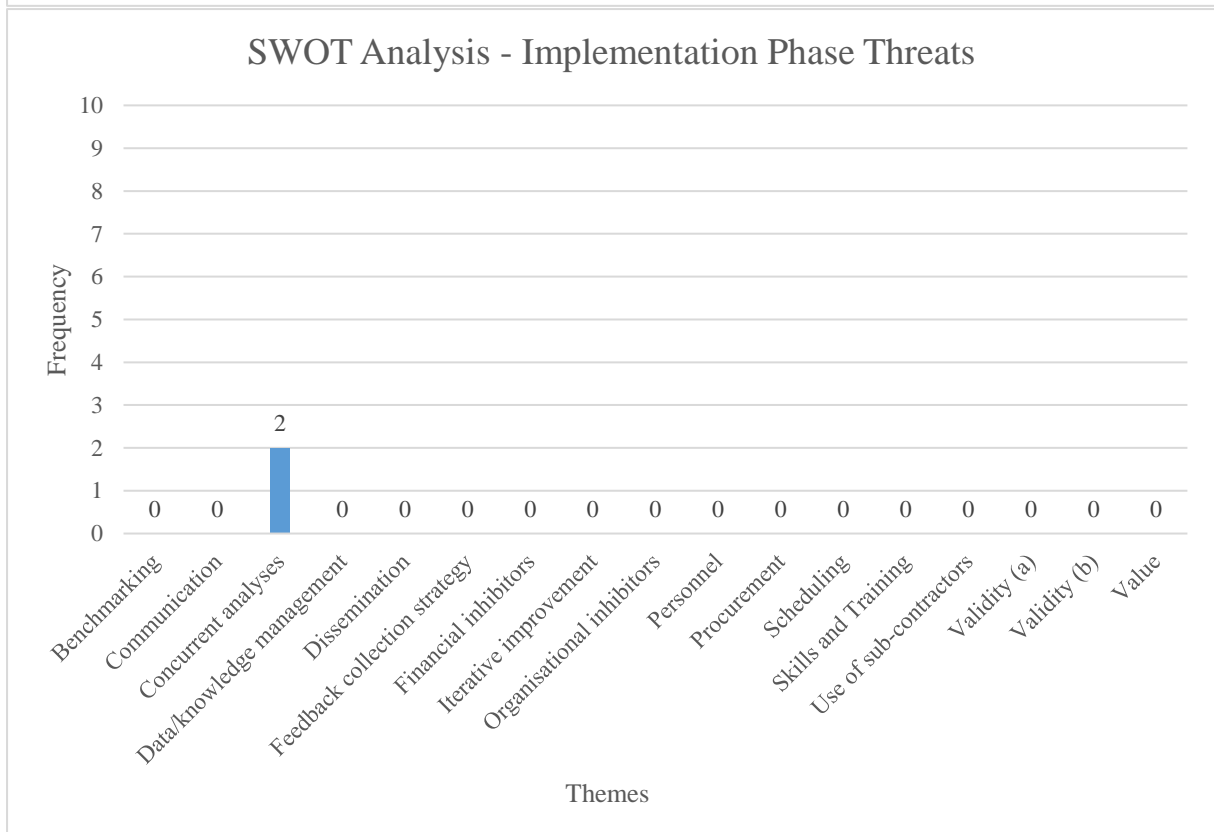
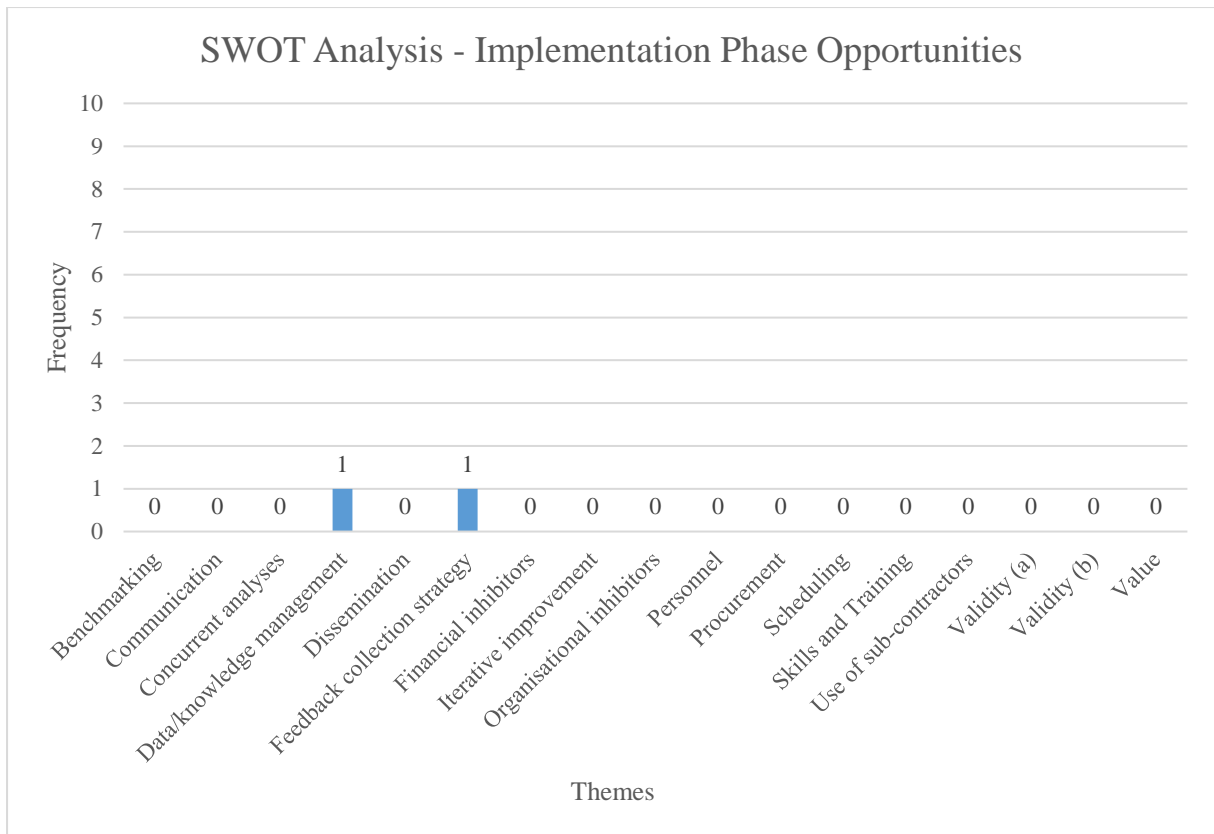
		comers to the game can pick it up as part of this whole process from here. We'll all have the same things, whether it is single use plastics, or whatever the current themes are around the organisation, energy targets, zero carbon, these are going to be big for anyone.
57	S1	The next question refers to the circular process, feeding the findings of POE forward into future projects, formalising the circular nature of the process
58	S2	The key thing to that is continuity, whether that is people or process, inevitably there are going to be different people involved, at this stage for the next project, so unless we try do what we are trying to do in terms of frameworks, and get that relationship moving forward as a ten year cycle activity, in a traditional frame of mind it becomes a design guide without any intuition behind it, is still down to interpretation then, so unless you have a way of sharing the intension, so people don't have to interpret, so that could be a person, what we do now is nominate a soft landings champion, but again you are stuck in this typical scenario of personnel change
59	S1	In light of changing personnel, its about ensuring consistency form the POE process
60	S2	Yeah, it then becomes more about the vision of the POE's and what they are trying to do, rather than the nuts and bolts of what is in the design guide, they almost need a values driven conversation at this point, a theme that then follows through, backed up by any technical support that you may need
61	S1	So a values driven approach
62	S2	Yep
63	S1	The next point refers to the ability of the process to engender iterative improvement of facilities
64	S2	Yep, absolutely
65	S1	The next point regards the ability to benchmark facility performance utilising this process
66	S2	Yep, again totally agree with that, I think you probably picked up from [S5]'s approach, it is quite different for each one, its quite difficult to pull out anything to compare against, but again that is down to it being an iterative process developed through a number of projects, so if you can have that generic type structure ready to go for different organisations about to embark upon that journey, including a standard or generic type design guide, your well on the journey then aren't you
67	S1	My final point regards the synthesis of the model with the RIBA work stages
68	S2	Definitely, because then you can contract based on the RIBA stages, with all of your different partners and everybody in the industry... the construction industry will recognise that, less so with your client organisations, but they are not really the ones inputting into the significance of what it is going to cost, how long it going to take, it gives you clear responsibilities at each stage also.

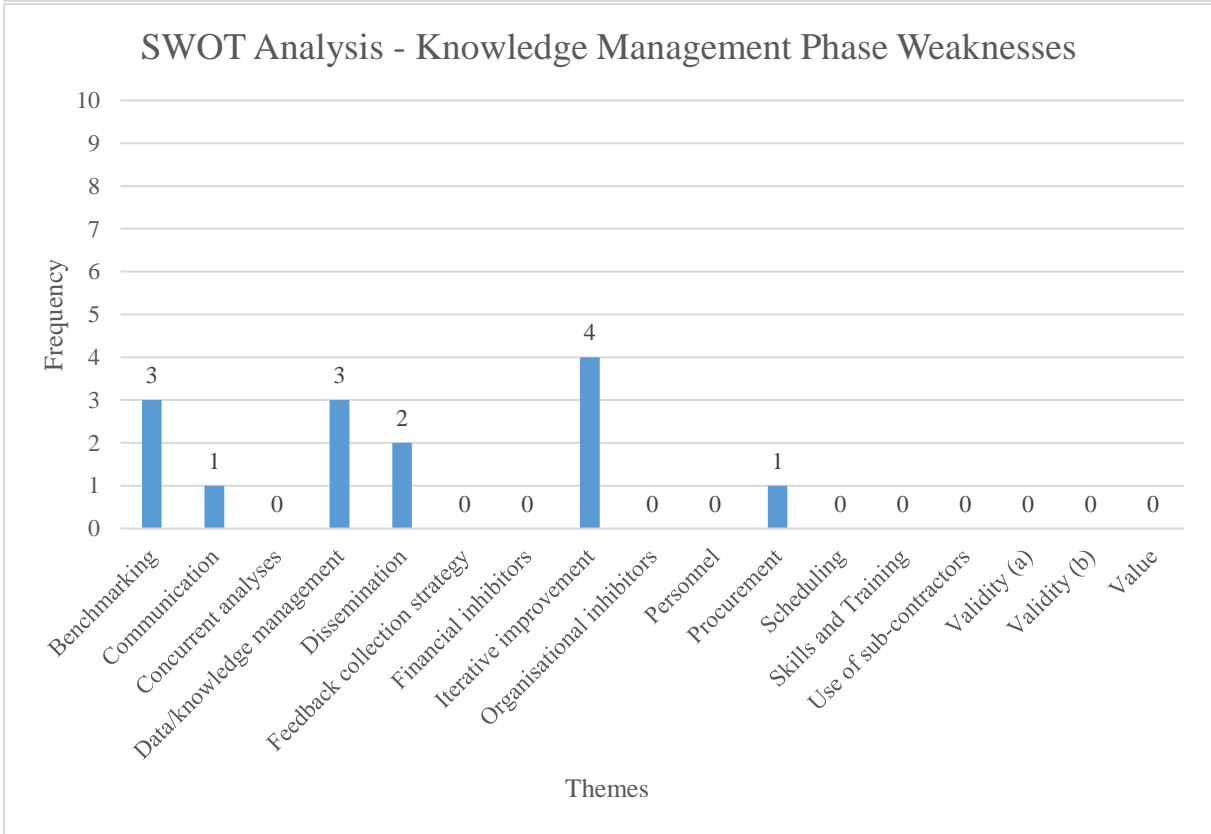
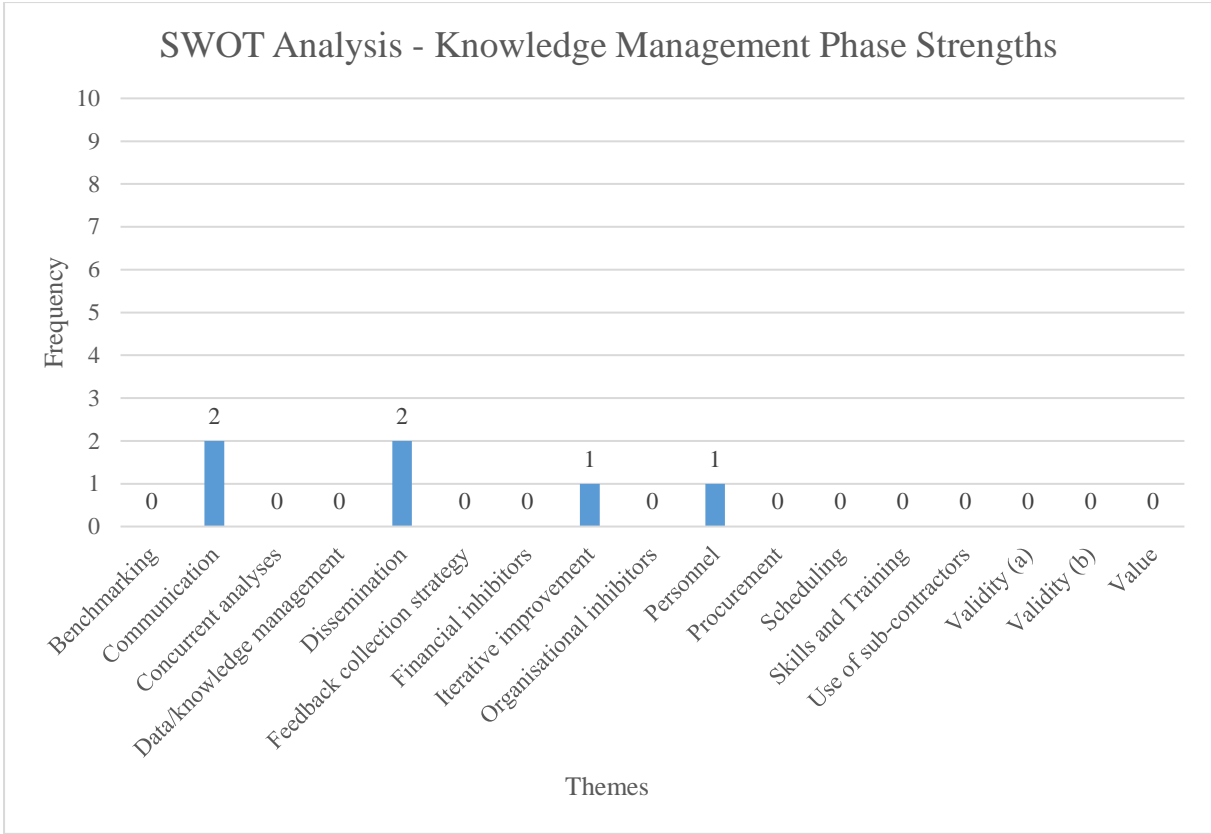
Appendix 10 - Additional SWOT Analysis Graphs

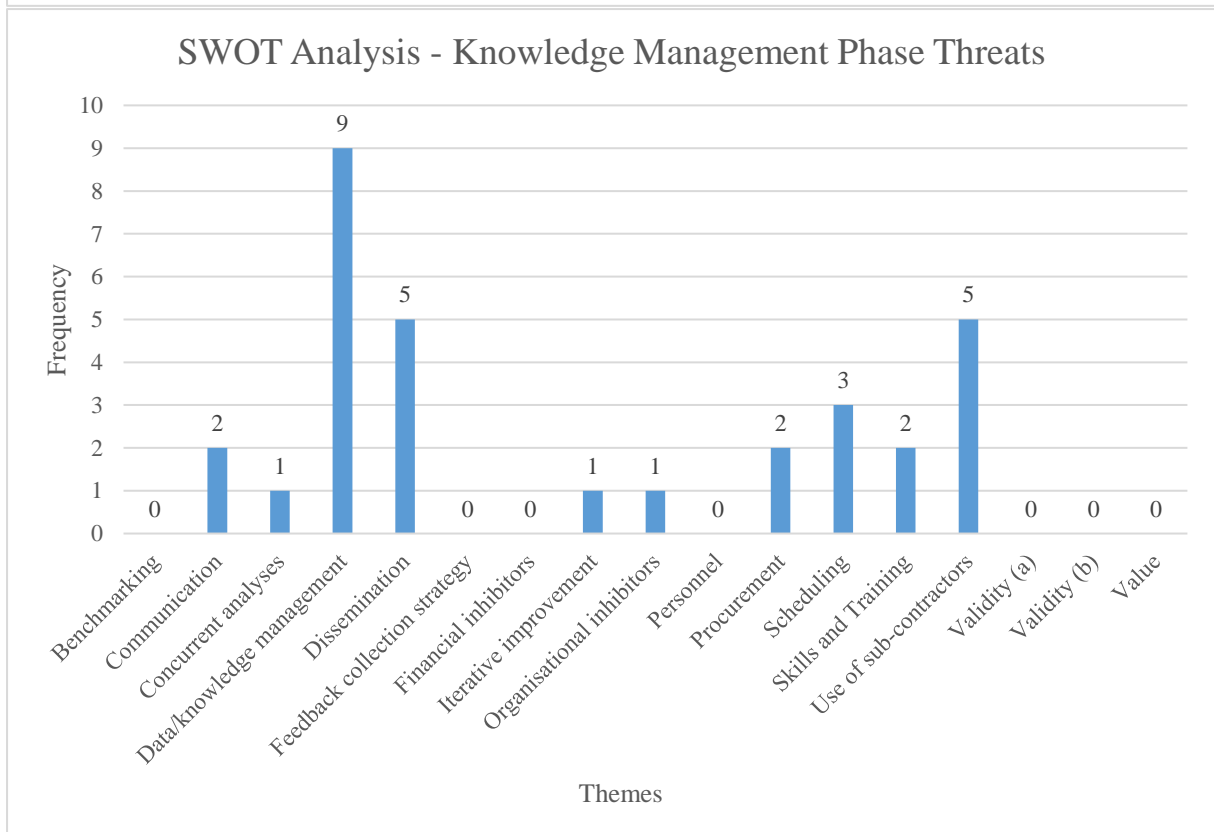
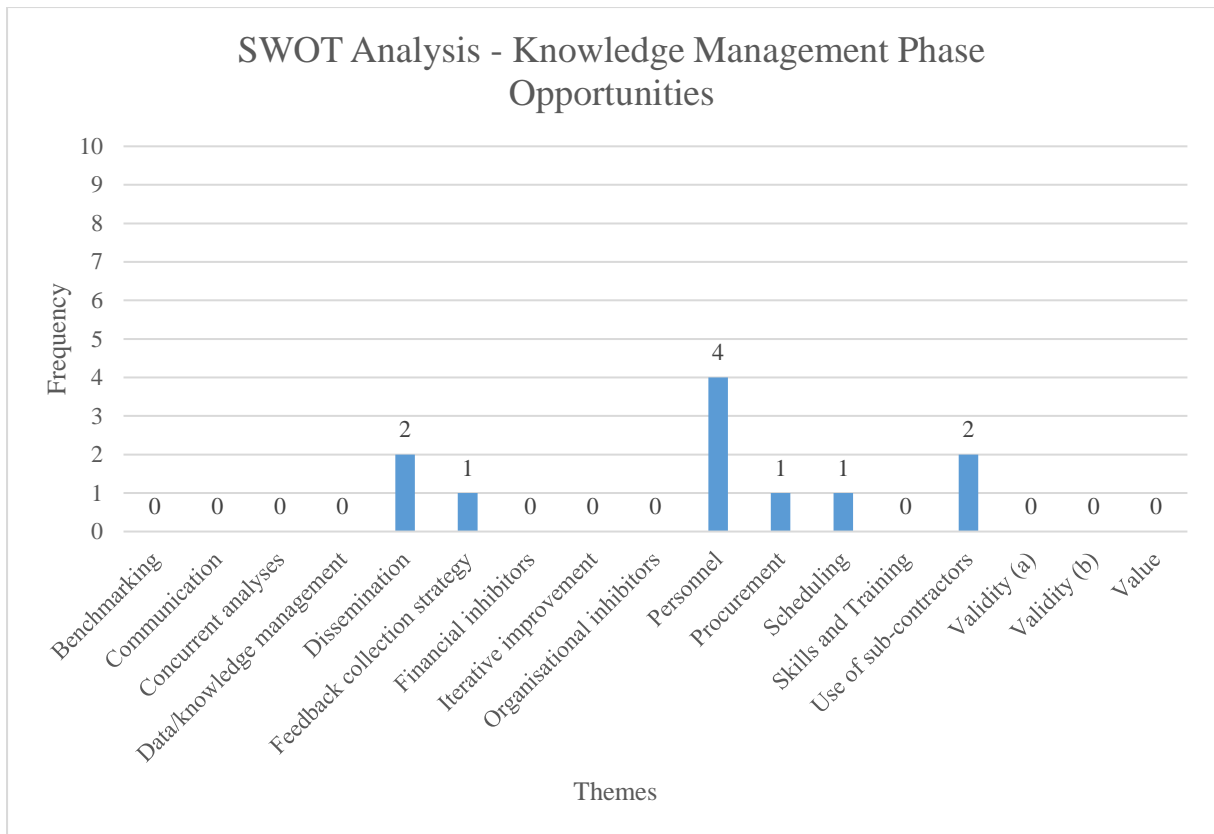












Appendix 11 - Informed Consent Form 1

INFORMED CONSENT FORM

i. Research Study Title

The study you are requested to participate in is titled: 'A Hybridised Model for User-friendly Post-occupancy Evaluation Planning for HEI Buildings.' It is being conducted by Christopher Roberts, a PhD student at the School of the Built Environment, within the faculty of Computing, Engineering and the Built Environment (CEBE), at Birmingham City University.

ii. Purpose of Research

Without a formalised feedback mechanism for contemporary Higher Education Buildings (HEIs), in practice these facilities remain 'untested prototypes.' Inhibitors to a formalised feedback mechanism include: i) a relatively small Community of Practice (CoP); ii) mitigation of liability; and iii) lack of a formalised process for practitioners to adhere to. This in turn prevents the accomplishment of academic objectives including 'iterative improvement' of HEI facilities, and the development of 'benchmark criteria' with which to assess building performance.

iii. Confirmation of Consent

As a participant in this research, you are requested to participate in a face to face interview, which the researcher will request to record (audio only).

Participant - please complete the following questions (Circle Yes or No for each question)

- | | |
|--|---|
| Do you understand the information provided? | <input checked="" type="radio"/> Yes <input type="radio"/> No |
| Have you had the opportunity to ask questions and discuss the study? | <input checked="" type="radio"/> Yes <input type="radio"/> No |
| Have you received satisfactory answers to all of your questions? | <input checked="" type="radio"/> Yes <input type="radio"/> No |
| Do you agree to have your interview recorded (audio only)? | <input checked="" type="radio"/> Yes <input type="radio"/> No |

Participants' involvement in this study is completely voluntary. As a participant you may withdraw from the Research Study at any point.

Participants Signature:

Name in Block Capitals:

Date:

Appendix 12 - Informed Consent Form 2

INFORMED CONSENT FORM

i. Research Study Title

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Participant - please complete the following questions (Circle Yes or No for each question)

Do you understand the information provided?	Yes / No
Have you had the opportunity to ask questions and discuss the study?	Yes / No
Have you received satisfactory answers to all of your questions?	Yes / No
Do you agree to have your interview recorded (audio only)?	Yes / No

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Participants Signature: ..

Name in Block Capitals: ..

Date: ..

Appendix 13 - Informed Consent Form 3

INFORMED CONSENT FORM

i. Research Study Title

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Participant - please complete the following questions (Circle Yes or No for each question)

Do you understand the information provided?	<input checked="" type="radio"/> Yes / No
Have you had the opportunity to ask questions and discuss the study?	<input checked="" type="radio"/> Yes / No
Have you received satisfactory answers to all of your questions?	<input checked="" type="radio"/> Yes / No
Do you agree to have your interview recorded (audio only)?	<input checked="" type="radio"/> Yes / No

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Participants Signature:

Name in Block Capitals:

Date:

Appendix 14 - Informed Consent Form 4

INFORMED CONSENT FORM

i. Research Study Title

The study you are requested to participate in is titled: 'A Hybridised Model for User-friendly Post-occupancy Evaluation Planning for HEI Buildings.' It is being conducted by Christopher Roberts, a PhD student at the School of the Built Environment, within the faculty of Computing, Engineering and the Built Environment (CEBE), at Birmingham City University.

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iii. Confirmation of Consent

As a participant in this research, you are requested to participate in a face to face interview, which the researcher will request to record (audio only).

Participant - please complete the following questions (Circle Yes or No for each question)

Do you understand the information provided?	<input checked="" type="radio"/> Yes	<input type="radio"/> No
Have you had the opportunity to ask questions and discuss the study?	<input checked="" type="radio"/> Yes	<input type="radio"/> No
Have you received satisfactory answers to all of your questions?	<input checked="" type="radio"/> Yes	<input type="radio"/> No
Do you agree to have your interview recorded (audio only)?	<input checked="" type="radio"/> Yes	<input type="radio"/> No

Participants' involvement in this study is completely voluntary. As a participant you may withdraw from the Research Study at any point.

Participants Signature:

Name in Block Capitals:

Date:

Appendix 15 - Informed Consent Form 5

INFORMED CONSENT FORM

i. Research Study Title

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iii. Confirmation of Consent

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Participant - please complete the following questions (Circle Yes or No for each question)

Do you understand the information provided?	<input checked="" type="radio"/> Yes / No
Have you had the opportunity to ask questions and discuss the study?	<input checked="" type="radio"/> Yes / No
Have you received satisfactory answers to all of your questions?	<input checked="" type="radio"/> Yes / No
Do you agree to have your interview recorded (audio only)?	<input checked="" type="radio"/> Yes / No

Participants' involvement in this study is completely voluntary. As a participant you may withdraw from the Research Study at any point.

Participants Signature:

Name in Block Capitals:

Date: