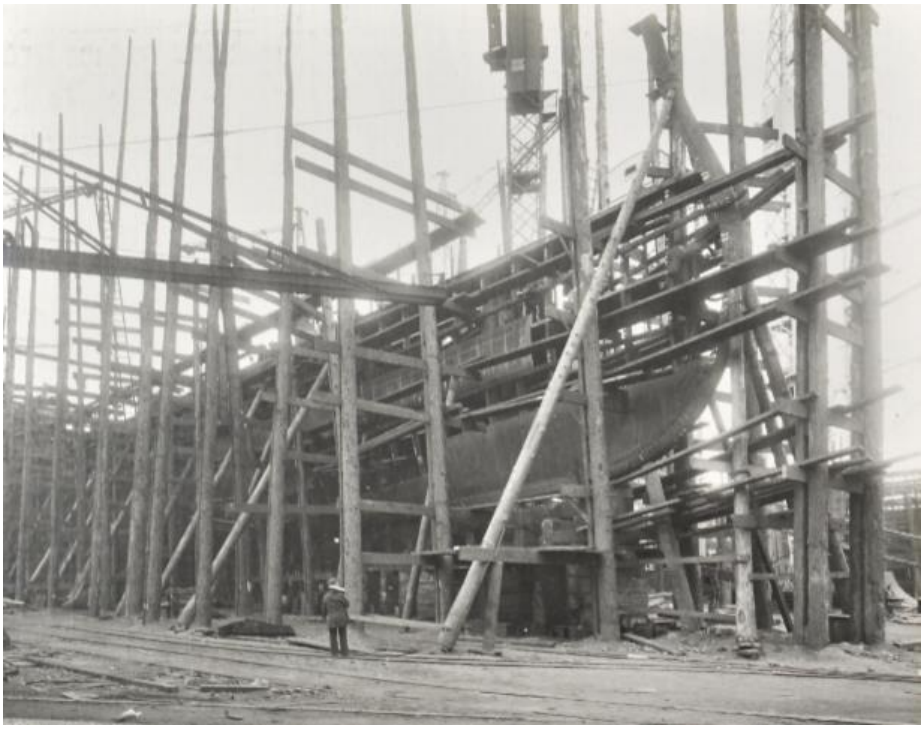


Detecting the early essence of ‘modern’ Project Management – An historic case study approach (HMS Barham 1912-1915)’

Detecting the early essence of ‘modern’ Project Management – An historic case study approach (HMS Barham 1912-1915)’

AUTHOR: AIDAN G. TURNER

A thesis submitted in partial fulfilment of the requirements of the University of The West of England, Bristol for the degree of Doctor of Philosophy.

SUBMITTED OCTOBER 2021

FACULTY OF ENVIRONMENT AND TECHNOLOGY

Word count: 79,809

Acknowledgements.

My thanks to my supervisors, Professor Jessica Lamond and Dr Glyn Everett for their invaluable help, kindness and support during the writing of this thesis.

My thanks too, to all those at home who have supported me through the process of researching and writing this dissertation and helped to steer it into port.

ABSTRACT.

This thesis investigates the management methods and tools and techniques used in the delivery of what we would today call a major project, but one which was completed some 50 years before Project Management was recognised as a management discipline.

The research takes a case study approach and researches, from a project management perspective, the management records and artefacts found relating to John Brown and Sons construction of HMS Barham, one of the Queen Elizabeth Dreadnoughts built between 1912 and 1915. It considers the means by which one of the central UK shipbuilders of WWI was able to meet the country's need for battleships and contrasts this with the approaches used today by Modern Project Management. The purposes of these artefacts, from a project management perspective, are tested with today's project managers in order to gain independent and expert confirmation of their function. Through this approach, the study sheds light on the understanding of Project Management from an earlier time than has been previously recorded to this degree of granularity. It helps to answer calls in recent academic articles for the more detailed study of project management histories that can add value to future studies, seeking to develop the study of project management, either from a practical or theoretical standpoint.

The study shows in detail the documents used and hence the functions carried out during what we would today refer to as a project's lifecycle. In addition, the study directly addresses and answers questions raised by the call for more research into project management history and establishes that it is indeed possible to research projects at this level of granularity, which the study establishes had not been done previously to this level of detail. The primary outcome of the research is to provide a better understanding of the practices and techniques of early projects, with its associated benefits

for those developing project management theories and to provide a systematic exploration of an historical project, enabling current research to be better informed by knowledge of past practice and past empirical explorations.

CONTENTS

HMS Barham – 3rd June 1914

CHAPTERS:

PAGE:

FIGURES:

PHOTOGRAPHS:

TABLES:

ABBREVIATIONS:

APM : Association for Project Management

BoK : Body of Knowledge

CPM : Critical Path Management

CU : Cambridge University

DE&S : Defence Equipment & Support

MPM : Modern Project Management– the set of principles and or processes

PERT : Performance Evaluation Review Technique or Program Evaluation Research Task

PM : Project Manager/ Project Management

RN : Royal Navy

SPO : Special Projects Office

CHAPTER 1

- INTRODUCTION

1.1 The context of the research

‘The modern project management (MPM) era started in 1958 with the development of CPM/PERT’ (Snyder, 1987).

The above quote illustrates a commonly held view which firmly links the birth of MPM with the advent of the US Polaris Project and the use of Critical Path Management/Performance Evaluation Review Techniques (CPM/PERT).

Other writers, for example Lenfle and Loch (2010), refer to the Manhattan Project of WWII as being the start of MPM. However, regardless of the specific project, both the quotation from Snyder above, and that from Lenfle and Loch suggest that something fundamentally changed around the 1940s-50s in the way in which ‘projects’ were delivered – the start of MPM.

The Webster Dictionary (2014) defines ‘start’ as ‘to come into being, activity, or operation’ or ‘a place of beginning’. ‘Beginning’ itself is defined by the Oxford Dictionary (2014) as ‘the first part or earliest stage of something’ or ‘the point in time or space at which something begins’.

In critically examining the significance of this ‘new beginning’ in the practice of managing complex ‘projects’, a number of initial questions arise. What was it, in this period, that was deemed to have ‘begun’ or changed so markedly as to merit being heralded a new dawn? The term ‘MPM' is used, but what is its exact meaning? What does it consist of? Can the components of MPM be defined? Where did they emerge from and how were they created? Do the 1940s/50s, in reality, represent the ‘earliest stage’ of MPM?

The Polaris project certainly led to development in some areas of MPM. The Special Projects Office achievements written about by Fazar (1959) provide evidence of the development of aspects such as PERT (see section 2.2.1)

and in conjuncture with Snyder (1987) would suggest a tie between the start of MPM and the Polaris project. Sapolsky (1972) credits the Polaris project with refining project management concepts. It was a large, $11 billion US, Government project tasked with delivering nuclear missiles which were to be carried by submarines. The project launched its first Polaris missile in 1961. Sapolsky notes that the project delivery was successful in terms of performance and in terms of meeting cost expectations and delivery schedules. It thus fulfilled the criteria of time, cost and quality established ten years later by Barnes (Naughton, 2013).

Whilst Sapolsky's book discusses these issues, it does not provide an overview of all the tools and techniques available to the PM, nor does it step back and discuss the overall purpose of project management in the way that this study does. It is written in a way that focuses on the achievement of the project aims. This is in contrast to this case study, which rather than deliberately looking for evidence of the success of the project aims themselves, looks for traces of the essence of MPM, through analysis of the management tools, and within a much earlier period than has been achieved to date.

The era of MPM itself was therefore identified in the period highlighted above by Snyder and Lenfle and Loch. This study however focuses on the preceding use of the tools, practice and approach of MPM, rather than the recognition of the 'era' of MPM itself.

One key challenge is therefore, to determine whether or not it is possible to identify, list and describe the initial and varied elements used to manage what the Association for Project Management (the APM – is the UKs only chartered body for the project profession, with over 35,000 individual members and more than 450 organisations registered as 'Corporate Partners'), would identify as a project - 'a unique, transient endeavour, undertaken to achieve planned objectives' (APM, 2014, p.12). The next challenge is to discover whether there are elements of the APM's definition of a project that make a 'modern' project, one managed under MPM

principles, a purely post-Manhattan/ Polaris phenomenon. It is true that complexities of considerable magnitude were inherent within both Polaris and Manhattan, but relative to the technology of the time, were these necessarily greater, or more complex, than previous large-scale military projects?

If it is accepted that the MPM era began with either Manhattan or Polaris, then how were earlier, similarly complex military undertakings, managed and delivered? Is it possible to trace any evidence of these processes in earlier endeavours to add to our knowledge of Project Management and to both determine and describe its direction of travel?

The study did not seek to discover and research the oldest possible example of a project using MPM type processes, but merely sought to establish whether traces of these processes were used earlier than currently thought. This choice and the reasons behind it are further explored in Chapter 4 which considers the importance of Historical Studies in PM.

The design, build and management involved in the construction of the UK's Grand Fleet, delivered at the start of the twentieth century, represents a valuable case-study that could potentially demonstrate the characteristics of MPM, 40 years before its recorded birth. This period offers the study the chance of finding numerous surviving production records. The more historical the research is, the less likely that records, many of them paper based, will have survived in the quantities needed to produce a full picture of a project's management. The reasons for selecting this time period are further explored in Chapter 4, one key determinant being the importance, or cost and novelty of the project. The greater these factors the greater the need for project monitoring and control.

The start of the twentieth century saw the construction of many large-scale military projects within the UK, and many of these took the form of naval assets. The construction of the UK's Grand Fleet was a massive undertaking, not merely in terms of size, (at the end of 1918, the Grand

Fleet consisted of 1,750 ships, a net increase of 448% or 1,360 (Brown, 1997)), but also when measured by levels of technology or cost.

The importance of maintaining British naval dominance was reflected in the Two-Power Standard that determined the acceptable size of the British Fleet. This standard was defined by Earl Cawdor in the House of Lords, quoting the Prime Minister of the day, as being ‘a preponderance of 10 per cent over the combined strengths in capital ships of the two next strongest Powers’ (Hansard, 1908).

The first of the Dreadnoughts (1906) ushered in such a step-change in warship design that the ships built to designs prior to 1906 became almost instantly outdated, and known simply as ‘pre-Dreadnoughts’. This is illustrated by the contemporary view from Ferraby (1917), who stated that the ‘division’ (between Dreadnoughts and pre-Dreadnoughts) began in 1906 with the evolution of a novel design in battleships. The first of the new class, the Dreadnought outclassed all the earlier designs so completely that it was no longer reasonable to describe the old and the new both as battleships.

Alongside the advance in naval technology noted by Ferraby, the first aircraft-carriers and submarine fleets were also being developed to help harness the emerging technologies of the time and to deliver military capability in a new way.

The desire for the new Dreadnought Class ships (1906) and the public perception of the importance of the Dreadnought Class in supporting the Two-Power Standard was summed up in the popular cry of ‘We want eight and we won’t wait,’ (BBC, 2014). The strength of public feeling is shown in a quote from Winston Churchill, the Home Secretary of the time, ‘the Admiralty had demanded six ships; the economists offered four; and we finally compromised on eight’ (BBC, 2014). The quote demonstrates some of the tensions present in the political arena at the time – public sentiment demanded costly military platforms yet the treasury, or economists, found it

difficult to allocate or justify the necessary funds. This is very much resonant of today's environment, where the need for the cost-efficient production of assets is paramount.

The Admiralty's dilemma, and indeed that for the Government of the day, was that whilst there was a loud public clamour for more Dreadnoughts to be built, there was also growing protest against the ever-increasing costs reflected in the official Naval Estimates. Therefore, if more Dreadnoughts were to be built, and the discord between these two contradictory public demands minimised, any ship-building programme would have to be delivered efficiently and effectively. These two key words, efficiently and effectively, are today at the centre of the definition of Project Management Governance (APM, 2006). The friction between these conflicting aims was echoed in the eventual scrapping of the 'Two Power Standard'. In March 1912, it was replaced with a reduced constraint, one requiring the fleet to be just 60% larger than the German navy, which was identified at the time as the next largest, potentially hostile, navy (Brown, 1997).

At the same time as the fleet was being constructed, there were emerging views on the importance of economics as a weapon of war:

> *'in the last war (1914-18) the condition of industrial civilisation had made our enemy more susceptible to economic pressure than in the past. And because of geography our navy was better able to apply it.'* (Basil Liddell Hart, quoted in Lambert 2012, p. 1).

Alfred Thayer Mahon, the American naval historian, argued that to maintain economic prosperity it was necessary to ensure command of the seas through naval power exerted by battle-fleets superior to one's potential rivals, (Sumida, 2004). If this view is accepted, then given the cost of producing the Grand Fleet (see Appendix 1.1), the methods of production become just as important a part of the 'economic pressure' as the effect which they would exert. This, then, is de facto the opposing side of the same coin. On one side was the economic pressure that could be exerted

on a country and on the other was the cost of applying that pressure as a weapon of war. Both aspects therefore became weapons of war.

1.2 The scope of the research and the research questions raised

The main aim of the study is to provide a better understanding of the practices and techniques of managing early projects, with associated benefits for those developing project management theory. The scope of the research was focused on a period prior to that recognised in the current academic texts as the start of MPM. It sought to discover documents showing clear evidence of project management practices in this pre MPM period. This approach presented the study with some clear challenges. The largest of these, evident from the outset, was that not all records of project delivery will have survived over time. It could be anticipated however, that the closer these records were to the current day and the larger, or more important the project was, the greater the chance of these records' survival. The scope was limited to searching within UK based projects due to the cost of international research. Beyond this, the scope of the project was further defined in order to maximise the likelihood of suitable records being found. The First World War admiralty shipbuilding programmes offered just such a possibility due to a number of convergent points.

Firstly, the introduction of the Dreadnoughts from 1906 and through the war years, was a time of considerable change in the design of warships being built. The revolutionary nature of the design (discussed further in section 2.3.1) would have meant that full documentation of the new designs and manufacture was more necessary than at other, more stable times. Secondly, the search period would extend the history of PM significantly without being so far in the past as to significantly limit the possibility of the physical survival of paper records.

Thirdly, the likelihood of archival records surviving would increase the greater the level of national importance attributed to the project.
Lastly, the records searched for, had to be ones which would be recognised as having a Project Management function. The scope of these records and the method of defining them is described fully in Chapter 3.

An initial review of the archives as described in Chapter 5, resulted in the choice of the construction of HMS Barham (1912-1915) being chosen as the case study.

This scope is reflected in the title of the study shown in Table 1.1 below.

Table 1.1 – Research Study - title

'Detecting the early essence of 'Modern' Project Management – An historic case-study approach (HMS Barham 1912-1915)'

1.2.1 The primary research question

The context above forms the backdrop to the study, leading to a number of questions.
The primary research question asks if we can derive useful insight on modern project management through the study of processes involved in construction projects dating from before the birth of Modern Project Management?

This initial question focuses on two areas of investigation: Firstly, can traces of MPM be found in earlier projects, and secondly what methods can be used to detect MPM prior to its formal recognition and establishment as a distinct discipline?

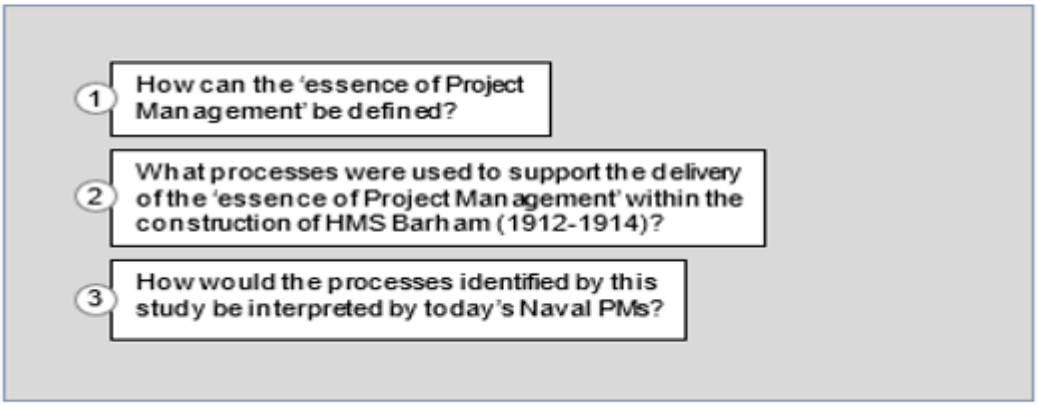
The secondary questions break down into two distinct areas. The APM's view, that the application of Project Management tools and techniques is the way through which projects of all descriptions can be delivered efficiently in economic terms and effectively in terms of meeting the customers' needs,

means that in order to answer the primary question, the study must consider the following secondary questions:

1.2.2 The secondary research questions:

Tables 1.2 and 1.3 below set out the secondary research questions.

Table 1.2 – Secondary questions relating to the search for project management artefacts within the construction of HMS Barham.



The first of the secondary questions above required the definition of the core tenets of project management, from the perspective both of those delivering and of those benefiting from the process of what is now known as MPM. The study refers to these as the Essence of Project Management. The core meaning of Project Management must be identified and used as a tool to search for evidence of the components of MPM some thirty or forty years before MPM began to be discussed as a subject in its own right. The research defined these core elements and employed a case-study approach to search for evidence of them being used within the construction of the Grand Fleet.

The second of the questions, outlined in Table 1.2, focused on the possibility of finding traces of the Essence of Project Management within the delivery of a sizeable construction project prior to the recognised era of MPM. Any such records found were analysed and this analysis was then

corroborated through a review addressing the third of the questions shown in Table 1.2.

While these records were analysed and assessed, a subsidiary aim of the study, which has recently come to the fore in project management texts, was investigated. This theme focuses around the question of the value that exploring historical projects can provide to the profession. The value provided by this kind of analysis is focused in areas such as increasing the understanding of project management's direction of travel, and in its ability to help the development of a theoretical base for project management (See Chapter 4).

This view led to the development of two additional secondary questions, shown in Table 1.3. Söderlund and Lenfle (2013), reveal that knowledge of the emergence of management practices and the way in which historical projects were organised is very limited. The study aims to help address this situation. The second of these two additional questions is derived directly from the research required for the first and focuses on the feasibility of conducting historical project management research itself. Both questions are shown below in Table 1.3.

Table 1.3 – Secondary questions relating to the study of project management history.

4	Knowledge of the emergence of management practices and the way in which projects were organised is very limited' (Soderlund & Lenfle, 2013) - Can this situation be improved?
5	How feasible is it to conduct research into historical projects? What are the difficulties in conducting this type of research and how have these impacted on this study?

1.3 Research Aim

The main aim of the study is to provide a better understanding of the practices and techniques of managing early projects, with associated benefits for those developing project management theory. The importance of understanding the historical development of an area of academic study is key if its direction of travel and the speed of its development is to be judged. This in turn is vital if we are to increase the opportunities of advancing the development of theory – in this case, Project Management theory. This is further discussed in Chapter 4. The study also aims to establish whether or not this type of historical research, to date undocumented, is possible and to describe a method by which it can be delivered.

1.4 Research Objectives

The study has the following objectives:

1. To establish what the Essence of Project Management is and to investigate its potential alignment to a systems approach.
2. To increase understanding of the history of MPM and to establish core conceptual frameworks and elements of MPM.
   Once identified, this made it possible to search for these elements of Project Management in a period prior to the recognised establishment of MPM as an identifiable management topic. In doing so the study offers a wider foundation for the development of Project Management theory.
3. To design a suitable archival approach to identify the Essence of Project Management in historic projects.
4. To identify and research relevant archives to establish the existence of any of these MPM elements within a chosen case study and to analyse each record found, both in terms of alignment to the Essence of Project Management and to systems theory.

5. To validate the findings with independent third parties currently employed in the construction of modern-day naval vessels.
6. To draw conclusions on the ease of researching historical projects and how much more can potentially be learnt by the profession through this kind of study.

The study uses a number of key sources of information.

Firstly, to establish exactly what is meant by ‘MPM’, texts reflecting the early stages of Project Management were reviewed. Key amongst these was Gaddis’ (1959) article ‘The Project Manager’, which is reportedly, although unsupportable in its claim, the first article to use the term ‘project manager’ Hornstein (2015). Definitions from the profession’s Bodies of Knowledge were also reviewed as well as a variety of articles from professional project management journals. A review of more recent articles looking at the definition of project management, from a stand point of Project Management theory development, added a new perspective to the definition of the Essence of Project Management.

Following this, a variety of sources of primary research were explored in order to establish how the construction of naval vessels was managed in the early 1900s. There is much literature on the design and related calculations of ship-building, but less which focuses on the actual methods, tools and techniques used to ensure the timely and cost-efficient delivery and management of naval production. The National Maritime Museum, and in particular the Ships Covers held at the Brass Foundry in Woolwich, proved a valuable source, as did the archives of some of the commercial shipbuilders themselves, now held, for instance, at Glasgow University (predominantly Clyde-based builders) and other collections, identified by Ritchie (1992), such as the records held at the Business Archive of the University of Cambridge. In addition, there are a number of other sources, such as Pollock’s 1905 book, reprinted in 2014, ‘The Shipbuilding Industry: Its History, Practice, Science and Finance’ (Pollock, 2014).

This archival research led to a case-study approach being adopted for the research, using information from both sources above. The approach taken to the study is expanded upon in Chapter 5.

1.5 Preliminary justification of the chosen Research Philosophy

The research was undertaken in response to a perceived gap in the literature, further explored in Chapter 2. There are, to date, no examples of project management histories which are primarily focused on the tools and techniques used to manage the delivery of project outputs. Studies to date focus on the outputs of projects, on the concrete results rather than on the art of project management itself. This lack of knowledge in respect of project management practices is recognised by Söderlund and Lenfle (2013). Turner (2011a) also recognises the need for more work centred on identifying the theoretical base of project management and addressing the lack of detailed research on historical project management methods. The need for additional academic research in this area has been clearly highlighted as important in itself, and potentially as a prerequisite to the formation of relevant theory (Lenfle 2014).

When considering the research philosophy of any study, the researcher's beliefs and assumptions are key, as is the impact that these have in helping to inform and shape the search for new knowledge.

There are four main ways in which this could have been approached, namely through a philosophy of Pragmatism, Positivism, Realism or Interpretivism. The approach taken to the study is discussed in greater detail in section 5.2. Section 5.2 identifies the nature of reality, or ontology, of the research as being mainly one of Internal Realism, but impacted too, by a degree of Relativism (section 5.2.2). This reflects the view that when viewing the research data, which is largely archival, there would have been

one reason or truth behind why the document was constructed, but in review of that purpose, the interpretation of some facts will be impacted by the observer's viewpoint, leading to 'many truths'. The position of the researcher relative to the study defines the study as taking a constructivist position (section 5.2.3). This is reflected in the use of a single case study approach, recognised by Easterby Smith, Thorpe and Jackson (2012) as deriving from a constructionist epistemology. This choice represents the view that there is essentially one truth, one reason why a document would have been created and kept as part of the project records, but it also recognises that the interpretation of some facts may be coloured by the observer's own viewpoint. The approach is rhetorical in that the research is more concerned with the goals, and aims of the data rather than how they are presented. The importance of this is reflected in the review of a sample of the data records with practicing naval PMs (see step 8, section 5.5.2). The research reflected this by searching for the purpose of production management records found, and also, by validating this analysis with third parties who had the potential to see different meanings in the documents.

1.6 The nature and scope of the research problem

The research first sought to establish exactly which records of manufacturing processes and organisation were available from the construction of British Naval Ships of the period. HMS Dreadnought construction began in 1906, and this period through to 1918 - the end of the First World War, was the initial period of study. It is within this timeframe that the British fleet grew significantly (Brown, 1997), meaning that there was the promise of a substantial number of records being found.

The research chose to focus on a single case-study, one of the Dreadnoughts of the Grand Fleet, and to compare the production techniques evidenced with the techniques which frame MPM.

Once the Essence of Project Management, (see Chapter 3), had been established, the two sets of information, the first describing what is meant by 'MPM' and the second describing the production management methods used within the UK military ship building industry at the time of the Grand Fleet, could be documented and compared.

1.7 The potential contribution of the research

The research seeks to directly answer the questions set out in Tables 1.2 and 1.3. In doing so, the study adds new knowledge in terms of the production management methods used in pre MPM approaches and reviews how similar, or otherwise, they are compared to today's Essence of Project Management. The research also addresses the meaning of the Essence of Project Management pre MPM and reveals evidence of the feasibility and potential pitfalls in conducting research into historical projects. (Chapter 4 provides a review of the importance of this type of research and the benefits it can bring.)

A thorough review of the research field outlined above, enabled the study to test what is an oft quoted and potentially too readily accepted view that MPM begun in the 1940s/ 1950s. The analysis undertaken investigated the nascent beginnings of MPM and seeks evidence for these stretching back further than has been previously recorded.

The fact that these questions have not been fully investigated before (Morris, 2013) means that modern-day projects are being managed without a full understanding of how MPM came into existence. Should we, for instance, believe in a 'Big Bang Theory' focused on the 1950s, or in a more gradual approach, an approach in which project management adapts to and reflects, changing societal views? An example of this could potentially be the value attributed to human life and hence the need to include greater levels of Health and Safety within today's projects. (For contrast with today's

projects, consider the acceptance of the death toll of 25,000, and a sickness rate well above 30%, reported during the construction of the Panama Canal, completed in 1914.) (Lewis, 2003).

The research addresses these questions through a comparison with current Project Management Techniques being used on naval construction projects. At the time of the commencement of the research, the Ministry of Defence had recently contracted for the construction ‘at shipyards around the country, of HMS Queen Elizabeth and Prince of Wales’ two aircraft carriers which are intended to be the future flagships of the nation (Royal Navy(i), 2014). In the same period, the Type 26 Global Combat Ship was also under construction. The Royal Navy is expected to deploy 13 Type 26 frigates in total, which will complete their delivery throughout the 2020’s (Naval Technology (2021). Dreadnought 2050 is also a current design concept being researched for future warships. Through reviews with current project staff working on these named projects and others, it is hoped to facilitate the comparison of the methods used today with those used a hundred years earlier, enabling lessons and conclusions to be drawn. It is not just PM experience gained on current projects which can be reviewed, but also that gained during the construction of the Type 45 Destroyers, the last of which entered into service at the end of 2013, (Defence Industry Daily, 2014) and which, like the original Dreadnoughts have completed their project lifecycle.

1.8 What is currently known and understood in this area – research to date.

The records of British naval ship building have not previously been reviewed for the purpose of comparing production methods with today’s project management methodologies. There have been a number of PhDs looking at the history of the industry and the historical contributions of individual constructors (for example Johnston, (1993) and Pinney (2001), but none that compare production methodologies. If we are to learn from this potential

area of research, it is important that this is done in a timely fashion, before these records become unavailable through either age or destruction of any private collections or archives that do remain.

Numerous books have been published as a result of research done to coincide with the centenary of the First World War. A number of these such as Johnston (2011) Johnston and Buxton (2013), Staff (2014) aim to trace the design and construction of the ships as well as document the full-service history of each ship. These studies discuss areas such as the layout of armaments etc., however there remains a gap in the exploration and analysis of the management activities involved in the construction of each ship.

The need for further research focussing on projects of the early 20th Century is further supported by Morris. In 'Reconstructing Project Management', (Morris, 2013), Morris, (who has been involved in drafting and redrafting versions of the APM's Body of Knowledge since before 1999,) (Morris, Patel, and Wearne, 2000), suggests that the roots of Project Management can be seen in the 'nascent aircraft industry of the 1920's' (Morris, 2013, p. 3). The evidence for this is presented in an American PhD (Pinney, 2001).

Although it might be considered that the ground might thereby already have been covered, Morris discounts this. He continues to say that in discussing the roots of Project Management, Pinney had focused on the rise of co-ordination in the aircraft industry of the 1920's. Morris voiced his opinion that similar evidence could be found in both shipbuilding and the military projects of the early twentieth century.

The study's proposition is therefore that, given the political and economic situation outlined above, it could be predicted that the search for, at a minimum, a trace of a project management approach within the military shipbuilding industry of the early 1900s was plausibly but as yet unresolved. As such it provides interesting ground to explore. The discussion above, in Section 1.1 of this chapter, considers the need for effective new warships

being balanced with the need for efficient use of resources. This tension, between efficiency and effectiveness, means that an approach bearing similarities with that offered by MPM would have been necessary. The opportunity behind the research is supported by Morris (2013), who says that he has chosen to focus on the aircraft industry because, in his words 'there is evidence at hand' but 'I simply don't have the time now to do the primary research that would lead to data for other examples…. these omissions, however, represent opportunities for other researchers.' (Morris, 2013, p. 3). One of the aims of this investigation and analysis is to focus on the opportunity identified to provide this primary research.

This study addresses the opportunity highlighted by Morris. By carrying out the proposed primary research, it is possible to address points raised by Morris and whilst doing this to also investigate the secondary questions recorded in Table 1.3, which have been raised by other academics. In doing so, the aim of the research is delivered - our knowledge of the development of the subject and methods used prior to the development of professions Bodies of Knowledge is added to and comment is made on the study's experience of conducting historical research which as Chapter 4 shows, is referenced as being important to the continued development of Project Management as an academic subject.

1.9 Structure of the research – an overview of the chapters

This study is structured along the following lines, with a view to enabling the reader to progress logically through the chapters and to follow the development of the argument in order to validate the conclusions of the research.

Chapter 1 - Introduction

The Introduction, the main body of which is above, establishes the basis of this study and introduces both the primary and secondary research questions that it addresses. It identifies key sources, that outline the

approach to the literature review, and begins to introduce the methodology used for the research.

Chapter 2 – Background and Context to the Research

Building on the Introduction, Chapter 2 examines relevant literature and demonstrates a wider appreciation of the current literature sources pertaining to the research questions themselves. It discusses MPM and considers why it is seen so often as a post 1940's phenomenon. It begins to consider how project histories have been reflected in academic literature to date, particularly in relation to naval shipbuilding projects.

Chapter 3 - Review of the Essence of Project Management

As outlined above in Section 1.1, it was necessary to define the Essence of Project Management in order to search for the evidence of it before it was formalised by the industry bodies. This is accomplished in Chapter 3, via a structured review of the literature, setting out the individual management processes which are given by relevant sources as being both key and central to the management of projects thus informing the search for them in Chapter 5. The relevance of the key source texts is discussed and analysed in light of a systems theory approach.

The chapter identifies the project management practices that can be claimed as part of the birth of MPM, and hence helps to establish a baseline of project management tools and processes that can be searched for within the construction of the Grand Fleet.

Chapter 4 – Historical Studies in Project Management

This chapter builds upon the literature review and considers the potential value to the discipline that the study of project management history can provide. Drawing on current academic literature, it suggests a number of benefits offered by this type of enquiry and reviews some of the potential difficulties that could be encountered in the research of project histories.

Chapter 5 - Methodology

Chapter 5 includes discussion of issues such as the studies overarching philosophy and ontology and also addresses detail of the study's design and implementation, together with details of how the interpretation and analysis of results was approached.

The chapter first positions the research and then discusses how the data relating to the Project Management element of the construction of the Grand Fleet case-study was delivered and analysed.

A key part of the approach detailed in Chapter 5 is the decision to adopt a case study approach to the research. Cresswell (2002, p. 61) says that 'a case study is a problem to be studied, which will reveal an in-depth understanding of a "case" or bounded system, which involves understanding an event, activity, process, or one or more individuals.' This supports the aims of this study as it seeks to provide an understanding of the process around PM and it hopes to reveal the 'in-depth understanding' to which Cresswell refers.
VanWynsberghe and Khan (2007) note a number of properties or features which are necessary for the research to be considered as case study. These features are:

- The case study calls for an intensive and in-depth focus on the specific unit of analysis.
- Case studies aim to give the reader a sense of "being there" by providing a highly detailed, contextualized analysis of an "an instance in action".
- Case study researchers choose to systematically study situations where there is little control over behaviour, organization or events.
- Case studies provide a detailed description of a specific temporal and spatial boundary.

- Case study routinely uses multiple sources of data.
- Case studies can enrich and potentially transform a reader's understanding of a phenomenon by extending the reader's experience.

All these features are present within the research as section 5.4 details and support the choice of a case study approach.

Within this approach, the construction of HMS Barham (1912- 1915) was chosen as the unit of study. The reasons behind this choice are discussed in section 5.4 of the study.

A central part of the methodology focuses on how the data was coded by the author and how this coding was validated, using Cohen's Kappa, through a third-party review. Included in the chapter are details of how a pilot test was conducted prior to the third-party analysis of the data. The impact of the pilot-study results on the approach to the research are also examined. This enabled the historical processes discovered to be compared to modern-day practices used by practicing naval Project Managers.

Chapter 6 - Research Results – Analysis of Data Found

The sixth chapter begins to analyse the data that was found.
First, it describes the data uncovered through the review of project documents relating to the case-study project. Secondly, it presents an analysis of the number of times that documentary evidence of each element of the Systems Model and each element of the Essence of Project Management was found. Finally, the validity of the data found and its initial analysis was confirmed through consultation with industry experts and using Cohen's Kappa, a measure of inter coder reliability.

Chapter 7 – Analysis of Archival Documents

Chapter 7 considers the strength of alignment of the research data in terms of its relationship to both the Systems Theory model and to the elements of

the Essence of Project Management. It details the source archive from where the data originated, before providing a detailed discussion of the archival documents found. This detail is displayed using both a matrix and a narrative approach. Reflecting the stated objectives centered on the benefits of project management historiography, the chapter concludes by reviewing the lessons learnt that have potential to contribute to the ongoing exploration of Project Management history.

Chapter 8 - Conclusion

Chapter 8 brings all areas of the research together in order to assess the implications of the research. This is done firstly with a view to answer questions relating to identification of characteristics of MPM in order to enable the study to comment on achievement of the direction outlined in the title itself - 'Detecting the early essence of 'Modern' Project Management – An historic case-study approach (HMS Barham 1912-1915)'.
The secondary aim of discussing the methods used during the study and the lessons thereby learnt for future studies of this type are also addressed in Chapter 8.

The study constraints and practical difficulties found whilst undertaking the research are highlighted and a critical assessment of the research is provided, covering the limitations of the study. The contribution which the work makes to knowledge is assessed and highlighted while areas for future research are identified.

1.10 Summary

The introduction has sought to establish both the grounds for the research and to begin to introduce the requirement, or need, for research into historic projects which is further developed later in the thesis. It outlines the approach taken to the research and lays out, in brief, how the conclusions of the study were validated through the methodology used.

The remainder of this report follows the approach laid out in Section 1.5 above, and begins with Chapter 2 – the Background and Context to the Research.

CHAPTER 2

- BACKGROUND AND CONTEXT TO THE STUDY

2.1 Introduction

The first chapter of this study began by taking two statements on the birth of MPM. One from Snyder, (1987) in which it was asserted that The MPM era started in 1958 with the US Polaris Project and the development and start of CPM/ PERT. The second view, quoting Lenfle and Loch, (2010) suggested that it was the Manhattan Project (1942-1945) of WWII that marked the beginning of MPM.
The introduction set out the primary research question which 'asks if we can derive useful insight on modern project management through the study of processes involved in construction projects dating from before the birth of Modern Project Management?

This chapter, – looking at the background and context to the study - reviews the academic literature focusing on the birth of MPM, as a new discipline. In particular it considers the contrasting claims of the Manhattan and Polaris projects and reflects on the drivers behind the birth of MPM. The beginnings of MPM, within the United Kingdom, and the underlying factors determining why and when this change came about, is important within this study. It is important because it pertains to the primary research question of whether or not it is possible to detect the early essence of MPM within a historic case study – that of HMS Barham 1912-1915. The study explores whether HMS Barham could have been constructed using a similar management approach to that used by MPM., albeit circa forty years earlier. It also directly addresses the secondary questions relating to the emergence of management practices and the way in which projects were organised. The literature review is split into three chapters as detailed below.

2.1.1 –The Focus of Chapter 2

Chapter 2 focuses on:

1. How MPM was perceived to have started the causes of this step change.

2. What constitutes MPM and what are the reasons for it being presented as a post 1940's phenomenon?
3. How has project history been presented in the academic literature to date and how is project management presented as an academic topic of enquiry in the years prior to the establishment of MPM?
4. What does the academic literature say in relation to how naval projects have been delivered in the UK?

2.1.2 The Focus of Chapter 3

Chapter 3 addresses the approach taken to defining the central core, or Essence of Project Management, signs of which the study searches for within the historical records, as per the methodology described in Chapter 5. It considers the question partly through a Systems Dynamics approach endorsed by, amongst others, Lyneis and Ford, (2007) and partly through an analysis of key Project Management texts including professional bodies own Bodies of Knowledge.

2.1.3 The Focus of Chapter 4

Chapter 4 considers the key reasons behind the importance of studying Project Management Historiography, and how academic literature reveals that the study of historical projects can help in the future development of Project Management, moving the subject forward as an academic discipline. Key gaps in research and the benefits that can be delivered through them are discussed.

Combined, the chapters support the following two key assertions, namely that:

- the research questions detailed in the introductory chapter are important in adding to our knowledge of Project Management, and secondly, that
- the research covers an area which has been under researched to date and as a result, the output of the thesis makes an original

contribution to the subject area and in so doing closes gaps in our knowledge identified within Chapters 2 to 4.

2.1.4 The Period of Dreadnought Construction

In the first part of this review, Chapter 2, the specific period at the centre of the study is the construction of the United Kingdom's Grand Fleet, or more specifically the period when the 36 battleships within the various Dreadnought classes were built, between the years 1906 and 1917 (see Appendix 1.1). The First World War was a period of considerable naval construction activity which saw the number of ships in the British Navy increase from '390 to 1750' (Brown, 1999, p. 10), not allowing for ships lost in action. This represents a very large shipbuilding programme indeed. If it is true that MPM began much later than the period of 1906 – 1917, as the literature suggests, then this raises many questions, for example:

- How were such a large number of ships able to be produced and to meet as pressing a deadline as that presented by the conflict of WW1?
- What management methodologies, tools and techniques were used to enable these deadlines to be met?
- What were the management records made at the time of Dreadnought construction and can they be traced today?
- Would project managers of today recognise these records as project management artefacts, or would any surviving records present a view of project delivery totally alien to today's project managers?

If the study were to evidence a significantly different method of managing the delivery of large projects, then there would be the potential to rediscover tools that could add value to today's project managers. This could benefit, for example, the areas of estimating, budgeting, contingency planning, managing additional work requests and varying risk management concerns, all of which are current issues within project management (NAO, 2015). If, alternatively, it can be shown that the methods and approaches used during the period of the study, bear resemblance to today's methods,

then it will be possible for the profession to deepen its understanding of how it has developed and to reconsider its roots and hence reconsider its direction and velocity of travel. The unknown nature of the answer to the above is highlighted by Ramadan and Tu (2012, p.5) when they report this as an under researched area stating that ‘only a small part of project management research studies project management practices’, as opposed to studying for example the reasons behind project success and failure.

The results of the current study therefore offer the prospect of adding to the canon of knowledge defining both the transition to MPM, and the reasons behind the development and need for today’s management methodologies. It seeks to add to ‘our knowledge of what to do in managing contemporary projects, as well as what to avoid,’ and by extrapolation to ‘add to our understanding of how project management should be carried out in both the present and future’ (Cleland and Ireland, 2006, p. 4).

Attarzadeh and Ow (2008) state that MPM, as a term, describes a well-understood discipline, capable of producing predictable and repeatable results. If this is true, in that it is a well understood discipline, which is capable of being used repeatedly, then it is logical to ask what the dominant tools and techniques are within the discipline and where they come from?
Attarzadeh and Ow (p.1) continue to say that the

> *‘methodologies of modern project management are highly analytical, usually requiring automated tools to support them on large projects. Like most other disciplines, it is learned through both practice and past experience. Project management encompasses many different skills’.*

Clearly the authors consider that MPM is a specific entity, and one that is dependent on ‘automated tools’, such as the computers of today. The review of the current literature addresses where MPM was first recognised and aims to understand the characteristics that made it different to previous project delivery, to investigate its perceived dependence on automated tools, hence providing a framework for the later archival research.

This does however present a problem. Söderlund and Lenfle (2013) endorse the views of Ramadan and Tu (2012) and say that as a profession, our knowledge of previous management practices and the way in which projects were organised is slight. Building on this, the feasibility of conducting historical project management research and the difficulties associated with it is discussed in Section 4.4. Within this chapter (see table 2.1) and then in more detail in Chapter 4 the literature is reviewed to find evidence of previous studies of historical project management and to assess how much they reveal about the methods, tools and techniques used to deliver these projects. If Söderlund and Lenfle are correct in saying that the evidence is limited, the Literature Review will reflect this. If this is not correct, or if the situation has changed since their 2013 article, then the literature will demonstrate the extent to which the recent literature has closed the gap identified by Söderlund and Lenfle. Should the gap still be wide, then this finding will add weight to the purpose of this study, which is to search for evidence of 'management practices' from pre MPM projects.

In addressing this, the first of the specific areas which Chapter 2 examines, focuses on the current literature recording the start of MPM.

2.2 The start of Modern Project Management

One view of the start of project management is that the

> 'project management approach is relatively modern. It is characterized by methods of restructuring management and adapting special management techniques, with the purpose of obtaining better control and use of existing resources. Forty years ago, project management was confined to U.S. Department of Defense contractors and construction companies. Today, the concept behind project management is being applied in such diverse industries and organizations as defence, construction, pharmaceuticals, chemicals, banking, hospitals, accounting, advertising,

law, state and local governments, and the United Nations.' (Kerzner, 2009, p.2).

This contrasts with the views of a number of authors such as Kozak Holland (2011), Cleland and Ireland (2006), Azzarpardi (2015), Frame (2002) who cite works of antiquity such as the building of the Great Pyramid at Gaza, the Great Wall of China and more recently the building of British cathedrals as being examples of early project management. Azzarpardi (2015) says though, that it wasn't until the mid-1950s that organisations began to apply formal project management tools and techniques. This view echoes Attarzadeh and Ow (2008), quoted above, in that they say that MPM relies on the birth of automated tools which largely came about with the advent of the computer which also began to appear in the 1950s. Frame (2002, p.1)) tells us that 'Project Management as it is practiced today, came into being in the post-World War II era.' Kerzner (2013) sees project management in the early 1970s as being the province of, and indeed being confined to, the US Department of Defense contractors and construction companies. This does suggest that MPM may have its roots in the type of defence project delivered by Manhattan or Polaris. Since that time, Kerzner (2013) sees MPM as being applied to a vast array of organisations both in the private and public sectors. Shenhar and Dvir (1996) too, are of the opinion that management historians would consider either the 1950s or 1960s as the start of the current approach to project management and flag up several large defence programs undertaken at that time as examples. They thus link the birth of MPM back to this era without concluding in favour of either the Manhattan or Polaris project as the dawn of MPM.

The views above are perhaps not as disparate as they might at first seem. All acknowledge that the middle of the twentieth century represents a time when Project Management made a significant leap forward in terms of acceptance, application and indeed function. Perhaps this should be expected, and represents a period of development at some point between the Manhattan and Polaris projects in which a new process began to be formulated within the US defence industry. If this leap forward had its roots

in the US defence program, then it will be important to understand what aspects of the program drove the developments – what were the organisational needs that induced this perceived advance?

2.2.1 The Definition of a Modern Project

In considering this question, it is important to refer to a list of modern project characteristics. Kerzner (2013) says that a project can be defined as being any series of tasks or activities which fulfils a certain list of criteria. He defines these criteria as having a specific objective or deliverable that is planned to be delivered between a pre-defined start and end date. Kerzner recognises that a project will also need to be completed within a specified budget and will consume both human and non-human resources. Maylor's definition of a project (2005) supports Kerzner's view. Maylor defines a project as consisting of a temporary endeavour, thereby having a start and a finish. Maylor continues to describe the characteristics of a project as being unique or non-repetitive activity focused on delivery within pre-specified performance, schedule and cost criteria.

One key factor here, is the requirement for 'defined start and end dates' within a modern project. This view is also supported by the definitions given by the OGC (2009) and Burke (2013), amongst others. Whilst projects of antiquity such as those listed above, at the start of Section 2.2, do often have some of the requirements listed by both Kerzner (2013) and Maylor (2005), others such as the defined start and end dates and clear specifications and budgetary limits are largely missing. The building of British cathedrals is such an example. Salisbury Cathedral's website (Salisbury Cathedral, 2021) states that foundation stones for Salisbury Cathedral were laid on 28th April 1220, and it was 'probably completed by 1266'. Part of the reason behind the uncertainty of the completion date is that Cathedrals were often continually developed over time, never seemingly reaching a 'specific objective' by a pre-defined end date. Turnbull (1993) describes the process as 'the ad hoc accumulation of the work of' a succession of nine different main contractors operating under more than a dozen major redesigns over a period of between 25 and 30 years. A similar

pattern is demonstrated by the construction history of Westminster Abbey detailed on its website (Westminster Abbey (2021), suggesting that at the endeavour's outset there was not a clear view of the projects' final state or end delivery.

Lock (2013, p. 2) expresses support for the idea that projects in antiquity were different in their make-up from the projects of today. He says that projects of antiquity had an 'urgency not driven by the rat-race' and consequently did not find themselves so confined by the pressures of the time, cost quality triangle present within today's commercially driven projects. Lock (2013, p.3) further suggests a different approach to human resource management that 'people were often regarded as a cheap and expendable resource.' Certainly, today's projects in the western world could not survive the sort of mortality rates incurred during, for example, the building of St Petersburg begun in 1703, in which 30,000 workers died (Lander, 2011). This observation helps to illustrate some of the contrasts between what is termed MPM and the projects of antiquity. Lock (2013) suggests that in the past, project management's focus on the efficient use of (human) resources has left a lot to be desired. This of course indicates not just the perceived expendability of human resource, but also the lack of value for any associated knowledge or experience within a project. In turn this suggests a lack regard for the time, cost quality triangle which has for so long been considered to be the bedrock of MPM, (Naughton *et al.*, 2013).

The modern view of the characteristics which a project displays, in terms of the type of work facilitated through the project approach, was explored by Nordon (1960). The paper discussed what was being observed in the process of computer development at IBM. Norden stated that there was a clear difference between ordinary production type work and something which was becoming to be identified as project type work. Just a year earlier in 1959, the issue was also highlighted, when it was recorded that 'among the major problems facing technical management today are those involving the coordination of many diverse activities toward a common goal.' (Kelley and Walker, 1960, p.160). They went on to expand on what was meant by

‘coordination’. They linked it to the ability to both have and organise information that could be used to form a basis for prediction and planning, as well as to evaluate alternative plans for accomplishing the objective. The checking of progress against current plans and objectives, and the ability to form a basis for obtaining project facts so that decisions can be made and progressed was also key.

These points were presented by Kelley and Walker as the bare minimum requirement, or management tasks, necessary for the successful delivery of a project in the 1950s, the time of their writing. Kelley and Walker, (1959, p. 160) recognised however that there were inefficiencies in the approach observed in 1959, due in part to the perceived increase in complexity within projects. ‘Generally, the several groups concerned with the work. do their own detailed planning and scheduling ……. independent from each other.’ This separation of production functions remained present within project management for a considerable number of years after Kelley and Walker’s 1959 paper. The need to combine elements within a project is recognised as early as 1964 in an early PM textbook. Martino (1964, p.15) discusses this need saying that all ‘elements and sub-elements compose the project. The objective is to coordinate all of them -often conflicting – in a master plan which must be a working model of the project.’ Much more recently, Fewings and Henjewele (2019) similarly acknowledge that the role of the Project Manager is to manage diverse interests and to unite differing project objectives to achieve a common goal.

MPM techniques were in use and recognised as adding value in the period leading up to Martino’s 1964 textbook. The Performance Evaluation Review Technique, (PERT), as described by Burgher, (1964, p. 103), PERT is a ‘remarkably effective method of project scheduling and coordination’ that was mandated, in July 1962, for all companies working on DoD contracts, by the US Department of Defense. This would seem to be an early, if not the first, example of MPM techniques being imposed upon contractors, and might suggest that scheduling, in this precise format, would not be found much earlier than this, as it ‘was developed in 1958 at the request of the

(US) Defense Department…when a more effective scheduling and control procedure was needed' (Power, 1962, p. 30). Martino himself, supports this development date for PERT. He writes, in 1964, (p5) 'during the past six years' (hence back to 1958) 'I have discussed and used PERT with many people.' He continues describing these early days of PERT usage as being full of sceptics, doubting the value of the technique. The continued use of PERT based techniques up to today serves to prove the views of these sceptics to be unfounded.

Whilst MPM techniques can be traced to specific years like 1958, they only facilitate the management of MPM traits, which existed prior to PERT, being accepted as a panacea. Scheduling is an issue that calls for a distinct, tailored tool and technique to manage it. The development of PERT has provided this. The description of a project outline by Kerzner (2013) and Maylor (2005) above recognises the need for other tools and techniques to help address other specific areas of MPM.

The characteristics defined at the beginning of this section, notably by Kerzner (2013) and Maylor (2005), outline what must be present within any case study chosen to explore the beginnings of MPM. As discussed above the selection of a relatively modern ship construction should meet these criteria in a way that the older projects of antiquity do not (also see Chapter 4). In studying this time period, the construction of the Dreadnoughts, it will be possible to analyse a period of project construction from before the recognised start of MPM.

2.3 What constitutes MPM and why is it seen as a post 1940's phenomenon?

Having established above that MPM, as a distinct set of management tools, began to crystallise and to be recognised across industries at the time of the Polaris Project, circa 1958, the full gamut of today's project

management tools can be seen in the guides published by the Association of Project Management (APM) and the Project Management Institute (PMI). Pinto and Trailer (1998) state that there are not many activities which place as large a demand on their leaders as project management does. Pinto and Trailer go onto list some of the issues that Project Managers need to be able to master, such as:

- understanding the interdependencies between stakeholders,
- the use of new technologies, estimating and balancing budgets and associated expectations;
- planning the project to maximise productivity; motivating others to execute the plan;
- analysing the actual results; and
- reworking and tuning the plan to deal with the realities of what really happens as the project is executed.

In order to manage a project and bring it to a successful completion these are just a small selection of necessary skills for a Project Manager.

In attempting to define these further within the study, reference is made in Chapter 3 to a range of sources which both represent and contrast the views expressed by a number of different sources. These Project Manager skills are referred to as the Essence of Project Management – see further discussion in Chapter 3.

The Association for Project Management (APM) is the UK's chartered body for Project Management and the Project Management Institute (PMI) is the American equivalent. Both of these institutions are the type of organisation which Pant and Baroudi (2008, p. 125) describe as taking a 'stewardship role in promoting the establishment of project management standards, training, education, and research'.
Perhaps Maylor, (2005, p. 7), sums up the situation in which early project managers found themselves, when he says that 'prior to the 1950s there

were no generally accepted or defined methods'. It is these seeming absences around which professional bodies such as the APM and PMI seek to establish agreement and common approaches.

Kloppenborg (2012, p.4) agrees with Maylor when he discusses the approach by which the early projects, prior to the birth of MPM, were delivered. He states that:

> 'throughout most of history, projects were conducted, but there was very little systematic planning and control. Some early projects were accomplished at great human and financial cost. Others took exceedingly long periods of time to complete. Project management eventually emerged as a formal discipline to be studied and practised. In the 1950s and 1960s techniques for planning and controlling schedules and costs were developed.'

This observation adds further support to the view that MPM is a post 1940's phenomenon at which time it began to be formally recognised as a method of managing the time and cost overruns of pre-MPM projects.

Kloppenborg continues to say that in the 1950's 'project management primarily involved determining project schedules based on understanding the order in which work activities had to be completed.' (pp. 4-5)
The emergence of a more formal approach, led to the establishment of professional project management bodies such as the PMI in 1969 (PMI, 2015). The establishment of these bodies together with the emergence of a structured, formalised discipline, are perhaps key events in establishing the beginning of what we today would term MPM. This is supported by the emergence, at this time, of early academic books dealing with Project Management as a distinct subject, (Baker,1962, Baumgartner 1963, Martino,1964 and 1965 and Peart 1971), Stretton (2007, p. 3) would seem to agree as he draws the distinction between 'traditional' and 'modern' project management:

‘When people talk about the history of project management, it is quite common for the Egyptian Pyramids (or the like) to be exampled as early historical projects. But there is rather widespread agreement that what could be validly called modern project management had its genesis in the 1950s. In the ensuing years, many distinctive project management tools, techniques and concepts have been, and are being, developed’.

Havranek (1998) would seem to support this in that he says that the traditional approach to Project Management focuses on three main areas: cost, schedule and achieving specifications, which we would today refer to as time, cost and quality. He defines MPM as having a much broader range of focus dealing with issues such as quality, risk management, human resources, leadership, organisational structure, to name a few. He goes on to conclude that ‘Project Management as a distinct discipline and profession has been developing since some time in the late 1950s.’ Havranek (1998, p. 6). If this is true, then we should not expect to see management of factors such as risk, quality or workers prior to the establishment of MPM. Certainly, in the search for the beginnings of today’s form of Project Management there is a case to be made as Havranek (1998) does, that the advent of the computer, of information systems, has allowed project management to develop some of its practises and ‘modernise’ its approach. The Polaris project is widely credited with being the genesis of PERT. Sapolsky (1972), Burgher, (1964) Power (1962) all support this view. Meredith and Mantel (2003, p. 1) quote the military as being due ‘a lion’s share of the credit for development of the techniques and practices of project management’ due to them being faced with ‘a series of major tasks that simply were not achievable by traditional organizations operating in traditional ways.’ They continue to cite the US Polaris project as the first of these ‘major tasks’.

Usually a new methodology or approach appears in order to satisfy a need or demand. Meredith and Mantel (2003) say that in the case of Project Management it was the demands due to three particular forces that drove the birth of MPM. The drivers behind these developments were the growing

demand for a broad range of complex, sophisticated customised goods and services together with the evolution of worldwide competitive markets for the production and consumption of goods and services. This added complexity to projects as they dealt with the resulting and exponential expansion of human knowledge.

These forces could, as Meredith and Mantel (2003) report, be subsumed by the single, slightly simplistic, heading of complexity. In order to deal with the increasing complexity, it was necessary to make use of emerging technologies such as the computer. It is interesting to note that at around the time of the Manhattan and Polaris projects, scientific thinking was being applied to the beginnings of commercially available electronic computers.

2.3.1 The Manhattan and Polaris Projects

To illustrate how important these developments were considered, it is worth referring to Sapolsky (1972), author of 'The Polaris System Development – Bureaucratic and Programmatic Success in Government'. Sapolsky says (p. 94) that the American Special Projects Office (the former R&D office of the US Navy tasked with delivering the US Navy's Polaris Ballistic Missile project), had 'gained an international reputation for the innovativeness and effectiveness of the management control systems.' Within this he describes PERT as 'a computerised R&D planning, scheduling and control technique developed initially in the Fleet Ballistic Missile Program' but now used more widely, although 'its adopters frequently note that PERT originated in the successful development of Polaris.' (p. 94). A wider point is then made that 'management concepts and techniques such as project management, program budget, management control centres and charting are often acknowledged to have been developed or perfected by the Special Projects Office.' It is interesting that Sapolsky notes that it is specifically a computerised planning tool which would suggest that MPM, if it is defined by its dependence on techniques such as PERT, must necessarily have come into existence during the post computer era.

The need for management systems is at one level clear, but less obvious at another. Sapolsky relates that alongside the benefit of increased control provided by innovative management techniques, there was an additional although less obvious benefit in that the fact that these techniques that were being used, helped create the perception that the Polaris Special Project Office was able to demonstrate an ‘extraordinarily effective management system.’ This perhaps was vital particularly in the early stages of the project where the US Navy (the intended users of Polaris,) ‘was the last of the three services to propose a ballistic missile program and the first to feel the effect of the new budget policies.’ (Sapolsky, 1972, p. 7). These new budgetary policies discussed by Sapolsky, followed the election of the 1950’s Eisenhower administration which promised fiscal restraint, but were due, in a large part, to increasing defence costs contributing to a growing federal budget.

Contrast this with the situation within which the Manhattan, or Atomic Bomb Project operated. General Groves states that the project had the full financial backing of the government together with the nearly infinite potential of American science, engineering and industry, and an almost unlimited supply of people endowed with ingenuity and determination (Groves, 1962). The Manhattan Project was therefore able to go about its business without too much thought for a cost management process, its over-riding success criteria being to simply deliver the Bomb before the enemy could. As Lieutenant General Somerville told Groves whilst assigning him to the project ‘If you do the job right it will win the war’. (Groves, 1962, p. 4). This demonstrates an extreme position within the Time Cost Quality trade-off triangle (Naughton *et al.*, 2013). Whilst it could be interpreted as ignoring cost, given the extreme environment of being directly responsible for the winning or losing of a world war, both cost and quality were very largely subservient to the time factor. The size of the explosion did not matter too much – as long as it was significantly larger than previous bombs, and the cost paled into insignificance compared to the cost of allowing the bomb to be developed first by the enemy.

It was possibly the initial insecurity around the Polaris project, along with the development of the computer and complexity of the project, which caused it to develop and promulgate the new, novel management processes which bolstered the narrative of it being the start of MPM. Sapolsky alludes to this where he says that in ‘programs that consume enormous amounts of resources and are subject to external review, the pressure to develop management techniques that warn of early operational weakness and that control deviations from established goals is considerable.’ (Sapolsky, 1972, p. 95). When compared to Manhattan, it is not the consumption of enormous amounts of resource which is the telling factor, as both projects had this in common, but more the subjection of Polaris to external review. The extreme and pressing nature of the Manhattan project meant that Groves had full authority. ‘Authority was invariably delegated with responsibility, and this delegation was absolute and without reservation.’ (Groves, 1962, p. 415). Combined, these factors meant that Groves just had to succeed in being the first to deliver the Bomb, whereas the Special Projects Office not only had to succeed in effectively delivering their project, but also in convincing their superiors that they would deliver their project successfully. This led to the perceived requirement to develop innovative or new management procedures in order to respond to the ‘pressure to develop management techniques that warn early of operational weakness and that control deviations from established goals’ mentioned above. (Sapolsky 1972, p. 95). This was magnified by the enormous amount of resource consumed by the project, the requirement to stand up to external review and the conflicting demands on funds, which it can be argued Manhattan did not have. Given the growing demand for a broad range of complex, sophisticated customised goods and services described by Meredith and Mantel (2003), the existing management skills reported, by Sapolsky as being ‘experience, bargaining skills and double-entry ledgers’ were deemed by areas within Congress to be ‘inadequate’. (Sapolsky, 1972, p. 96). These unmet demands within US Government fermented to produce the belief that there were deficiencies in the management processes being used to deliver major projects of the time. This was a view held across a variety of large projects and it was reported that many project planning systems of the time

possessed deficiencies as a result of inadequate methods of dealing with complex projects, (Kelley and Walker, 1959).

Complexity within projects has been defined by Baccarini (1996, pp. 201-202) as 'consisting of many varied interrelated parts, … e.g. tasks, specialists, components and interdependence or connectivity – the degree of interrelatedness between these elements.' Others (Lu *et al*. 2015), have defined project complexity as being centred on task and organisational complexities. Lu *et al*. (2015) conclude by summarising a number of previous papers' views stating that 'project complexity can be defined as consisting of many varied interrelated parts and has dynamic and emerging features.' San Cristobal (2017) echoes the views above and although he states that there is no general consensus of what constitutes project complexity, recognises that there are some commonly acknowledged causes of complexity. These are elements such as the overall number of tasks in a project, the number of interfaces, which supports the view of Lu *et al.* (2015). San Cristobal builds on the view of Baccarini (1996) by referencing Tatikonda and Rosenthal (2000) who cite levels of technology, novelty and difficulty in attaining goals as being sources of project complexity.

Project complexity is an issue within modern construction PM. Indeed, project complexity has recently been addressed as one of the most relevant topics in project management research (Cicmil et al. 2006), and 'in recent years, the construction industry has seen rapid growth in projects of increasing size and complexity.' (Luo, *et al*. (2017, p.04017019). Luo *et al.* go on to acknowledge that among both practitioners and academics, construction projects are recognised as becoming more complex. They recognise four factors driving the increase in project complexity within construction projects, namely: the degree of project uncertainty, the impact of infrastructure newness, the degree of infrastructure interconnectivity, and the infra-structure size.

This definition of complexity certainly reflects the characteristics of both the Manhattan project and the Polaris project. Equally though, it could be a description of the activities required to complete the construction of the first Dreadnought, a ship which launched in 1906, caused ‘general astonishment’ due to both its speed and ability to carry heavy armament – usually two factors which contended against each other (Brown, 1983). The ships were revolutionary in that they made older battleships redundant (Jackson, 2010), due, as stated, to their speed and armaments. These attributes were supported by the use of cutting-edge technologies of the time, such as Parson’s revolutionary steam turbines (Reay Atkinson *et al.*, 2020). The advanced design of the ships required the sourcing of a large number of different items, such as the guns and armour belts, from a wide variety of manufacturers other than the main contractor. No two ships within a class were identical, each tried to learn from earlier variants and to develop in order to stay ahead in the naval arms race. The construction involved many different tasks, specialists and components demanding management of the interdependencies and the connectivity described by Baccarini (1996). If increased complexity is at the root of the development of MPM, then the complexities exhibited by the Dreadnought construction would surely also have required, or have benefitted from, some elements of MPM management practices?

So, if high levels of complexity existed in projects before the 1950s, then the question arises as to whether there were other drivers behind the claims for the Polaris project being the start of MPM?

It appears that at this time, there was the potential for large gains, both personally and in terms of project efficiency, to be made from the pioneering of effective modern methods of project control. (Sapolsky, 1972). As early as 1956 EI duPont de Nemours & Co. (often referred to simply as DuPont) were interested in using computers as an aid in managing the increasingly complicated projects being run within their engineering sector. Specifically, they asked:

‘could a computer-orientated system be used:

1. To prepare a master schedule for a project?
2. To revise schedules to meet changing conditions in the ‘most’ economical way?
3. To keep management advised of project progress and changes?’

(Kelley and Walker, 1959, p.160.)

The Polaris project has been credited by Sapolsky as being a step change in the complexity of projects, due in part to the large numbers of specialist sub-contractors.

The paper by Kelley and Walker (1959, p.161) describes how the ‘Critical-Path Method’ was developed, at least partially, in response to the questions posed by DuPont. It recounts the reasons behind the interest in the CPM technique as being four-folds. The first of these is its ability to 'be used to solve a class of ‘practical’ business problems.' Secondly it depended on ‘the use of modern mathematics’ and thirdly it depended upon the use of the new ‘large-scale computing equipment’ for its ‘full implementation’. It had also been put into practice and been shown not just to draw on modern approaches, but also to deliver successful results, thereby re-enforcing the interest in its use. (Kelley and Walker,1959, p.161).

It is reported that the ‘first live test’ of the CPM approach was the construction of a new chemical plant, the first part of which completed in March 1958, having had an overall time span of ‘several years’, (Kelley and Walker, 1959, p. 169), suggesting that if the project completed in March 1958 and if it took several years it must have started around March 1956 or earlier.

Given this evidence, DuPont’s use of the Critical Path Method (CPM) would seem to predate its use by the Special Projects Office (SPO). A report published by the SPO relating to the instigation of the PERT technique states; ‘This report summarizes the work and results of the first phase of Project PERT (Program Evaluation Research Task). The project began on

27 January 1958 with the purpose of studying the application of statistical and mathematical methods to the planning, evaluation, and control of the program of the Navy Special Projects Office. This is supported by Maylor (2005 p. 115) who identifies the 'first users/developers' of CPM as being not just the Dupont organisation (DuPont Consulting, and Kelly and Walker (Remington-Rand and DuPont respectively), but also the Catalyst Construction Company who used it for the planning and control of a construction project on behalf of the DuPont Corporation.

Interestingly Maylor (2005, p. 115) gives the time of first use as being 1957/8 however, the evidence presented above would perhaps suggest a marginally earlier date. It is however possible that both the PERT Methodology and the Critical Path Method (CPM) were developed at the same time. Meredith and Mantel (2011, p. 307) relate that PERT was 'developed by the US Navy in cooperation with Booz-Allen Hamilton and the Lockheed Corporation for the Polaris missile/submarine project in 1958. The Critical Path Method was developed by DuPont Inc. during the same period.' Meredith and Mantel (2003) continue to say that both methods, CPM and PERT, are similar and indeed, are often combined for educational presentation. This view is supported by Burgher, (1964). Burgher says that both techniques were developed 'at about the same time'. PERT was developed with the aim of helping in the planning of R&D activities which is supported by what would seem to be the original interpretation of the PERT acronym. PERT is currently interpreted as meaning 'Project Evaluation and Review Technique' McCahon (1993), Adler *et al*., E. (1995). Others such as Shipley, de Korvin, and Omer, (1997) and Meredith, and Mantel (2011, p.307) refer to PERT as 'Performance Evaluation and Review Technique'.

Possibly the original interpretation of PERT is 'Program Evaluation Research Task as recorded by Roseboom, Clark, and Fazar, (1959, p.647). This is also the way it is presented on a July 1958 document - Summary Report Phase 1, Special Projects Office. By April 1959 there is evidence (Fazar, 1959, pp 9-15) that the Special Project Office themselves were referring to PERT as 'Program Evaluation and Review Technique.

What is important here is not so much the meaning of the acronym, but more the timing of its development. Whether we are referring to PERT or CPM both appear to date from the second half of the 1950s.

The basic steps within today's project management scheduling procedure can be defined as follows:

1. 'Identify the constituent parts
2. Determine their logical sequence
3. Prepare estimates of time and resource
4. Present the plan in a readily intelligible format'

(Maylor, 2005, p.104)

The process of constructing the Gantt chart itself is seen as being closely related to the development of the PERT/ CPM analysis. In describing how to produce a Gantt Chart, Meredith and Mantel (2011, p.332) say 'first the PERT/CPM network…is redrawn...' thereby defining the PERT/CPM to be a prerequisite of Gantt Chart construction.

The difficulty in wholeheartedly accepting this view, is that whilst it may well be the modern understanding of the project planning process there is one major historical problem in accepting that it was always thus. If PERT and CPM's existence dates from the 1950's and they are a prerequisite for Gantt Charts, then how could Gantt Charts have been used in times before the existence of CPM/ PERT?

The Gantt chart 'was developed nearly a hundred years ago' (Geraldi and Lechter, 2012, p. 579) and had its roots even further back than this in the 1890s, (Clark, Polakov, and Trabold, 1922). A number of authors such as Field and Keller (1998), Nicholas (1990) and Wren (1994) tie the development of Gantt Charts to activities during the first World War. Without the ability to perform CPM or PERT there would have to have been a different method for, or approach to, constructing the Gantt Chart. The

answer to the riddle of which came first – CPM or the Gantt chart is revealed in the development of use for Gantt Charts. Gantt originally developed his charts for use within ‘repetitive routine operations’, (Geraldi and Lechter, 2012, p. 580) a fact borne out by Clark, Polakov, and Trabold, (1922) in pages 6-8 of their book. It is in later years, around the 1950s, that Gantt Charts developed into the form and use that we know them by today. A Gantt chart, as used in its current format is in itself a presentational tool, now widely used within PM to convey details of a project’s schedule - the detail calculated by the CPM analysis. It could be argued that a Gantt Chart, as merely a tool adopted by the profession, doesn’t directly contribute to our understanding of the drivers for MPM. This view however, does not reflect the increased need for clarity of communication due to growing levels of project complexity. The Gantt Chart’s ability to provide clear communication across the project team and hence contribution to MPM, is borne out by its widespread use and central place within the professions BoKs. (APM 2006, 2012, and PMI (2017).

The development of MPM also reflects the changing focus of society in terms of the relative importance of individual facets of project management over time. An example is the introduction and use of hard hats. Hard hats first saw widespread use in 1931 during the construction of the Hoover Dam, underslung catching nets were first used in bridge building as part of the 1933-1937 construction of the Golden Gate in San Francisco (Pollalis and Otto, 1988). These additions have since developed into a wider role for Health and Safety reflected by its inclusion as a section within the APM BoK 5 (2006). The focus on health and safety is a far cry from the record of earlier construction projects. As mentioned in section 2.2.1. above, the construction of St Petersburg is often quoted as having cost the deaths of tens of thousands of workers as evidenced by Lander (2011), Blackbourn, (2007) and (Wilde 2001) the deaths being caused among the peasant workforce due, at least in part, to malaria which was present at the site of St Petersburg, but also from malnutrition and mis-treatment of the work force which suggests that the workforce were relatively unskilled and undervalued, reflecting the human resource management approach of the

time. (Lander, 2011). A similar, although much older example, is given by Reiss (2015). Reiss writes about the construction of the Egyptian temple at Abu Simbel, and again highlights the lack of a health and safety focus within projects of antiquity.

The sixth edition of the APM BoK6 (APM, 2012) includes ‘sustainability’ for the first time within its contents, again reflecting societies concerns of the time. Over time, the focus of the BoKs is inevitably open to change as cultural norms vary. Sustainability is very much more of an issue in today’s projects than those delivered at the time of the Dreadnought construction and so in attempting to define and search for the Essence of Project Management at the time of the Dreadnoughts, Chapter 3 necessarily reflects these societal changes.

Over time, it can therefore be seen that content, or the relative importance of PM content, can change as a result of societal views or as a result of technological developments such as computers and the relative importance that society places on different aspects of project management control, such as health and safety. This view, supported by Floricel *et al*. (2014), means that project management artefacts need to be contextualised within the cultural and economic norms of their time.

The discussion above, relating complexity to the development of early MPM practices, and societal demands, would suggest that similar circumstances of complexity would have impacted those delivering the Dreadnought builds, but potentially with a slightly different focus on what was considered important. The delivery of the Dreadnoughts would therefore have demanded similar feats of managerial organisation in order to deliver them within the tight timeframes demanded, but with the potential for alternative priorities in terms of PM priorities.

The research, presented here, seeks to find and trace the development of components of project management and to assess if, in the shifting focuses

over time, some approaches or methods may have earlier beginnings or indeed have been lost.

2.4 The presentation of project histories, particularly pre MPM, in academic literature to date.

In addressing the subject of this thesis, it is important to assess the extent of the work already completed in this area and to identify potential gaps within the presentation of project histories to date.

Previous academic papers relating to historical project delivery are therefore essential in establishing the current state of knowledge, and are reviewed in this section.

In 2011, Söderlund produced a list of seven historical project studies from four different sources which formed the starting point for the literature search. Additionally, Kozak-Hollands 2011 book ‘History of Project Management’ was reviewed. Through searches detailed in Appendix 2.2, and the use of snowball sampling, this study has found twenty-one studies, from seventeen different authors relating to specific projects from history. Of these, ten were written in 2011 or later, which would have meant that they were unavailable to Söderlund at the time of his writing, but does illustrate the growing interest in project histories.

Details of these are contained in Table 2.1 below:

Table 2.1 – Details of Major Project Histories Reviewed.

	REFERENCE	YEAR CONTENT REFERS TO:	COMMENTS AND FOCUS OF CONCLUSION:
1	Brown, J. K. (2014). Not the Eads Bridge: An Exploration of Counterfactual History of Technology. *Technology and Culture*, *55*(3), 521-559.	1874	Focuses on designs, materials and the story of the construction practices
2	Marshall, N., and Bresnen, M. (2013). Tunnel vision? Brunel's Thames Tunnel and project narratives. *International Journal of Project Management*, *31*(5), 692-704.	1843	The narratives around the project history, construction methods, (not management methods).
3	McCurdy, H. E. (2013). Learning from history: Low-cost project innovation in the US National Aeronautics and Space Administration. *International Journal of Project Management*, *31*(5), 705-711.	1992	Not pre-1940s.
4	Hughes, M. (2013). The Victorian London sanitation projects and the sanitation of projects. *International Journal of Project Management*, *31*(5), 682-691.	19th C.	Refers to the advancement of the management of projects. Includes table of PMBOK areas covered by the project (p. 689), but the actual management documents are not discussed.
5	Sui Pheng, L. (2007). Managing building projects in ancient China: a comparison with modern-day project management principles and practices. *Journal of Management History*, *13*(2), 192-210.	C1103-1734	Some inferences are unsubstantiated. Some organisational chart and labour costs are inferred. Some evidence is given from direct quotes, but no examples of management artefacts are shown. Some tie back to PMBOK areas of Integration/ Scope/ Time/ Cost/ Quality/ HR/ Communications/ Risk and Procurement management, no evidence of management artefacts.

6	Sapolsky, H. M. (1971). *The Polaris system development*. Cambridge, MA: Harvard University Press.	1956-1960	Not pre-1940s.
7	Norris, R. S. (2002). Racing for the Bomb. *General Leslie R. Groves. The Manhattan Project's, Indispensable Man. South Royalton*.	1942-1946	Not pre-1940s. Background on the people involved in making the atomic bomb.
8	Walker, D., and Dart, C. J. (2011). Frontinus—A project manager from the Roman Empire era. *Project management journal*, *42*(5), 4-16.	97AD	Sources used are largely textual sources. Based largely on 2 books by Frontinus, the first is an operation manual for the aqueducts in Rome, and the second outlines performance statistics for the aqueducts. Considers top level issues, funding/ decision making/ labour provision/ knowledge transfer/ legal frameworks. No evidence of specific PM docs is provided.
9	Lenfle, S. (2008). Proceeding in the Dark. Innovation, project management and the making of the atomic bomb. In *CRG Working Paper (08–001)*.	1942-1946	Not pre 1940s
10	Engwall, M. (2012). PERT, Polaris, and the realities of project execution. *International Journal of Managing Projects in Business*, *5*(4), 595-616.	1956-1960	Not pre 1940s
11	Kwak, Y. H., Walewski, J., Sleeper, D., and Sadatsafavi, H. (2014). What can we learn from the Hoover Dam project that influenced modern project management? *International Journal of Project Management*, *32*(2), 256-264.	1936	Considers success factors for project. No reference to examples of PM docs.
12	Kozak-Holland, M., and Procter, C. (2014). Florence Duomo project (1420–1436): Learning best project management practice from history. *International Journal of Project Management*, *32*(2), 242-255.	1420-1436	Conclusions are drawn from textual documents, it tells the 'story' but does not discuss PM artefacts in detail.

13	Söderlund, J., and Tell, F. (2009). The P-form organization and the dynamics of project competence: Project epochs in Asea/ABB, 1950–2000. *International Journal of Project Management*, *27*(2), 101-112.	1950-2000	Not pre 1940s
14	Rhodes, R. (2012). *The making of the atomic bomb*. Simon and Schuster.	1942-1946	Not pre 1940s
	Hughes, T. (1998). *Rescuing Prometheus*. (Containing details of 4 project histories):.		
15	i) Sage – US Air Defence Project	1950	Not pre 1940s
16	ii) Atlas – International ballistic missile project	1945	Not pre 1940s
17	iii) Boston Central Artery Tunnel Project	1982	Not pre 1940s
18	iv) ARPANET – Defence IT	1969	Not pre 1940s
19	Brooks, C. G., Grimwood, J. M., and Swenson Jr, L. S. (1979). Chariots for Apollo: A History of Manned Lunar Spacecraft, NASA. *Washington, DC*.	1960	Not pre 1940s
20	Halliday, S. (2001). *Great Stink of London: Sir Joseph Bazalgette and the Cleansing of the Victorian Metropolis*. The History Press.	1859-1870	Written more as a social history than a project management history
21	Beyer, D. E. (1991). *The Manhattan Project: America makes the first atomic bomb*. F. Watts.	1942-1946	Not pre 1940s
22	Kozak-Holland, M. (2009). Project lessons from the Great Escape-Mark Kozak-Holland looks next in his series at project communications. *Project Manager Today*, *21*(7), 24.	1944	Not pre-1940s – and limited reference to PM BoKs.
23	Kozak-Holland, M. (2011). *The history of project management*. Multi-Media Publications.	Ancient History to 1940	Book reviews past projects looking at 'how each of the nine knowledge areas of project management have been practised throughout the ages.

Each of the project histories in the table above were reviewed according to two criteria:

- Was the project at the centre of the research delivered prior to the 1940s?
- If prior to the 1940s, what does the paper report on?

If the project was not delivered prior to the 1940s (the period in which Manhattan Project was delivered,) then the paper cannot add anything to the discussion of project methodologies prior to 1940 and so was not analysed any further.

In the cases where the project was delivered prior to the 1940s, then it was possible that it could add to the knowledge of project management tools prior to the 1940s. The analysis in Table 2.1 above, shows that of the nine relevant studies, four, (numbers 1,2, 8 and 12) focus on designs and construction methods for example, but provide no systematic evidence of the project management artefacts used, instead they narrate the 'story' of the project. Three of the documents (numbers 4,5 and 23) talk about the nine 'knowledge areas' of project management, (integration, scope, time, cost, quality, human resources, communications, risk, and procurement) (Zwikael, 2009), but do not drill down beyond this to consider the specific project management tools used within these historic projects. The remaining two, numbers 11 and 20, approach project management from either a social history perspective or a review of project success factors, neither discuss the project management tools used.

This analysis shows therefore, that project histories often recount merely the events of a project, they frequently relay the story surrounding a project but don't often explore what might be called the mechanics of the project, the nuts and bolts of how a project is managed and implemented are often not evidenced in any way. Where the histories go deeper, they stop at the level of the 'knowledge areas' and evidence, through the project narratives, where and how the project research has been conducted in accordance with

these knowledge areas. Previous research therefore, lacks any detailed insights on the project management tools that were necessary to successfully control and complete projects. This implies a potential lack of understanding of the mechanisms of project management that represents a significant research gap.

2.4.1 Summary of project management literature findings

The literature reviewed in Table 2.1 above reveals an interesting trend. Many of the examples found focus on elements of projects which are constructed from personal memories and experiences. Both Walker and Dart (2011) and Kozak-Holland and Procter (2014) for example draw from texts written at the time that can claim to be related to project management but can't claim to be written with project management as the central focus. Walker and Dart for instance draw on two manuals written around the time of construction. The first is an operation manual which therefore focuses on the post-delivery part of the project lifecycle, while the second outlines performance statistics for the project again a post-delivery part of the project. Some consideration is given to areas such as the funding, decision making, labour and legal frameworks involved within the project but these are not evidenced by actual project management artefacts. Kozak-Holland and Procter take a similar approach in that they draw on general documents of the time but they lack any detailed discussion of project management artefacts. This is an important gap in our knowledge pre MPM and the key research focus of this study.

2.5 Literature relating to the delivery of Naval projects

Of the available academic literature focused on naval shipbuilding projects, there is comparatively little centred on the UK navy. The majority of what has been written is focused on the American navy. In the American context, Minami *et al.* (2010) looks at ways of preventing both cost and project completion time over-runs through the adoption of lean processes. Also,

within the US context, Cooper (1980) focuses on the issue of contract cost disputes. Outside of the US, there are a number of papers focusing on shipbuilding. For example, Levering *et al.* (2013) review the Dutch Shipbuilding practices between the years 1950-2010, Birkler *et al.* (2005) produce an interesting review of the differences between the military and commercial shipbuilding markets for the immediate period from 2005. It shows Germany, France and Russia as being the dominate markets for military shipbuilding but again, has a forward-looking focus as opposed to an historical one. Papers from the UK describing the early development of UK naval projects are, as has been said, limited. Young (2002) gives an excellent insight into the political stakeholder aspect of the UK Polaris project, that concludes that there 'developed from the mid-1950s a powerful and well-informed case for the future (nuclear) deterrent being manned by men in dark blue, rather than light blue, uniforms', (Young 2002, p.77), thereby stressing the importance of the navy over time. Corker, (2018) offers a fascinating insight into the difficulties faced, in the aftermath of WW1 by the Sheffield based armaments industry (including the Sheffield arm of John Brown & Co.) who at the time were responsible for seventy per cent of the armour made for British warships. WW1 was a time of change within the shipbuilding companies too, not just in the armament industry. Pollard and Robertson (1979) remark on the changes in the financial structure of shipyards. The 'trend towards larger and more complicated vessels' (p. 70) drove the need for greater investment in shipyards – increased size and the increased financing of both the amount and complexity of tooling required as the type of ships being built moved away from wooden iron clad ships towards steel. The increased investment required also caused, or at least was contemporary with, a change from the period up until 1914 (Pollard, 1979 p.72) where firms 'were owned by successive generations of fathers and sons…until the twentieth century' when 'genuine joint stock enterprise' made headway in the industry. This change would have been quite dramatic, the reasons for it can be seen in the striking change in the amount of investment required in for example, the tooling and the facilities and sheer size of yards and berths required to build the new 600ft warship designs. Greater investment, from a wider set of

investors would have required a different commercial structure, increased reporting and the need for different management procedures. All this suggests that this era would indeed be a good period in which to look for early traces of project management.

Other articles, for example, Atkinson (2008), look at one specific element of a potential project – the strategic effect that it is to deliver, it's reason for being commissioned or the outcome of the projects cost benefit analysis. None of the articles however, directly discuss a full or integrated range of project issues or indeed of construction management from a time period similar to that of this study. Others, such as Stratmann *et al.,* (2006) for example, consider the early or design phases of warship construction from a project management perspective, presenting this from the prospective of research with Vosper Thorneycroft carried out early in the 21st century. Keane (1996) reviews the structure of project teams and discusses the advantages of an Integrated Project Team (IPT) for US warship building. The IPT approach is a process whereby all parts of the construction team are co-located which can improve project focus and project communication. It is a process which was adopted in the UK by the UK MoD's procurement agency DE&S in the early 2000s, but which was short lived and discarded on economic grounds. The US paper by Lombardi and Rudd (2013) draws on the experience of the UK's Daring Class programme of six ships. It focuses on the increased cost of the programme and how this has been reflected in reduced numbers of ships, from twelve to six. This echoes the pressures faced by Churchill with the Dreadnought programme recorded on page 4 of this study. Lombardi and Rudd speak of changing maritime ambitions, technological challenges and related cost increases impacting on the programme, all issues faced by the WW1 Dreadnought constructors. The Dreadnought era did however have one key advantage compared to the Daring Class era. The proximity of threat and hence the benefit from, or need for, the ships was vastly more tangible. The Lombardi and Rudd paper highlights that the Daring Class programme suffered from changes in both strategic direction and sponsorship caused by government changes and three separate Strategic Defence Reviews. These resulted in the project

benefits being called into question in a way that they weren't for the Dreadnoughts, given the two very different environments into which the projects were delivered.

There have also been a number of books written, both around the time of the Grand Fleet construction and since, that provide some useful contextual information around the construction of the dreadnoughts. These are explored in section 2.5.1.

2.5.1 History of the Design Process

Brown (1983) approaches the topic from the point of telling the history of 'the men who for a hundred years have designed, built, refitted and repaired the ships of the Royal Navy.' (Brown 1983, p.11). The book quotes Admiral Sir John Fisher as highlighting the main Dreadnought design requirements as being 'guns and speed associated with suitable protection'. Generally Brown talks about the individuals involved in the Royal Corps of Naval Constructors rather than process management detail, he does however recount the story of Thomas Mitchell who was promoted to 'Manager of the Construction Department' (p.91) and subsequently was knighted as a result of the very quick build time recorded for HMS Dreadnought. This would indicate that he was the main person held responsible for the successful progress and completion of the Dreadnought, much as a project manager might be regarded today.

Pollock (1905) also mentions the Naval Constructors, but his contemporary book focuses more on the art and science of construction rather than the people themselves.

2.5.2 History of the Construction Process

In Pollock's (1905) book, titled The Shipbuilding Industry: Its History, Practice, Science and Finance, (p.81) the author describes the importance of the design process, or the drawing office, to the 'modern shipyard'. This process was then followed by the illustrating of the design in either a two, or three, dimensional format and then into detailed working drawings. These

drawings would have been constructed by either shipyard ‘designing staff’ or the ‘independent outside naval architects’ of whom Brown refers to above. The form of the hulls and their efficiency would have been tested in tanks of water, such as the ‘governmental tank at Haslar’ (Gosport, Hants). (Pollock 1905, p.85.) Pollock also notes that John Brown and Co. had recently acquired a test tank at their Clydebank works which they also used for propeller design experiments.

Whilst the above is not really indicative of a production management process, but more a design process, Pollock does state that various ship components made by other manufacturers ‘gradually arrive in the yard in the sequence required’ (Pollock 1905, pp.89-90). This implies an order and that a degree of planning would be needed to bring together all the components. Pollock goes on to discuss various processes, for example the work of the riveting teams and the caulkers in great detail, but does not address production management details. He does however talk of ‘the concurrent advance of other features in the structure’ (Pollock 1905 p.112) again intimating the degree of planning and organisation involved in the process.

2.5.3 Changes in Warship Size and Constructors

Brown (1983) also mentions an interesting shift in the preponderance of battleships built at private yards, as opposed to government dockyards:

Table 2.2 – Analysis of Battleship building yards adapted from Brown (1983, p. 92)

Battleship Class:	Dates:	No. of ships built by: Private yards:	HM
Devastation to Centurion	1869-90	16 (48%)	17 (52%)
Majestic to Lord Nelson	1893-1905	7 (23%)	23 (77%)
Dreadnought to Queen Elisabeth	1905-13	22 (59%)	15 (41%)

The implication of the above is that whilst not specifically detailed in the text, the private yards could be a significant source of production management data later in this study. The reason behind this could potentially be both the comparatively low capacity of HM Dockyards for large Dreadnought class ships, and the increase in demand since the Lord Nelson class ships. One contributory factor in this shift, although not comprehensively listed by Brown, would have been the increasing size of the classes, (see Table 2.3 and Figure 2.1 below), linked with the added capacity for large berths within the commercial yards. The apparent ability of the commercial yards to build vessels more efficiently due in part, to lower management overheads compared to the HM Yards (Spectator, 1967), or simply due to the increased output demanded in times of conflict (Brown, 1983) would also have added to the trend towards private yards.

Table 2.3: Illustration of the size of warship classes between 1905-1912. Adapted from Thomas and Patterson (2010)

PROGRAMME	CLASS	SHIP	COMPLETED (1ST OF	LENGTH (FEET)	DISPLACEMENT (TONS)	MAIN ARMAMENT
1905	DREADNOUGHT		DEC 1906	527	17,900	10 X 12"
1905	INVINCIBLE		MAR 19098	567	17,400	8 X 12"
1906	BELLEROPHON		FEB 1909	526	18,600	10 X 12"
1907	ST VINCENT		MAY 1909	536	19,250	10 X 12"
1908	NEPTUNE		JAN 1911	546	19,680	10 X 12"
1908	INDEFATIGABLE		FEB 1911	590	18,800	8 X 12"
1909	COLOSSUS		JUL 1911	546	20,000	10 X 12"
1909	ORION		JAN 1912	581	22,500	10 X 13.5"
1910	LION		MAY 1912	700	26,250	8 X 13.5"
1910	KING GEORGE V		NOV 1912	597	23,000	10 X 13.5"
1911	IRON DUKE		MAR 1914	622	25,000	10 X 13.5
1911	TIGER		OCT 1914	704	28,430	8 X 13.5
1912	QUEEN ELIZABETH		JAN 1915	654	27,500	8 X 15"

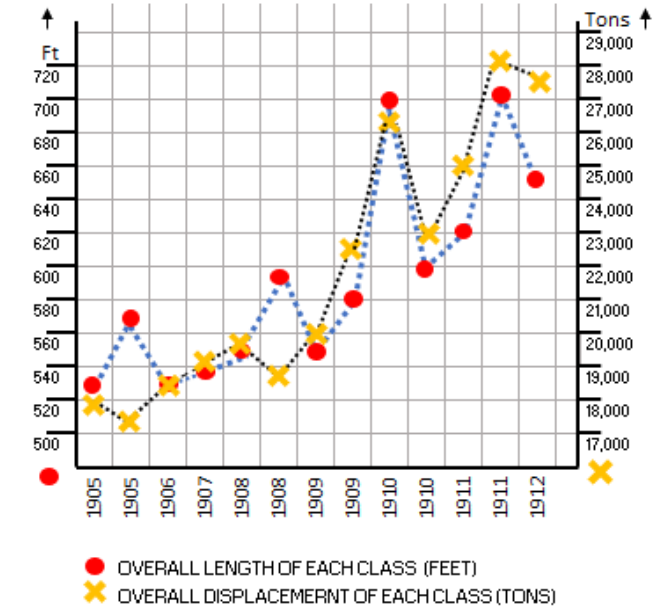


Figure 2.1: Comparisson of the growth in both length and displacement through the Dreadnought Programmes 1905-1912 - Adapted from Thomas and Patterson (2010)

The decision had been taken to build the first ship of each new class at Portsmouth. This necessitated the building of new, longer docks. (Riley, 1985). Dock numbers 14 and 15 were constructed in 1896 and had a length of 563'. Both however were soon found to be too small for the growing size of the Dreadnoughts. The 1905 Invincible class programme was 4' longer than the docks, and the 1908 Indefatigable class was 590' in length. This caused the docks to be extended again when in 1907, No. 15 was extended and No.14 in 1914 when it became 720' long. Laid down in 1909, this meant that HMS Lion (700' long) had to be constructed not at Portsmouth but Devonport. The 622' Iron Duke 1912 was able to be constructed at Portsmouth (probably in No. 15 dock,) but the largest of all, the 704' Tiger, laid down in 1912 was built at John Brown and Co.'s Clydeside yard.

The analysis above of the delivery of naval projects shows much detail, but does not record or even discuss, the project management processes used or the construction management processes used in the dockyards. Far more written information is available about the dockyard history and construction of the yards or about the design of the ships than the

management processes. Within the construction of a naval warship there is therefore a gap in the recorded project management knowledge, whether it be directly linked to modern times or to the period of the Great War.

2.6 Summary

This chapter has addressed what is meant by MPM and considered its beginnings. It has investigated how the academic literature attributes such a significant divide between pre and post Manhattan/ Polaris projects and the potential causes of this. It has also considered how project history has been presented in the academic literature to date in terms of analysis of the mechanics of project delivery, with an emphasis on those pre MPM histories. In doing so it has provided contextual information for the study. It has also identified that complexity of processes alone is not sufficient justification and that scheduling and planning tools were available before the Manhattan/Polaris project. Claims linking the birth of MPM to the Manhattan/ Polaris period are more closely connected with the PERT and CPM methods which required high levels of computational power. There is also some evidence for shifts in health and safety and the management of human resource, developments being recognised within the APM's BoK. The study will need to examine the BoK, amongst other potential sources, in order to determine the Essence of Project Management. This study will need to search for and identify evidence of the Essence of Project Management in order to establish if these shifts in emphasis can be evidenced between the time of dreadnought construction and the period identified as the birth of MPM.

Chapter 3 develops these themes further and examines what exactly should be considered as the Essence of Project Management and therefore identifies the characteristics of project management that should be the focus of any search within archival records.

CHAPTER 3

- REVIEW OF THE ESSENCE OF PROJECT MANAGEMENT

3.1 Introduction

This research aims to discover if the roots of MPM stretch beyond the reported birth of MPM in the 1940's/50's back into activities undertaken around the beginning of the twentieth century and into the management methods used at that time. This raises an interesting question around the nature of PM activities and what we know and how we know it. The term 'Project Manager' came into use in the 1950's as first discussed in section 1.4 above, but what were the PM principles that a 'Project Manager' needed to display at the start of MPM? This chapter seeks to establish what we know about these principles of PM, referring to 'the iron triangle' of PM constraints established by Barnes in 1969, (Naughton, 2013) in section 3.3.2 and by providing a review of key documents from the profession's development.

The study uses the term Essence of Project Management to describe the quintessential core, or heart, of what project management means and to identify the components that contribute to the meaning of project management.

The need to define this term stems from the fact that MPM was both recognised and established post WWII and so documented and defined in terms of this post-war time period. The study reaches back beyond WWII, and so it needs to describe activities which could potentially have been delivered pre-WWII and that could either be identified as Project Management, or be seen to be delivering the functionality of Project Management.

This chapter considers the precise nature of the Essence of Project Management at the heart of this research. This in turn enables the study to reflect on how this was, or was not, manifested in the pre-WWII era and to determine the areas of potential research within the Grand Fleet documents.

3.2 Understanding the Essence of Project Management

In order to reach a full understanding, two approaches were taken to defining the search criteria for the archival review element of the research. These explored both the first formalised (and therefore closest to the date given for the birth of MPM) BoK and academic articles focused on the subject. Alongside this, a wider societal view of projects was taken involving a holistic analysis of projects in context of the system.
To determine the Essence of Project Management first, it was necessary to establish what the purpose, aims and functions at the heart of MPM are – what is it that represents the crux of MPM? – a definition termed within this study as the Essence of Project Management. Through a review of key literature, such as early project management texts, key professional bodies of knowledge and more recent academic writings on the subject, the content of MPM is established. Given the era of the focal point of the study, these texts are sourced from a period ranging from the reported start of MPM through to modern day discussions on the topic and can be recognised as seminal texts, from a viewpoint of introducing the term PM, from providing the bedrock of the modern profession and being at the forefront of recent academic thought surrounding the theory and development of PM.

Second, in order to validate the review of focal literature the research is also viewed through the prism of Systems Theory. Project Management is often considered to have parallels with Systems theory, (Yeo, 1993, Fortune and White, 2006). This study follows the approach of Walker and Hughes (1984) who used Systems Theory to analyse aspects of a project, and Aramo-Immonen and Vanharant (2009, p.582) who state that ‘the network structure of a mega-project such as in shipbuilding’ can be used to convert the ‘results of the’…’project level analysis into system level information.’ They continue (p.586) to say in discussing Systems Theory, that ‘a systems’ view to project management is a relevant approach for a scholar because a networked mega-project structure with a significant number of interfaces between different subprojects can be seen as a multi-project system.’

Section 3.4 returns to this subject and discusses it in more detail and adding additional supporting references for the approach.

3.3 Establishing the Essence of Project Management

The study is limited to a period of some seventy years, since the documented birth of MPM in the 1940s/50s, from which to draw an understanding of the Essence of Project Management. It is quite possible that over the timeframe the meaning or fundamental tenets of project management may have changed, to reflect a maturing profession. Both Jaafari (2003) and Crawford, Pollack, and England, (2006, p.175) support this view, and indeed see it as a field that continues to develop, in 'response to changing emphases in the management community and the demands of new project management application areas.'

Geraldi, Lee-Kelley and Kutsch (2010, p.8) define a project as 'a 'vehicle of change' including a defined scope which needs to be delivered in a defined time and at an agreed cost' This is undoubtably true but in terms of identifying the Essence of Project Management a more granular definition is necessary.

If this study is to review the past for traces of project management then, given the potential changing nature of PM discussed above, it is logical to take a range of sources from across the seventy-year period. The formal identification of project management as a management tool should provide a description of what the study should be looking for in terms of evidence of PM functions. One key area noted, by both academics and professionals, as being important in this search is the professional Bodies of Knowledge (BoKs). Morris *et al.* (2000, p.155) note that the APM'S BoK for instance, forms 'a basis for baselining competencies in project management and for benchmarking project management Best Practice and performance'. Indeed, APM BoK is viewed as being 'is one of the most influential

publications on what constitutes the knowledge base of the profession' (Morris, Jamieson, and Shepherd, (2006, p.461)). The intention of the APM in developing it's BoK, was to provide the most 'comprehensive view of the knowledge required to accomplish projects successfully – one which looks at what needs to be managed across the total project life cycle in order to deliver success to all principal stakeholders'. (Morris, Jamieson, and Shepherd, 2006, p.462). This therefore results in it being at the core of outlining 'what currently might reasonably be called the discipline of managing projects' (Morris, Jamieson, and Shepherd, 2006, p.463). The documents reviewed and the reason behind their selection are discussed below in section 3.3.1.

3.3.1 The rationale for selection of sources

To provide a suitable definition of the Essence of Project Management, the documents were chosen to meet a number of criteria. The first of these is that they represent a wide spread of publication dates ranging from the definition closest to the reputed beginning of MPM through the foundation of today's professional bodies and onto recent academic articles addressing the issue. This temporal spread of sources (from 1959 through the 1990s up to 2006) enables the research to reflect elements that might have been recognised at the start of MPM or indeed that might have been unrecognised at the start yet still part of the PM approach as defined by more recent sources (Jaafari, 2003 and Crawford *et al*., 2006).

The first of these sources is dated 1959. This date is thirteen years after the Manhattan project was closed, three years after the Polaris Missile Project began and approximately a year before Polaris' 'first flight took place on 7 January 1960.' (Naz *et al*., 2008, p.1). The second document is from 1992, forty-two years into the seventy-year period, while the third is a series of articles from 2006, sixty-six years into the period. The range of documents selected is therefore representative of the spread of time since the foundations of MPM. The documents themselves also represent an authoritative voice on a number of levels.

Firstly, the documents chosen were:

a) An article from the Harvard Review by Paul Gaddis (Gaddis, 1959).

b) The Association for Project Management, (or APM), first Body of Knowledge (BoK1) (1992).

c) A series of editorials from the International Journal of Project Management in which JR Turner aims to 'derive the structure of project management' in order to develop a theory of Project Management. (Turner, 2006 (2), p.93).

Article a) is reputed to have been the first to use the term 'Project Manager' in print, Hornstein (2015, p.292) agrees with this saying 'Gaddis (1959) seems to be the first to coin the term 'project manager'' and indeed this article has been described as 'the first epoch-making article on project management in a leading journal' (Andersen, 2006. p.17) and as such helps to form an opinion as to the nature of project management, at a point comparatively close to that being studied.

Article b) represents the first dissemination of the meaning of Project Management within the UK by the Association for Project Management (APM), the UK's only, and recently chartered, professional body for PM. As such it was composed by the leading exponents of project management at the time and offers an authoritative view of the content of Project Management. This view is supported by Willis (1995, p.95) who says that the purpose behind the BoK was to 'encapsulate the various aspects of project management as it is practised', and continues to record that 'all project-management-associated aspects are covered in the BoK.' (p.96) This is further supported by Morris *et al*. (2006, p.461) who confirm that the APM Body of Knowledge, 'is one of the most influential publications on what constitutes the knowledge base of the profession.'

Article c) is the most recent of the three. Written by Prof. Turner in a series of guest editorials of the UK's preeminent Project Management peer

reviewed Journal, they offer a valuable insight into the constituent components of Project Management.

The definitions derived from these three sources were compared and a consolidated definition of the Essence of Project Management was derived which was then used throughout the remainder of this study. This was done by first reviewing for attributes that were common to either all three sources or two out of the three sources. This then left the research with some terms which were mentioned only in one of the three sources. Rather than simply discard these terms, they were reviewed in light of current PM texts for potential relevance. This is expanded upon further in Section 3.3.3 below.

3.3.2 A review of the Essence of Project Management sources

As noted above, the first of the three sources was:

a) PO Gaddis – The Project Manager

The 1959 Harvard Review article entitled 'The Project Manager' begins by stating 'In new and expanding fields like electronics, nucleonics, astronautics, avionics, and cryogenics, a new type of manager is being bred. Although he goes by many titles, the one most generally used is project manager.' (Gaddis, 1959, p.89). This article is one of the first to use the term 'Project Manager' and in it, Gaddis assesses exactly what he considers to be the role of the Project Manager. Within the article, (p.89) Gaddis sets himself the task of considering 'what does a project manager… do?' 'what kind of man must he be?' and 'what training is prerequisite for success?'

If, as Gaddis describes him, this is a 'new type of manager' then a key part of the above questions must be 'what is his role and his key functions?' and further to this, how can the answers to these questions help focus on the definition of what is at the core of MPM?

Gaddis describes the project manager's function as being to create a complex product by harnessing the expertise of those around him, from the

‘concept through the initial test operation and manufacture stages.’ (Gaddis, 1959, p.89). In doing this Gaddis recognises the need for co-ordination and organisation of expert functions through the life span of a project. He describes a project as ‘an organisation unit dedicated to the attainment of a goal – generally the successful completion of a development product on time, within budget, and in conformance with predetermined performance specifications’ (Gaddis, 1959, p.89). In doing so he highlights the need within Project Management to control costs, to complete within time and to specification, which mirrors the components of Dr Martin Barnes’ ‘Iron Triangle’. (Naughton, 2013, p.1). Barnes is credited with ‘envisaging, for the first time, the necessity and significance of integrating the three elements to improve project control. This simple illustration set the foundation of the well-known classic triangle in PM history’ (Vahidi, and Greenwood, 2009). Several sources, for example, Taylor (2015) and Langston (2013) support this view and credit Barnes with devising the Iron Triangle of Time Cost and Quality, others such as Atkinson (1999, p.337) reference earlier works from the 1950’s citing Oiesen (1971) who stated that ‘Project Management is the application of a collection of tools and techniques (such as the CPM and matrix organisation), to direct the use of diverse resources toward the accomplishment of a unique, complex, one-time task within time, cost and quality constraints. Each task requires a particular mix of these tools and techniques structured to fit the task environment and life cycle (from conception to completion) of the task.’

The article by Gaddis predates Dr Martin Barnes by ten years and establishes the emphasis on time, cost and quality control as being at the core of MPM development in line with Atkinson (1999), indeed Atkinson tells us that they are inextricably linked with measuring the success of project management.

Following on from Gaddis’s identification of Time, Cost and Specification as being central to a project’s delivery, Gaddis lists a number of factors or characteristics which he considered key considerations when defining a project:

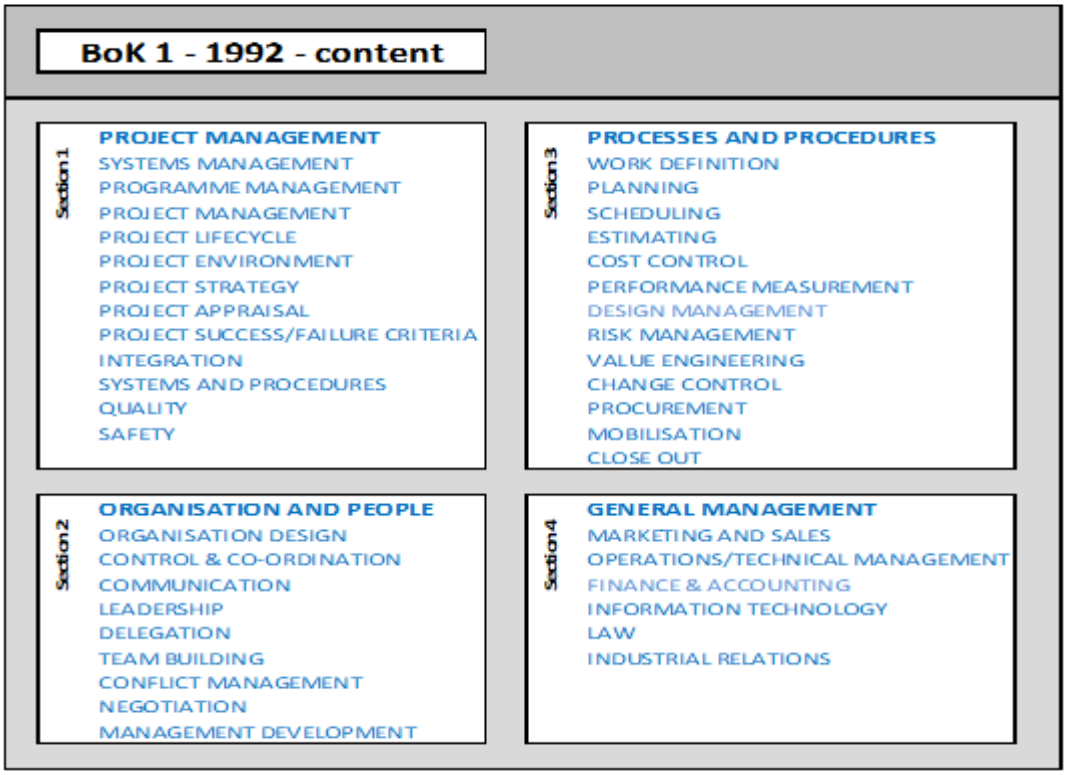
- Projects are usually structured and organised by task
- The PM manages other workers
- Delegation
- The PM's task is finite in duration
- Team tailored specifically to the project
- Lack of feedback information particularly in the early stages
- Structure – clear definition of authority and ownership
- Delivery within Time Cost and Specification is required
- Organisation Planning – 'shaping a team that can 'play over its head'' (Gaddis, 1959, p.93)
- Soft Skills – an understanding of the personalities/characteristic and attitudes of the team members
- Advance planning – avoid crises
- Good two-way communication within the team
- Goal driven
- Progress Reporting

These features, which Gaddis defines as being central to defining a project and the project manager's activity and hence to project management, are compared to the views of the APM and Turner below.

b) The Association for Project Management – the first Body of Knowledge (BoK1).

Within the United Kingdom the foremost professional body is the Association for Project Management, or APM. The APM was founded in 1972 and issued its first Body of Knowledge (BoK1) in 1992. The content of BoK1 gives a clear insight into what the APM thought the key components of Project Management were at the time that the profession was formalised, indeed Morris, Crawford, Hodgson, Shepherd and Thomas, (2006, p.712) see the BOK within PM as a 'knowledge framework', and agree that the BoK is central to establishing the compass of the profession.

Table 3.1 – BoK1 content



The introduction to BoK1 states ‘this document distils the essence of what the Association of Project Managers considers to be the knowledge and experience that people involved in the formal management of projects need to have.’ This gives additional comfort, if any were needed, as to why this publication was chosen as a source for the definition of the components of MPM. Written by the newly established and now chartered UK professional project management body, this provides a valid place from which to use in the search for the meaning of MPM.

As Table 3.1 above denotes, the APM split the body of knowledge into four areas; Project Management, Organisation and People, Processes and Procedures, and lastly, General Management. It is these areas which ‘describe the topics that practitioners and researchers see as relevant to managing projects’, Morris, Jamieson, and Shepherd, (2006). It is not proposed to look for traces of ‘General Management’ within the Essence of Project Management as this would widen the field of study considerably and take away from its focus.

The other three areas within BoK1 however provide possible areas of comparison when reviewed in light of both JR Turner's and Gaddis' articles.

It may be thought that other Bodies of Knowledge might have been worth including in greater detail. The obvious choice would have been to include the Project Management Institute's, or PMI's body of knowledge. There were multiple reasons for not doing so. Firstly, the PMI is an American body and this research is specifically centred on UK projects. The APM's first BoK predates that of the PMI by four years and so is closer to the origins of Project Management, at least in terms of the date of issue. More importantly though, Morris (2013, p61) is of the view that the PMI's PMBOK is 'too narrow in its definition of the subject', a point agreed with by Pant and Baroudi, (2008). Morris points out that the PMBOK was published 'essentially focussed on execution delivery and largely ignor(ing) the front-end' (Morris *et al.*, 2006), making it inferior in content to the APM BoK. Morris says that in 1998 the PMI published its International Competence Baseline in which it adopted the APM BoK almost completely as its model of project management. The two bodies of Knowledge are therefore very similar as can be seen in appendices 2.1 and 2.2. This degree of similarity and the adoption of PMI content identified by Morris means that the use of the UK based Body of Knowledge alone provides good coverage of what both Bodies would define as being the Essence of Project Management. It is these areas which 'describe the topics that practitioners and researchers see as relevant to managing projects', (Morris, Jamieson, and Shepherd, 2006).

c) International Journal of Project Management 2006 - JR Turner's editorials

From January 2006 through until May 2006, the International Journal of Project Management published a series of four editorials focused on Turner's call for research into the development of a theory of PM. (Turner, 2006 a - d).

A by-product of this search for a theory is, (Turner, 2006(a) p.1) the identification of a ‘number of inherent components of project management’ and it is these that will be analysed and used to help formulate the central content, or essence, of Project Management.

Turner, (2006(b), p.93) defines Project Management as being ‘the means by which the work of resources assigned to the temporary organisation is managed and controlled to deliver the beneficial change desired by the owner.’ This echoes heavily the content of Barnes’ Iron Triangle, but also in doing so highlights the importance of monitoring and control as aspects of PM, through what it identifies as the project lifecycle. The article talks of a project having a lifecycle which includes the definition of the desired end state or benefit. Turner, (2006(b), p.94) defines the four steps of PM as: ‘planning’, ’organising’, ’implementing’ and ‘controlling’. To underline this Turner reminds us here that the process of project governance has at its core the requirement of ‘defining the objectives, the means of obtaining them and the means of monitoring performance.’

In the series of four articles, Turner derives a number of ‘premises’ which he defines as ‘statements that cannot be proven. It is an assumption we make upon which we base the theory.’ From these he derives a number of ‘lemma’ defined as ‘a result that derives from the premises we have made so far’, and then a number of ‘corollaries’ which are defined as being ideas, arguments, or facts that result directly from something else. The weakness in this is perhaps that his corollaries are derived from his original set of premises, which by his own definition ‘cannot be proven’, (Turner, 2006(1) p.1) but these are well recognised basic tenets of project management, a point that became evident in the comparative part of the analysis. As a result, the list of corollaries that his articles generate is still very much of interest, particularly if backed up by the review of the other sources. The catalogue of elements which are reported in the articles as comprising Project Management can be listed as:

1. Project Contract and procurement management
2. Information Management
3. Financial Management
4. Resource Management
5. Project appraisal
6. Project definition
7. Breakdown
8. Risk Management
9. The management of the project
10. The project and project management lifecycles
11. Scope Management
12. Requirements Management
13. Benefits Management
14. Project Organisation
15. Quality Management
16. Cost Management
17. Time Management

Turner (2006(3), p.279) also begins to describe some ‘useful tools’ that can assist the project manager to deliver the elements listed above. These include items such as configuration management, bar charts, responsibility charts (combining product, organisation and work breakdown).

Professor Turner’s qualification to add light to the definition of the Essence of Project Management cannot be doubted. Professor Turner’s CV (Turner, 2018) lists two current Professorships as well as multiple past visiting Professorships and Fellowships across the world. Alongside this he is the current Editor in Chief of the International Journal of Project Management and lists over a hundred and twenty separate publications in Project Management journals and magazines. He has authored nine books on Project Management and lists fifty-seven conference presentations.

The list of project management attributes above is therefore backed with a wealth of experience and is based on the considerable amount of research undertaken by Professor Turner throughout a number of years.

3.3.3 Comparison of APM BoK1 content and the Gaddis and Turner articles.

Table 3.2 below shows a comparison between the three sources of the content in terms of PM 'topics' or attributes.

The left-hand side of the table shows the attributes mentioned by Gaddis (1959). These are listed under column A. Column B and C then detail if these attributes were found in APM BoK 1 and in Turner's article respectively. The frequency with which each attribute occurs is then recorded. It is recognised that attributes could be omitted from Gaddis, particularly given its publication date, but included in the APM BoK. These are recorded in column D and their appearance in Turner's articles is recorded in column E. All elements of Turner's articles were included within either Gaddis's paper or the APM BoK.

Table 3.2 – Comparison of APM BoK1 content and the Gaddis & Turner content

TOPICS HIGHLIGHTED IN P GADDIS ARTICLE 'THE PROJECT MANAGER' HARVARD BUSINESS REVIEW 1959	ARE 'GADDIS TOPICS' INCLUDED IN APM BoK1 &/OR TURNER'S PAPERS? P. Gaddis - The Project Manager 1959 A	APM - BoK 1 1992 B	Articles in IJPM - R. Turner 2006 C	TOTAL OCCURRNCIES OF TOPIC = [A+B+C]	TOPICS ADDRESSED IN THE APM BoK BUT NOT INCLUDED IN GADDIS D	Are Topics included in the IJPM papers by R. Turner, but not in Gaddis? E	TOTAL OCCURRNCIES OF TOPIC = [D+E]
Projects are usually structured and organised by task.	✓	✓	✓	3	MANAGEMENT DEVELOPMENT	X	1
The PM manages other workers	✓	✓	✓	3	PROJECT ENVIRONMENT	X	1
Delegation	✓	✓	X	2	PROJECT APPRAISAL	X	1
The PM's task is finite in duration	✓	✓	✓	3	INTEGRATION	X	1
Team tailored specifically to the project	✓	✓	X	2	SAFETY	X	1
Lack of feedback information particularly in the early stages	✓	X	X	1	DESIGN MANAGEMENT	X	1
Structure – clear definition of authority and ownership	✓	✓	✓	3	VALUE ENGINEERING	X	1
Delivery within Time Cost and Specification is required	✓	✓	✓	3	CHANGE CONTROL	✓	2
Organisation Planning – 'shaping a team that can "play over its head"' (Gaddis 1959 p 93)	✓	✓	X	2	PROCUREMENT	✓	2
Soft Skills – an understanding of the personalities/characteristic and attitudes of the team members	✓	✓	X	2	MOBILISATION	X	1
Advance planning – avoid crises	✓	✓	✓	3	MARKETING AND SALES	X	1
Good two way communication within the team	✓	✓	X	2	OPERATIONS/ TECHNICAL M'MENT	X	1
Goal driven	✓	X	X	1	INFORMATION TECHNOLOGY	X	1
Progress Reporting	✓	✓	✓	3	LAW	X	1
The design, manufacturing and check-out stages	✓	✓	✓	3	INDUSTRIAL RELATIONS	X	1

From Table 3.2 above, eight aspects of project management are common to all three articles, these are shown in Table 3.3 below while Table 3.4 shows a further seven attributes that are included in two of the three sources:'

Table 3.3 – Aspects common to the Gaddis, APM and Turner sources

1	Projects are usually structured and organised by task.
2	The PM manages other workers
3	The PM's task is finite in duration
4	Structure – clear definition of authority and ownership
5	Delivery within Time Cost and Specification is required
6	Advance planning – avoid crises
7	Progress Reporting
8	The design, manufacturing and check-out stages

A further seven areas are common to two of the three articles:

Table 3.4 – Aspects common to 2 out of 3 of the, Gaddis, APM and Turner sources

1	Delegation
2	Team tailored specifically to the project
3	Organisation Planning – 'shaping a team that can 'play over its head''
4	Soft Skills – an understanding of the personalities/ characteristics and attitudes of the team members
5	Good two-way communication within the team
6	Change Control
7	Procurement

These aspects of project management are common to the sources and therefore at the core of what project management is understood to be. As such they form the central theme of the definition of the Essence of Project Management which this study uses.

Having reviewed the list above within Tables 3.3 and 3.4, one further action was undertaken to ensure that nothing of the Essence of Project

Management was missed in terms of the functions searched for within the records of the Grand Fleet constructors. Some elements, such as ‘goal driven’, ‘project appraisal’ and ‘mobilisation’ found within Table 3.2 were revisited in light of current PM literature as a final check on their suitability to be included in the definition of the Essence of Project Management. A review of recent literature shows that they are phrases and terms which are frequently heard within project management today (Zwikael, Chih and Meredith, (2018), Higgins, (2018) and Tonchia, (2018)) and as such represent elements recorded in the established documents reviewed in Table 3.2, but which did not score highly across all three documents (registering just the one ‘score’), but which could potentially be part of the definition of the Essence of Project Management reflected in recent publications. In order to establish a full definition of the Essence of Project Management, both across the period of seventy years and also one which can be considered up to date, the APM’s most recent (at the time of writing) publication, BoK6, was also reviewed. It includes aspects such as the management of plant and machinery and internal and external resources with regard to project delivery, which Gaddis (1959) alludes to but does not fully spell out, and these elements of the APM’s definition of PM were added as part of the Essence of PM reflecting their relevance across the seventy years since MPM has been recognised (areas such as P3M (Project, Program and Portfolio Management) information technology and telecoms are clearly of less relevance to the period of study). These items were added to the search parameters selected through a purposive approach and are included in the final list of Essence of Project Management along with those listed in Tables 3.3 and 3.4.

3.3.4 The characteristics of the ‘Essence of Project Management

From the reviews presented above, the Essence of Project Management can therefore be listed as consisting of the following characteristics:

- Projects are usually structured and organised by task
- The PM manages other workers
- The PM's task is finite in duration
- The project has a clear structure – a clear definition of authority and ownership
- Delivery within Time Cost and Specification is required
- Advance planning – avoid crises
- Progress Reporting is required
- The project has distinct stages – e.g. design, manufacturing and check-out
- Delegation is a factor within the project
- The project has a team tailored specifically to the project
- The team organisation planning is structured to deliver synergistic benefits – 'shaping a team that can 'play over its head''
- Soft Skills – understanding of the team personalities and attitudes is required
- Good two-way communication within the team is required
- Change Control is necessary
- The project is goal driven
- An initial project appraisal is required
- Management of plant and machinery is necessary
- Management of both internal and external resources is required

It is worth noting that Morris (2001) says that the APM BOK was translated and used by several European countries including Austria, France, Germany, Switzerland, illustrating its wide acceptance as the basis for project management. Morris and Hough (1987) say that the APM BoK was influenced strongly by research into what is required to deliver successful projects. Much research, (Baker, *et al.*, 1974; Baker *et al., 1986*; and Cooper, 1993) suggests that at the core of this is the need to manage traditional items such as scope, time, cost, resources, quality, risk, procurement. Crawford and Pollock (2007, p.92) state that having reviewed PM practices across a number of different countries when analysed 'no

significant differences could be found in different countries' practices'. The commonality of the approach to project management and hence the commonality of the Essence of Project Management is noted by (Shenhar and Dvir, 1996, p.607) who observe that the '… wide deployment of projects in organizations today, has not been accompanied … by a parallel development in project management theory". This shows therefore that despite there being a recognised uniqueness in projects (Crawford and Pollock, 2007), there is a set of core characteristics which remain consistent when managing projects – the Essence of Project Management.

The eighteen characteristics that describe the Essence of Project Management in section 3.3.4 above, are therefore key to the research as it goes forward. It is hence vital that there is clarity with regard to what each characteristic means. All the phrases in the list above are recognised within recent project management literature and are defined in that literature. Project Management, though, in keeping with other disciplines uses some words or phrases to which it attributes specific and specialised meaning. Where some of the key words from the above list, potentially fall into this category, they have been traced back to current project management literature and defined as per Table 3.5 below.

Table 3.5 – Definition of key project management terminology

Key word/phrase:	Definition:	Source:
Project Task	'Project tasks are defined in relation to project objectives.' A 'project is decomposed into progressively simpler and more manageable component tasks'	Duimering *et al*., 2006. (p.239 and p.240.)
Task Duration	'the time needed to complete project tasks.'	Lorko *et al.,* 2019 (p.49)
Project Structure	'The functions of a project organizational structure include: definition of relationships in terms of communication and reporting; allocation of responsibility and authority for decision making; allocation of tasks'	Baccarini (1996) (p.202)
Time Cost and Specification	'The concept of the Iron Triangle,' 'is a fundamental aspect of how we understand success in projects. The Iron Triangle is a	Pollack *et al*. (2018) (p.527)

	representation of the most basic criteria by which project success is measured, namely, whether the project is delivered by the due date, within budget, and to some agreed level of quality, performance or scope.'	
Project Stages	- 'a six stage model of the life of a project, the stages being as follows: 1. Conception phase. 2. Planning phase. 3. Production. 4. Handover. 5. Utilisation. 6. Closedown.'	Munns (1996) (p.84)
Project Delegation	Project delegation 'involves delegating roles that a user can assume or the set of permissions that he can acquire, to other users.' Or n 'Delegation is the practice of giving a person or group the authority to perform the responsibilities of, or act on behalf of, another.'	Joshi, (2006) (p.82) APM (2012)
Project benefits	A project is described as 'an advantage on behalf of a particular stakeholder or stakeholder group'	Badewi, (2016) (p.763)
Project Soft Skills	Project soft skills consist of 'results orientation, interpersonal skills, personal account-ability, flexibility, problem solving, and planning and organization.'	Stevenson and Staerkweather (2010) (p.664)
Change Control	'Typical change control process are to enter the initial change control information into your change control log; determine if the change should be processed; submit recommendations to management and/or the customer for review and approval; update the project plan; distribute the updated plan; and monitor the change and track progress against the revised plan.'	Heagney, (2016) (p.139)
Goal Driven	The project is set up so that the 'Business goals and objectives must be satisfied in order to justify the budgeting and development'.	Levi and Arsaniani (2002) (p.46)
Project Appraisal	'The appraisal phase of the project life cycle commences with the inception of the project and ends with the sanction of the project for implementation. During the appraisal phase the key decisions on the viability of the project and the most feasible project option are made in sequence.'	Afia and Smith (27) (p.63)

3.4 Project Management and Systems Theory

Yeo (1993, p.11), contemporary with the issue of the APM's BoK1, writes that the 'practice of project management has its origin in systems analysis and systems engineering'. He continues to explain why he makes this statement saying that 'systems analysis requires the setting of clear and credible objectives' while 'systems engineering is goal-seeking, and emphasises communication and feedback control – these are all factors that can be found in the list of characteristics of the Essence of Project Management produced above.

The split between Systems Analysis (which is the identification of potential alternative approaches to a problem and then the selection from potential alternative solutions) and the implementation of that solution represented by Systems Engineering, reflects the pre-production and then the manufacture sections of a modern project lifecycle. Indeed, Yeo states that 'systems thinking and its application to solving problems began in the 1950s' 'mainly in the defence and aerospace establishments' (Yeo, 1993, p.111) which points out common threads between systems thinking and the development of MPM.

General Systems Theory was described by Boulding (1956, p.208), contemporary with Gaddis' article, as being 'the skeleton of science in the sense that it aims to provide a framework or structure of systems on which to hang the flesh and blood of particular disciplines and particular subject matter in an orderly and coherent' fashion. Another article written at this time states that Systems Theory has its roots in the post WWII world where 'the 'scientific' thesis of General Behaviour Systems Theory…..sets forth starkly the major tenets of general systems theory' (Buck, 1956, p.223).

This interestingly places the origins of General Systems thinking somewhere between the Manhattan project of WWII and the Polaris project. Kast and Rosenzweig (1972) writing in the same year as the APM was

founded, review the concept of ‘systems’ and discuss features and observations such as:

- The Input-Transformation-Output Model where an ‘open system’ is considered to be a transformation model, receiving various inputs and transforming them in some way before creating an output.
- Systems have boundaries which separate them from their environments. Distinction is drawn between a closed system that has rigid, impenetrable boundaries and an open system with permeable boundaries enabling interaction with its environment.
- Feedback enables a system to maintain a steady state. Information relating to outputs or processes is input into the system allowing changes to be made in the Input-Transformation- Output of the model. Feedback can be both positive and negative. Negative feedback allows the system to adjust to maintain its agreed course.

This approach is built upon in a more recent article by White and Fortune (2009), where the authors describe a system as ‘an organised whole or a set of components that are interconnected and working as a whole to achieve a purpose.’ (p.37).

The Formal Systems Model was described in detail by Fortune and White (2006). In constructing their model, they acknowledge the work of Checkland, (1981) who in turn drew on the ideas of Churchman (1971) and their model is shown in diagrammatic form at Figure 3.1 below:

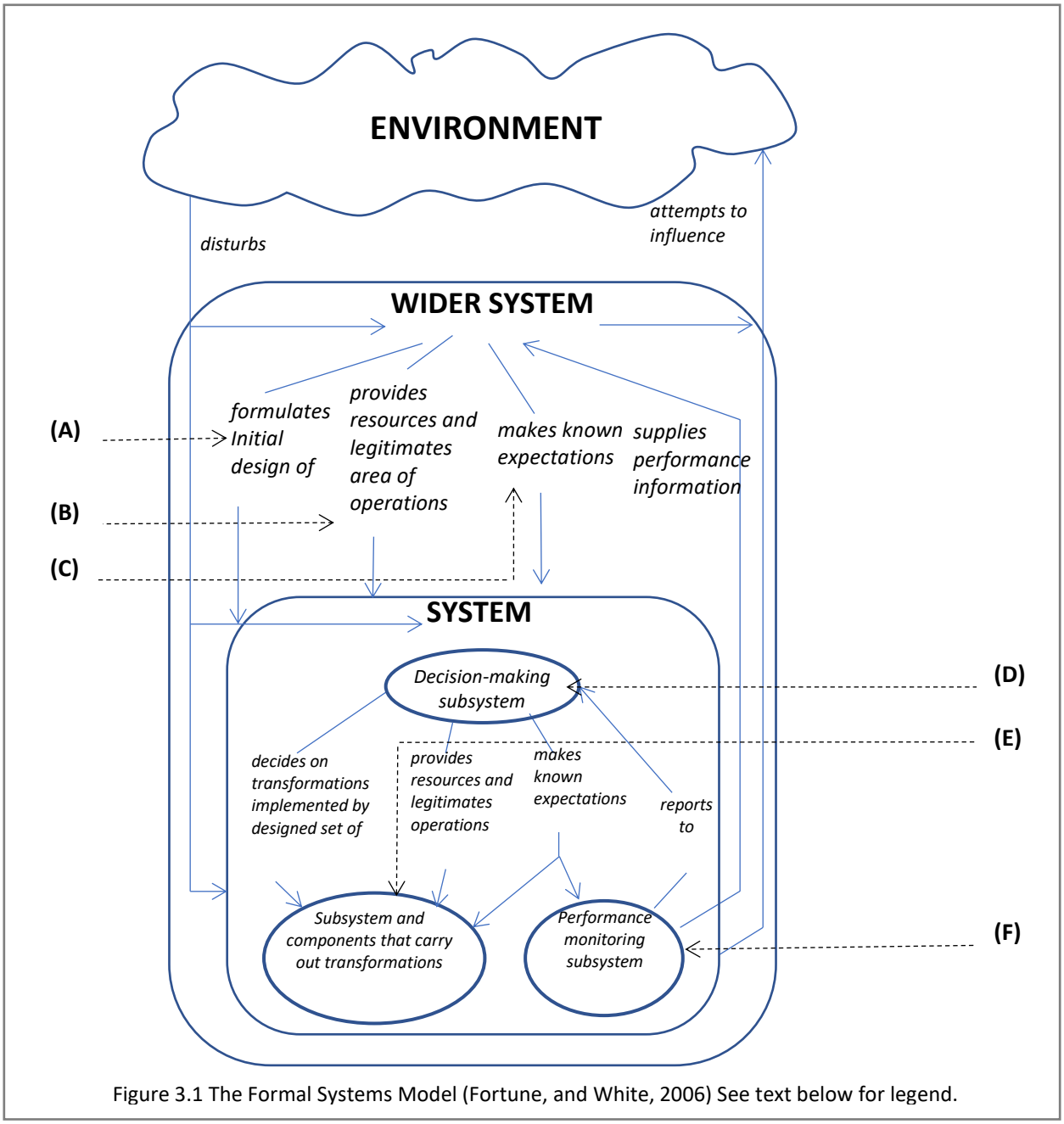


Figure 3.1 The Formal Systems Model (Fortune, and White, 2006) See text below for legend.

Figure 3.1 above shows that subject to the system environment, there are two key areas – the 'Wider System' which performs the functions of systems analysis and includes actions such as:

- (A) formulating initial design
- (B) providing resources
- (C) setting expectations

The second key area is the ‘System’ itself which undertakes the tasks of systems engineering as defined by Yeo (1993) and consisting of three main subsystems, namely: -

- (D) a Decision-making subsystem
- (E) a Subsystem and components that carry out transformations, and
- (F) a Performance Monitoring subsystem.

Koskela and Howell (2002) give support to the Systems Theory analogy stating that Project Management comprises of two different types of process, those that specify the project product and those that initiate, plan and execute the output of the project, thus drawing parallels with the ‘Wider System’ and ‘System’ shown in Figure 3.1. The Wider System and System are analogous to the design authority, or customer and the production agent or shipbuilder within this study. Thus, if it can be determined whether a particular element of the Essence of Project Management sits within the Wider System or the System, then some expectations can be formulated as to in which archive evidence should be sought, e.g. either the Brass Foundry which contains predominantly ‘customer’ records or the Scottish Business Archives which contain predominantly ‘constructor records’ (see Chapter 7, Section 7.2.1).

In order to further validate the elements of the Essence of Project Management listed above, Table 3.6 below, maps the elements against the components of the Systems Model. This helped inform future analysis when considering how the elements of the Essence of Project Management are related and contribute to each of the subsystems in turn. It is noticeable that some of the elements of the Essence of Project Management appear in multiple elements of the Systems Model. This is because items such as change control are a ‘whole life process’ and can be necessary in all parts of the project lifecycle and across both the Wider System and the System and that most elements of the Essence of Project Management are present in systems and vice versa.

Table 3.6
Initial comparison between the elements of the Essence of Project Management and the component sub-systems of the Systems Model

ELEMENTS OF THE 'ESSENCE' OF PROJECT MANAGEMENT	ELEMENTS OF THE SYSTEMS MODEL					
	A	B	C	D	E	F
	Formulating initial design	Providing resources	Setting expectations	Decision making subsystem	Transformations subsystem	Performance Monitoring subsystem
Projects are usually structured and organised by task.					✓	
The PM manages other workers					✓	
The PM's task is finite in duration					✓	
The project has a clear structure – a clear definition of authority and ownership	✓		✓	✓		
Delivery within Time Cost and Specification is required		✓			✓	✓
Advance planning – avoid crises				✓	✓	
Progress Reporting is required					✓	✓
The project has distinct stages – for instance: design, manufacturing and check-out	✓				✓	
Delegation is a factor within the project.	✓			✓		
The project has a team tailored specifically to the project		✓				
The team organisation planning is structured to deliver synergistic benefits – 'shaping a team that can "play over its head"'				✓		
Soft Skills – an understanding of the personalities/characteristics and attitudes of the team members are required.					✓	
Good two way communication within the team is required.	✓				✓	
Change Control is necessary.			✓	✓	✓	✓
The project is goal driven	✓	✓	✓	✓		
An initial project appraisal is required.	✓	✓		✓		
Management of plant and machinery is necessary.		✓		✓	✓	
Management of both internal and external resources is required.		✓		✓	✓	

3.5 Summary

The chapter provides a key building block for the study as it provides a definition of the Essence of Project Management. The definition builds on the understanding derived in Chapter 2.2 which introduced MPM as a concept.

The definition of the Essence of Project Management has been developed from key project management texts (as defined in Section 3.2 above). This definition is used going forward, together with the definition of the Systems

Theory Model given in Section 3.2.2, and forms the basis of both the search and the analysis of data as described in the following chapters.

CHAPTER 4

- HISTORICAL STUDIES IN PROJECT MANAGEMENT

4.1 Introduction

Chapter 4, Historical Studies in Project Management, reviews both the importance of historical studies within project management and evaluates their potential contribution to the development of project management as an academic subject. Alongside this, it considers the potential audience for this type of study and reflects upon how this audience can best be reached and engaged by the study of project management histories.
It addresses the various approaches taken by studies to date and asks where this study sits within the work completed to date in this area.

4.1.1 Historical Studies in Project Management

In recent years there has been a growing interest in the history of major projects and the study of how they were both managed and delivered.

> 'There are signs in recent years…. that corporations, sponsors, governments, international bodies and indeed fellow employees and managers are now paying serious attention to what project management as a discipline has achieved, and what it can contribute in the future.' (Hodgson and Cicmil, 2008, p.1).

This view is supported by Lee-Kelley *et al.* (2002, p.584) who state that the degree to which project management has become embedded within organisational design 'has resulted in it becoming a core process for most organisations.' These quotes help to substantiate the view that Project Management, as an expanding profession, needs to both know and understand where the techniques used within PM have come from. This is necessary if PM is to calculate its direction of travel and hence where it is going and how it should develop, and if it is to fully understand the context and issues within in the project lifecycle spoken of by Lee-Kelley *et al.*, (2002).

Lenfle (2014) considers that the paucity of work carried out on PM histories to date is not a shock. PM is by definition apt to 'project' forwards and, as

Lenfle notes, the teaching of management research tends to be very much ahistorical. Lenfle (2014, p.921) asserts that the lack of history means that there is a need to fill this void by studying the 'actor's practices in detail, in order to build relevant management theories.' He is not alone in this view, Cicmil *et al.* (2006) argue for research on the 'actuality' of project management to be carried out, in order to support a bottom-up approach to the study of PM, with a view to facilitating the development of PM theory.

Lenfle (2014, p.922) believes that 'historical analysis is a powerful tool to complement project management research,' and that to date it has been significantly underused in the search for understanding of management practices within projects. This lack of research into historic management of projects, Lenfle continues, is a contributory factor to the problem of relevance within project management as an academic subject, and one that is evidenced by a weak understanding of both the beginnings and the development of project management.

This comparatively recent recognition of the need, and purpose behind the study of Project Management history is also reflected in contemporary 'special issues' of the International Journal of Project Management. Two editions in particular, in 2011 and 2013, have focused on the history of Project Management. (IJPM Vol 29 issue 5, and IJPM Vol 31 issue 5). This has been followed by more recent discussion of where the study of Project Management is heading (Geraldi and Söderlund, 2018) and through which the notion of the creation of a specific academic field of 'Project Studies' has been championed. This recent acknowledgement of the need for PM history is in marked contrast to earlier content analysis of journals, for instance over the ten years between 1996 and 2006, a study of PM journal literature (Crawford *et al.,* 2006) found no reference to articles focusing on project history.

Figure 4.1 below shows how these fields of Project Studies, Project Management Research, History of Project Management, Project Histories and the History of the Management of Projects relate to this thesis.

The diagram shows the terms Project Studies or Project Management Research to be the overarching area of exploration into the area of PM. There are other subsets, but one particular subset within this area is the study of the History of Project Management which encompasses a wide area detailing societies interaction with projects. This area includes the study of Project Histories themselves, relating how specific individual projects were undertaken from a variety of different standpoints. The History of the Management of Projects is just one of these standpoints and it looks at how projects were delivered and how they provided for aspects of what was discussed in Chapter 3 – the Essence of Project Management. It is inside this last area or subset of Project Studies that this thesis is positioned.

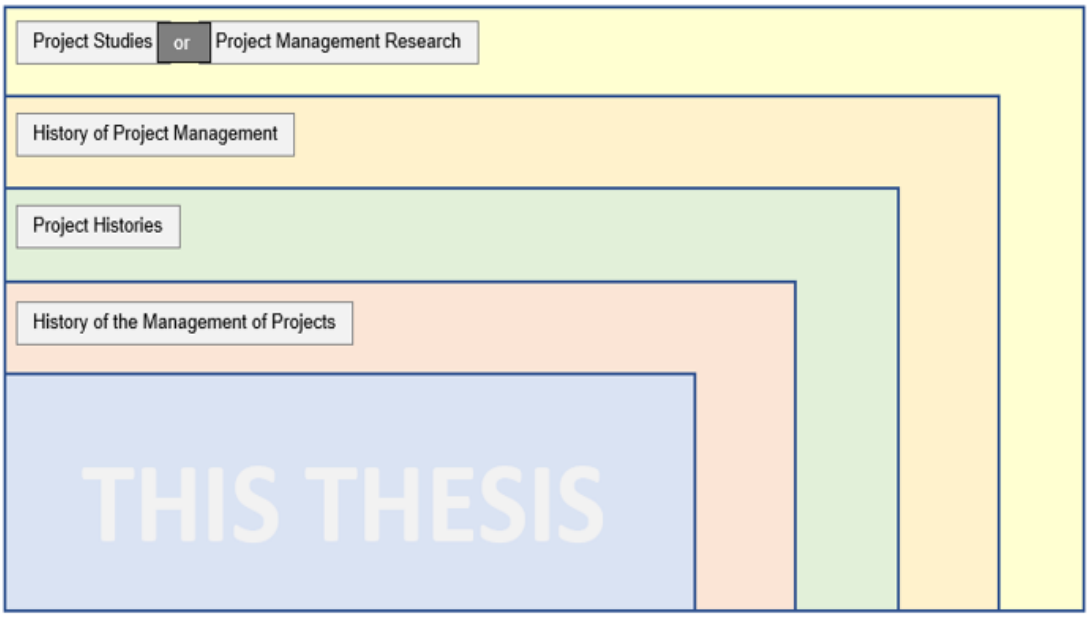


Figure 4.1 - The position of this thesis within related research fields

4.2 The benefits of the study of Project Management histories

It is acknowledged that 'projects and programmes are now commonplace in both the private and public sector' (Lee-Kelley, 2011, p.23). If projects are so pervasive, and it is recognised that the history of project delivery should

be studied, then it is rational to ask for what aim or purpose it should be studied. It should be possible to clearly identify the hoped-for benefits and to determine where any potential difficulties within the study of project history might arise.

Kozak-Holland (2005, 2007, 2009, 2011,2013) has published a number of articles in this field. His work does not tend to focus in depth on the tools and techniques as would be recognised by the Association for Project Management or the Project Management Institute, instead he uses historical projects to illuminate such things as how an adaptive enterprise is delivered so that it can meet emerging requirements, and how the project manager can deliver within a large project. Nevertheless, he is very much of the mind that using 'examples from the past helps make sense of today's projects' (Kozak-Holland, 2011, p.20). This becomes an essential duty of today's project manager if projects are to be delivered efficiently and effectively as the APM's definition of project governance requires.

Söderlund and Lenfle (2013) also reflect this, recognising that any research undertaken today is informed by past experience and past empirical studies. One benefit implied by this is that if the profession can be more certain of its foundations, it can expect to improve the basis of future research – history 'can help us to better understand the roots of project management and the evolution of current managerial practices.' (Söderlund and Lenfle, 2011 p.491). It is not however a one-way street. The authors also say that the projects of the past need to be continuously revisited to ensure that the past is interpreted with the benefit of new concepts and approaches. This leads to the conclusion reached by Kozak-Holland (2013 p.90) that 'this type of research also avoids repeating mistakes' within project delivery.

A further potential benefit of historical study is that it provides a different lens through which to view and debate project management 'truths'. An illustration of this is contained in Lenfle and Loch (2010) which reviews the Manhattan project. The authors disagree with Shenhar and Dvir's view (2007), that the Manhattan project showed the traits of organisation,

planning and direction which influenced the development of today's project management practices. Lenfle and Loch (2010) observe that the Manhattan project exhibited managerial processes such as, running a parallel development strategy (simplistically the development of both the thin and fat man variants of the bomb), and employing an experimental and concurrent engineering process. They contest that this is in contrast to the efficient, effective delivery tenets of today's project management. This suggestion however could be countered by the view that the project occupied such an extreme position, within Barnes' 1969 model of the Iron Triangle, (Vahidi and Greenwood, 2009), that these traits of parallel processes were entirely consistent with benefit realisation and the concentration on delivery time at the almost total expense of project cost. Discussions such as this offer the possibility of helping academics reassess the meaning and application of fundamental beliefs within project management thought and perhaps deliver new insights. Indeed, Söderlund and Lenfle (2013, p.655) argue that 'a better understanding of history might create an improved understanding of the difficulties in creating, shaping and managing projects – and thus add to the empirical wealth of the subject.' They can certainly, as demonstrated above, help to stimulate a conversation and hence to develop understanding, a need which Flyvbjerg (2006) identifies.

The preceding paragraph is an illustration of the 'power of examples' (Flyvbjerg, 2006). Project management examples offer the enquirer a concrete case around which to develop ideas and discuss concepts. The Sydney Opera House is another example of this discussed by Söderlund and Lenfle (2013), and one that has, they say, led to scholars debating the differences between 'project success' and 'project management success'. 'Project success' can characterise a project which was poorly delivered but for a variety of reasons, possibly societal or temporal for example, be deemed a triumph even though the project management itself was a highly inefficient or ineffective process, indeed the Opera House is just such a case. It is of course equally possible that a project managed efficiently and effectively could be deemed a failure due perhaps to a failed strategy – the introduction of the Betamax video product is a case in point (Tellis and

Golder, 1996). It is reported that the Betamax project failed due to a combination of a compromised design and total disregard for consumer preferences and lack of market research (Rosen *et al.* 1998). The historical study of projects therefore has a second benefit of enabling researchers to illustrate their core arguments and crystallise theoretical concepts around them.

If a sufficient number of historical projects was studied and documented, then once a critical mass was reached, a repository of project histories could be developed and enable 'process tracing' or pattern recognition to take place (Gaddis, 2002). From this, a greater light could be shed on the profession's development, both past and future. As part of this, Gaddis (2002) talks about a 'historical consciousness' which would, he says, enable the project management community to see the path they are on and the direction of travel, which would in turn reveal the bigger picture and the developing patterns within it. Keiser (1994) supports this view saying that historical analysis can be used to evaluate and critique present theories, enriching our understanding of them by appraising the steps which led to them.

With the completion of any modern project, we would expect a project review to be conducted (Morris 2001). The study of past projects can add a longer lens to this practice and enable practitioners to draw from a deeper well of experience. Gaddis describes this benefit well when he says '…if we can draw upon the experience of others who've had to confront comparable situations in the past then – although there are no guarantees – our chances of acting wisely should increase proportionately' (Gaddis, 2002, p.9). The hope expressed by Gaddis is that by 'expanding experience' it is possible to 'increase your skills, your stamina – and if all goes well, your wisdom.' The wisdom or insight gained should have direct impact on the delivery of the benefits discussed above as well as the potential for direct application to future projects.

Alongside the advantages noted above, Söderlund and Lenfle (2011) identified their own list of benefits derived from historical PM research, some of which are covered above. The opportunities presented by historical PM research were described as being the chance to establish a more complete understanding of project management, and within this to both identify and discuss problems generic to the practice of project management. This will in turn help to broaden the conceptual base of project management beyond its general US defence industry derivation. The study will also help identify practices that appear crucial in terms of project success, and lastly help to document the emergence of certain key project management practices, tools and techniques.

In relation to the issue of furthering the understanding of project management, Elton (1967) offers an additional viewpoint. He says that having an awareness of history can help to root an identity. In the case of project management, a better understanding of its roots is discussed more recently by Söderlund and Lenfle, (2013, p.661), who support Elton's view saying that it could help to 'contribute to defining and redefining project management as a particular scientific enquiry'.

An important potential by-product of helping to define the roots and the identity, development and evolution of project management is, as Kozak-Holland (2013, p.88) maintains, that future researchers could use 'this work towards establishing the discipline, and researching a theory of project management.' This is indeed something that the profession has, in academic circles been keen to do, particularly since Turner's series of editorials in the International Journal of Project Management (2006, a, b, c, d) focusing on the possibility and development of a theory of project management.

As Section 4.3 below, illustrates, the existing research into the history of Project Management is skewed towards large US projects. If a more rounded view of the development and building blocks of PM is to be formed, in terms of practices and techniques, this sample base needs to be widened

and the emergence of management practices both catalogued and analysed. This both bears out the views of Söderlund and Lenfle (2011) and supports the value of the research undertaken by this thesis in that it researches an area other than that of ‘large US projects’.

There are of course authors who consider the possible arguments against, or faults with, management research of the type discussed in this chapter. Tourish, (2019) regards one of the key problems within management research to be the poorly written nature of the research produced, the lack of originality within that research and the lack of appeal outside of a very narrow audience. He also questions the amount of plagiarism, data falsification and selective interpretation of evidence within some management research.

Amongst the first of these issues is the question of the originality of the research. The discussion above, along with Table 4.1 below, go some way to establishing the originality of this study, while further on (Section 4.5.1) steps are discussed which help to widen the appeal of this research. This helps to address two of the key concerns mentioned by Tourish. As to whether or not this study is open to accusations of either data falsification or selective interpretation of evidence can be judged within Chapter 5. Chapter 5 introduces research approaches aimed at counter-acting these possibilities, for example the presentation of photographic evidence and its review by an independent panel of experts.

4.3 The analysis of historical projects

4.3.1 Theoretical approaches

Whitty and Schulz (2007) seek to trace the development of Project Management and speculates on its links to Puritanism, Liberalism, Newtonianism and Taylorism (Scientific Management) which they claim have influenced the development of Project Management. Whitty and

Schulz review the spirit behind Project Management and its development. Other writers, such as Geraldi and Söderlund (2018, p.67) focus more on the development of the 'field of project studies.' They divide the 'field' into three distinct types of research, adapted from Geraldi and Söderlund (2016). These three types centre around what they term 'technical interest, understanding interest or emancipatory interest' (p.61). When viewed through the characteristics of how each approach or 'interest; seeks to develop the understanding of projects and their impact on practice, they respectively offer a focus on:

(i) how projects can be controlled, developing general theories,
(ii) the actuality of projects as a 'lived experience',
(iii) projects as a phenomenon reflecting on the development of theory.

Whilst research has been done into aspects of project history (Kozak-Holland and Procter, 2014, Kozak-Holland, 2011) these studies do not have a detailed focus on the analysis of management tools and techniques which were used to deliver these historical projects. It may be that this is due to the everyday records of project definition, management, control and monitoring having failed to survive the passage of time. This could perhaps be due, in part, to their perceived lack of importance once the project was completed and to an only relatively recent appreciation as to the potential insights that these records could offer in terms of PM development. Whilst this may be a correct perception, it is not one that has been explored, or indeed tested, to date. This is, in part, what this study addresses in approaching the search for historic PM records and in facing the challenges involved in finding such artefacts.

4.3.2 Analytical/ Disciplinary Perspectives

Söderlund and Lenfle, (2013, p.653) have said that 'project management scholars and historians have carried out surprisingly little research on the landmark projects of our past.' The paper however, states that there is much to be learnt from the history of projects and the nature of project management. The value identified is in an understanding of the techniques

used in previous projects that contribute towards an understanding of the PM discipline and how it has developed over time.
With the continuing maturing of Project Management as an academic study, there is an increasing desire for understanding its roots and foundations, to answer the question of how early projects were delivered. What exactly was in the early, or even, pre-project managers' tool box? Söderlund, (2011, p.491) reflects this stating 'there is a growing concern in the project management community about the lack of understanding of the emergence of project management and the importance of landmark projects.' (Something that Söderlund continues to reflect upon in his 2013 paper quoted above).

Söderlund thereby moves the debate onto 'landmark projects' as a specific tool that can be used to shape the form and direction of project management study.

In considering the few examples of studies of 'landmark' historical projects, Söderlund (2011) characterises them into four main areas, in terms of their authorship, each with their own short comings (see Table 4.2 below):

Table 4.2: Summary of the main sources of historical Project Management studies.

Adapted from Söderlund (2011)

STUDY/ AUTHOR:	AREA:	START DATE OF PROJECT STUDIED:	SHORT COMING(S)
The Polaris System Development. Sapolsky (1972)	Development of the US Polaris missile	1955-60	US based case study going back to 1950/60s Written by a political scientist rather than from a project management viewpoint
The rescuing of Promethus T Hughes 1998	Four US case studies:		US based projects going back to 1945 at the earliest. Written by an historian of technology rather than Project Management
	SAGE – US Air Defence Project	1950	
	ATLAS - International Ballistic Missile Project	1945	
	Boston Central Artery/Tunnel Project	1982	
	ARPANET – Defence/ IT	1969	
Chariots for Apollo: a History of Manned Lunar Spacecraft Brooks et al 1979	The US Apollo space program	1960	US space program written by historians
The Making of the Atomic Bomb Rhodes 1986	The Manhattan Project	1939	US project history written by a journalist

From Table 4.2 above, it can be seen that there are no histories of projects, written by project managers, identified in the list provided by Söderlund. This would suggest that the studies have not been written specifically from a project management viewpoint and hence potentially do not address the issues of exactly what could have been contained in the early project manager's tool box. Indeed, Söderlund and Lenfle (2011, p.491) express concern over this saying that 'with the notable exception of Morris' work (1997) and the in-depth studies of Hughes (1998) we actually do not know of any history of project management.' This is said noting that the remaining artefacts in Table 4.2, and even those of Thomas Hughes, are written by either political scientists or general historians, meaning that whilst they

provide valuable empirical data, they do not approach the study specifically from the project management viewpoint.

Since the 2011 paper by Söderlund and Lenfle, Morris has published a work titled ‘Reconstructing Project Management;’ Morris (2013, p.3) in which he expresses the view that there are still ‘some obvious omissions’ in terms of research gaps, particularly within the shipbuilding and military project areas, which he concludes deserve further research (See also Chapter 2 - Table 2.1 above, where additional material beyond 2011 has been reviewed as part of this study).

From a geographical and temporal perspective, what has been written and reviewed by Söderlund and Lenfle (2011) tends to be US based and to reach back only as far as the Second World War era. Indeed Lenfle (2014, p.4) in line with this, recognises ‘two concerns: that existing history is oriented mainly to the United States, and that there is weak understanding of the roots and evolution of project management.’ This suggests that Lenfle would consider that there is more to be discovered, both in terms of the use of Project Management tools and techniques and the way in which these have been applied and developed over the years. Lenfle is not alone in this, the quote above from Morris (2013) clearly shares this view.

Perhaps the history of Brunel’s Thames Tunnel, (Marshall and Bresnen, 2012) pushes against the US centric profile. As a project management case study, it is interesting as it discusses the way the project was delivered in terms of how the physical build was approached and the various elements of construction. What it does not do, other than very briefly, is to refer to the project management tools and techniques used. It does not tell of the management artefacts produced, nor does it analyse the project control documents so that they can be compared to the methods of today and any divergence, whether large or small, can be judged. As a project history, it remains weak in terms of the ‘understanding of the roots and evolution of project management’.

Discussion of this lack of research into the tools and techniques of PM is not necessarily a criticism, as Söderlund and Maylor (2012, p.690) point out, to 'address the complexities of real projects it is necessary to view them from different angles, since it is only through these multiple angles that the viewer can actually get some idea of the many features inherent in the work.' It is however an observation that this kind of research is, to date, thin on the ground.

Project Management authors such as Morris (2013) are of the view that there are opportunities for researchers to further explore the development of the project management discipline and for them to consider the meaning of the management of projects, rather than merely applying its methodologies in a mechanistic way. Both Söderlund and Lenfle (2013, p.654) support this saying that 'there is definitely …room for more historical studies of projects and project management – describing and analysing it from a project management point of view.'

4.4 Some difficulties of studying project history

Despite the benefits discussed in section 4.2 above, there are also many challenges in undertaking studies of historical projects identified in the literature.

When compared with numerous approaches to qualitative research, a key difficulty of historical research is summed up by Baker (1997) in the title of his intriguingly named paper 'The Dead Don't Answer Questions'. Hughes (2013) refers indirectly to the effects of this and in talking about historical project research says 'in terms of the paper's perspective, it is no longer possible to undertake original empirical work and so consequently the analysis is based on secondary sources.'

A further difficulty in studying Project History is highlighted by Söderlund and Lenfle (2013) who say that there is a considerable difference between Corporate History and Project History itself. Corporations typically fund the writing of their own histories, such as, in the timeframe of this study, the History of Vickers, by Scott (1962) however these studies tend to concentrate on the development and operations of the corporation. The detail of everyday operations is seldom covered.
Kieser (1994, p.619) sees historical material as ‘inexhaustible’. Whilst this may be not be true for all types of projects, depending directly on the volume of archival material that survives, Kieser continues to analyse the issue stating that due to the potential volume of material ‘a selection cannot be avoided’. This selection needs to be made carefully if an element of researcher bias is to be avoided.

Söderlund and Lenfle (2013, p.657) highlight a different area of potential difficulty experienced in the historical research of project management. They discuss the temptation of ‘presentism’ where the researcher risks looking ‘for traces of the present in past projects’, at the expense of accurately analysing past activities.

An equally important issue is the problem of ‘finalism’, also defined by Söderlund and Lenfle (2013, p.657). They see the danger as being that of ‘trying to find the foundations of the present in some distant times, and analyse history as a finalised process that necessarily leads from that point to the present.’ This in some ways could be considered the opposite of ‘presentism’ in that it looks at ways in which the past could have led to the present, or final, destination, rather than looking at how traces of the present could be reflected in the past.

The ‘power of example;’ as discussed by Flyvbjerg (2006) (see section 4.2), helps to counter these problems and to establish an approach of using ‘history as a method to question and deconstruct existing concepts and truths’, which Lenfle (2014, p.6) attributes to Foucault saying that the study of project management history can help us to critically examine existing PM

theory and to uncover project managers' actual practices. Thus, the issues of presentism and finalism are risks and difficulties that the study faces in analysing any relevant archival finds. With thorough investigation and an appreciation of the issues, these dangers can be, at worst, reduced to a manageable level.

4.4.1 Potential difficulties of positioning research with the PM field.

In researching past projects, it is worth noting that there are a number of different 'categories' of, or approaches to Project Management research that can be undertaken. Söderlund and Lenfle (2013, p.657) list the following five types of PM research:

1. 'History of project management practices
2. Landmark projects and project narratives
3. Corporate project history
4. History of project-based production
5. History of project managers'

The second of these categories – 'landmark projects and project narratives' is in a sense the odd one out as it centres on single projects – not on a particular concept or technique overtime. It leads to the in-depth documentation of one particular project. Söderlund and Lenfle (ibid) are of the opinion, as is Morris (2013), that there are many cases within this category that remain to be analysed and with the potential to offer rich lessons for the PM community.

This study falls into this category. It uses one particular project, or ship, as the central unit of analysis and so points towards this second category rather than, for instance, the third – 'corporate project history' which would mean that the unit of analysis was the organisation that constructed the ship, rather than the ship itself.

The narrower focus of category 2 in contrast to category 3 does however throw up a potential difficulty for the researcher.

The challenge that this provides for such studies is whether or not it is possible to find production management data relating to one specific project after significant time has elapsed. Corporate histories tend to be better preserved than what could be termed ‘everyday records’ for a number of reasons. They are often specially commissioned and published, again Scott (1962) is a prime example. By virtue of the very fact that everyday records are exactly that, they tend to be valued less by the companies that produce them and so are often badly preserved, if at all. Schwartz and Cook (2002, p.1) state that ‘archives are established by the powerful to protect or enhance their position in society’ in the ‘selection of a tiny fragment of all possible records to enter the archive’ memories of the past are shaped. It is, they say, the cost of archiving every record which leads to the preservation of just those records interpreted as ‘important’. This is an example of the issues around material selection, and hence, bias discussed by Kieser (1994).

This means that complete pictures of a project’s everyday project management procedures can be hard to find. If they can be found, they might produce a sketchy picture, there might be holes in the records which again could leave the researcher open to the dangers of presentism and finalism as described by Söderlund and Lenfle.

This potential lack of project information leads to the tendency pointed out in Söderlund and Lenfle (2013) of looking at the extremes of project management performance. This leads to two types of projects being studied, either the really well delivered projects or the abject failures of the project world. These tend to have better kept records, indeed Söderlund and Lenfle (2013, p.659) reflect on this danger saying:

> ‘should we only study the extremes, are then (sic) only ones possible to study actually the extremes, since the mundane perhaps normal projects which actually perhaps concerned the most people, are not accessible because no one bothered to save records about these everyday projects so to speak.’

This leads to the danger that we are then creating a history of the best and the worst, but no history about the life of normal projects. The obvious concern with this is that we could end up presenting the exception as the rule, if we do not study ‘middle of the road’ projects. Kozak-Holland also acknowledges this potential problem, saying (2011, p.527) that he excluded many historical projects from his studies because ‘their documentation is sparse and sporadic, or non-existent, or there are no archaeological records or ethno-history. Only the final output of these projects.’

In studying operational history, Kieser (1994) expresses a different opinion with regard to historical studies. He states that one of the weaknesses of historical research is that ‘since the historical material is inexhaustible, a selection cannot be avoided’. The result of this is, that it is the choice of the researcher that effectively then writes history. This is doubtless true if there is indeed an endless supply of data to be reviewed. In balancing Elton’s view expressed in Section 4.2, with that of Söderlund and Lenfle in the preceding paragraph, a sharp focus on the subject area and firm definition of the unit of study is required (discussed later in Chapter 5). This focus means that the amount of relevant information is vastly reduced making any selection of material potentially less open to researcher subjective due to its comparative scarcity, and perhaps more dependent on issues of survival.

In Kieser (1994) and Haussman (1991) it is reported that any historical event can have multiple causes. The paragraph above reflects a similar issue to that reported by Kieser and Haussman, since there is the potential for any findings to be subjective. If several factors have been identified as a possible cause then it is incumbent on the researcher to establish which of these factors alone (if any) would have been sufficient to bring about the outcome. If no single cause proves to be sufficient on its own then a complementary set of causes should be considered.

4.5 The relevance of PM History and suggested approaches to it.

Section 4.5 analyses four key texts with a focus on both the importance of and approach to undertaking research into project management histories. It builds upon the preceding part of this chapter and considers how these texts might impact on and help frame this research. The examples of case studies given in the papers come from both recent and ancient timeframes and demonstrate how lessons may be learnt and help to consider the suitability of research techniques within the field. The overarching aim of the papers is to put forward the case of project histories as a vehicle of contemporary relevance in expanding the Project Management knowledge base.

The first of these papers, (Jacobsson and Söderholm, 2011) covers the potential approaches to the study of project histories and reviews the possible research approach required in order to make project research both relevant and interesting to today's project managers.

Building on the first paper, the second paper (Sankaran, 2018) proposes that lessons can be gleaned from four purposefully selected 'megaprojects', and considers how this could be done.

Procter and Kozak-Holland's 2019 paper discusses the relevance of historical projects, focusing on demonstrating the contemporary relevance of PM research from case studies of historical projects. In doing this they extend the coverage of the review from recent history back to ancient histories and adopt an alternative approach in order to do so.

The fourth and final paper considers how historical case studies enable us to expand our knowledge base, providing a description of the research methods and techniques used to demonstrate the relevance of project histories to contemporary project management.

4.5.1 Can project histories be of interest to today's PM?

Jacobsson and Söderholm (2011) argue that in order to be of interest to the research community and to contribute to that area of research, research should both describe and reflect the phenomena, or observable facts, of the field being studied. The view expressed in papers by Lenfle (2014) and Cicmil *et al*. (2006) is that the lack of historical study in this area of project management histories leaves a gap in our understanding of the actor's practices within PM which in turn, limits our ability to build relevant management theories.

Jacobsson and Söderholm (2011, p.378) say that a 'partly new strategy' is required in order to broaden the base of academic interest by making research on projects relevant and interesting to a wider audience and to so demonstrate its applicability to fields of organisational and management theory.'

The authors are of the view that new theory will only prosper if it is of interest to a specific audience. Drawing on the work of Davis (1971), they say (p.379) that 'what the research community finds interesting is theories and propositions that deny certain assumptions …' and that 'contradict old truths' and 'taken for granted assumptions.' Ferraro et al, (2005) recognise that exploring these 'taken for granted assumptions' is a valuable undertaking in itself if research is to facilitate change and the advancement of the subject. This interest is echoed by Hodgson and Cicmil, 2008, who say that there is now significant attention being paid to what project management has achieved, and what it can contribute to project management's future direction. In this area of growing interest Lee-Kelley *et al*., (2003), also support Jacobsson and Söderholm in highlighting the importance of reflecting the phenomenological or contextual factors within projects.

As a result of the perceived need to make research relevant, Jacobsson and Söderholm (2011) suggest that the adoption of a new, focused approach will make project management research relevant to a much wider audience. Using four different case studies they outline four different 'alternative

strategy(ies) needed to take ….project research to the next level', (p.379.)
This takes a dual approach, firstly inviting theories from outside the PM field, which they see as having the potential to challenge conventional truths and secondly the authors discuss the need to build a 'new conceptual model' to focus future research on, (p.381).
The four approaches they outline are termed:

i). In search of best practice
ii). In search of legitimacy
iii). In search of inspiration
iv). In search of contribution

i) Best Practice

The first of these suggests that research should be approached from both an efficiency and effectiveness angle, seeking to define the most appropriate tools and techniques for the Project Manager. Viewed very much from the practitioners' angle, this would result in helping to establish best practice within the field. This, the authors argue, defines the audience for the research as being the PM community itself, a view supported by Kozak-Holland (2011) and Söderlund and Lenfle (2013), and leads to a tendency to see PM success as a problem of delivery optimisation.

ii) Legitimacy

The second focus for research is that of legitimacy. Having a similar practice led emphasis to that of best practice, it seeks to broaden the theoretical base of PM incorporating theory from areas such as Teams, Leadership, Cost Control and Governance amongst others. This is not dissimilar to the approach taken by Shenhar and Dvir (2007).

The danger however, within this approach is identified (Jacobsson and Söderholm, 2011) as being that it often seeks to analyse how well the theory fits the known environment of PM, effectively giving way to the 'taken for granted' assumptions to which both Jacobsson and Söderholm (2011) and Davis (1971) referred. Its primary audience is similar to that outlined

above – the practitioners themselves, and the usefulness is again defined as a measure of its relevance to the practitioners.

iii) Inspiration

Deliberating on inspiration as a PM research stream, the authors define this focus of the research as being the explanation and understanding of projects as phenomenon, or observable facts. Projects themselves are seen as one organisational form amongst others, part of a wider social or business system, meaning that the research agenda is more open and invites contributions from other backgrounds.

In the same way that Söderlund and Lenfle (2013) argue that the improved knowledge of the history of projects could create a better understanding of how projects are managed, the authors here express the view that this better understanding could also be gained by drawing on a broader theoretical base, one that could 'inspire' the development of PM theory.

iv) Contribution

The fourth approach to research is described as a search for contribution. Here Jacobsson and Söderholm, (2011 p.384) discuss the part that the study of the 'uniqueness of projects…or project-related issues' can play in the development of PM theory, perhaps either directly or through the 'power of examples' (Flyvbjerg, 2006), which can help the development of theory by giving new theories a point to coalesce around.

The above approaches are supported by both Gaddis (2002) and Keiser (1994). They respectively discuss a historical consciousness which enables the PM community to identify the path they are travelling on and hence the bigger picture and the developing patterns within it. This leads to the view that historical analysis can provide a deeper understanding of present theories by evaluating the steps which led to them. Jacobsson and Söderholm (2011) offer an assessment as to how this historical consciousness can be developed and Figure 4.2 below summarises how they recommend that this is tailored for specific audiences.

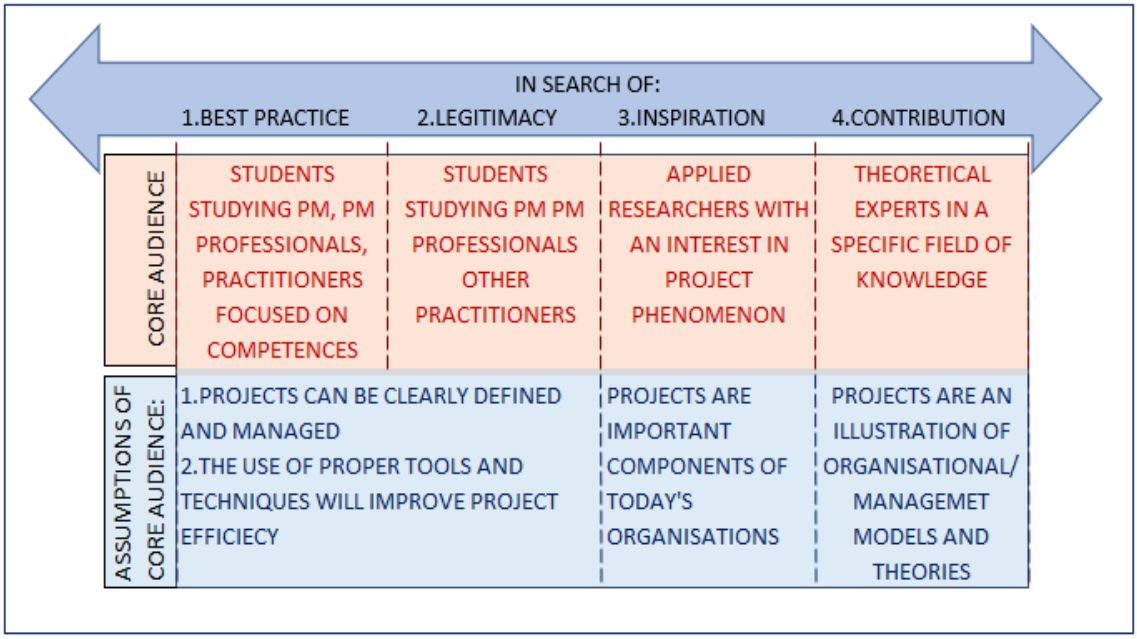


Figure 4.2: Summary of the four streams of research (taken from Jacobsson and Söderholm (2011))

Jacobsson and Söderholm (2011, p.386) state that 'in order to be perceived as interesting to a specific core audience, the theories and propositions presented need to deny some, but not all, of the 'taken for granted' assumptions'. From a perspective point of view, project management histories are ideal vehicles to provide alternatives to some of these 'taken for granted assumptions. PM itself tends to take a forward-looking stance, and tends to look to the future, which leads to it having a very much ahistorical stance. (Lenfle, 2014). In pushing against this, PM histories introduce a new and possibly unexpected viewpoint. Adding to this a direct challenge to, or questioning of, long held assumptions produces an interesting angle for research, even if the original assumptions are, after research, held to be true. If this were the case, then in taking this approach the least that is achieved is a validation, or strengthening, of these assumptions. Jacobsson and Söderholm's approach does therefore provide a vehicle, through the field of interest or relevance, by which PM research can be widened.

4.5.2 PM lessons drawn from studies taking ‘alternative’ approaches

Sankaran (2018) contributes, in a slightly different way, to this cross fertilisation of research. He adopts a narrative enquiry approach often seen in other research areas such as organisation studies, (Boje and Boje, 2001 and Czarniawska-jeorges and deMontheux, 2005) or psychology where narrative analysis can be used to consider the meaning of research findings within specific historical contexts and hence help to understand behaviour and actions (Esin, 2011). By using a methodology ‘new to project management’ research (Sankaran, 2018, p.53) it can be argued that the research is opened up to alternative research areas where this methodological approach is both more common and more suited. This can provide ‘wide implications for..society’ and other areas outside of main stream PM research.

Sankaran’s paper focuses on aspects of leadership demonstrated within a variety of large projects completed within the last 140 years.
The research centres on reviewing the life stories of ‘megaproject managers’, (Sankaran, 2018. p.55), it identifies key themes in the, predominantly, secondary data reviewed, (a series of six books focusing on the lives of the megaproject managers) and asks what can be learnt from their life stories.

The Project Managers reviewed in the article are John and Washington Roebling (Brooklyn Bridge), John Frank Stevens (Panama Canal), Grahame Campbell (M4 Western Highway, NSW) and Elattuvalapil Sreedharan (Pampan Bridge, Konkan Railway and the Delhi Metro). The studies result in a number of similarities between the project managers’ leadership styles being identified. These do seem to add value to a description of PM leadership styles but also highlight the necessity for someone to undertake the task of ‘institutional management’ (Sankaran, 2018. p.76). This is deemed necessary due to the nature of the megaprojects studied. By definition, they are of such a size that they draw the attention of public bodies, local and national governments. This is discussed as being a role perhaps over and above that of the PM, a person who is in a position to give

the project top-cover, whilst not perhaps being suited to the day-to-day project management of the PM. The similarities identified between the project management leadership roles are listed as being a need to:

- select the right people and to give them sufficient training
- build trust
- deal effectively with power and politics
- be ready to innovate

Whilst these are not specifically included as knowledge areas in for example, the Association for Project Management's Body of Knowledge (6th edition) (APM BoK6) (see Appendix 2.1), a case could be made for them being alluded to in various sections of APM BoK6 on Resource Management, but it isn't made as explicit as in Sankaran's findings above. Assuming these findings to be accurate, and they certainly appear well supported within the article, this method of narrative research does offer potential learnings, and an opportunity to refocus the PM lens. In doing so, it supports the suggestion that new, alternative methods of research analysis have potential relevance within the sphere of PM research. This does however depend on reliable project histories having been written and kept, or on the ability to interview contemporaries of the PM, this raises the question of how far back into history is it possible to research?

4.5.3 Lessons drawn from megaprojects of antiquity and their relevance

The third paper studied in this section extends the delivery of major projects back approximately 4,580 years to 2,560 BC and analyses the construction of the Great Pyramid of Giza. (Procter and Kozak-Holland, 2019).

The authors make the point (p.364) that there 'is very little reliable documentary evidence from the time of the construction of Giza' and hence note that similar to the approach taken by Sankaran a year earlier, they will use secondary 'evidence from the literature of many disciplines'. The paper then follows Sankaran in providing a narrative approach to the research.

Both research studies are clearly case studies, an approach described by Yin (1994) as being ideal when there is a requirement to address how or why questions. This wider approach to PM research is supported by both Morris (2013) and Hodgson and Cicmil (2016, p.745) who's work helped to 'either reframe(d) projects and project management using novel theories or ideas, or challenge(d) established totems of faith in the project management field' and to establish a wider base for PM within academia, much in line with Jacobsson and Söderholm's (2011) approach.

The issues involved with undertaking research 4,580 years after the event are highlighted by Procter and Kozak-Holland (2019, p.366) who reveal their 'sole early source' of written evidence concerning the pyramid's construction as being authored by a Greek traveller, some 2,000 years after the project's completion. Whilst this evidence may seem somewhat distant, the authors also draw on modern techniques such as DNA analysis that can provide further evidence of the origins of those who worked on the construction and can be used to assess, and build upon, previous archaeological evidence. Procter and Kozak-Holland (2019, p.368) having analysed the changing pyramid designs over a period of some 320 years, do offer some evidence of PM and state that the 'progression in pyramid building demonstrates the development of building techniques and project management from experience.' The evidence of PM however is slim and could be described as learning from experience. With the exception of the Bent pyramid of Snefru, there is limited evidence of, for example Change Control as a process, even here the author's do not refer to a formal change control process such as PMs of today would identify with. Across the six pyramids discussed there is no continual thread of project management encapsulated in one project manager – but rather more evidence of learning from experience at a societal level. There appears though to have been a deliberate attempt to capture this knowledge, indeed Procter and Kozak-Holland (2019, p.377) say that the leader of the Giza project, 'Hemienu had been prepared for this role (building the Giza Pyramid) all his life with extensive knowledge of previous pyramid projects'.

The paper overall draws on sources written between 1962 and 2018 and reports on little resembling primary evidence. Much of the paper discusses details of construction plans, of the physical appearance, of the pyramids and consequently reflects little of what today would be called PM tools (see Appendix 2.1). This is to be expected given the degree of antiquity surrounding the project, but none the less, illustrates the increased difficulty of both finding and correctly interpreting evidence of PM process with the passing of time. This can however lead to generalities or errors being made. For instance, Procter and Kozak-Holland (2019, p.374/5) say that the workforce varied between 13,200 and 40,000 workers over 10 years. They follow this by stating that 'each day, 21 buffalo and 23 sheep were sent to the site …where the workforce feasted at night'. This would seem to be a wholly inadequate supply for 13,200 workers let alone 40,000, and the consistent nature of the supply, as stated, also fails to reflect the varying quantities necessary to mirror the variations in the workforce numbers.
The Giza project shows how society's structure was mirrored within projects, for instance in the reflection of the hierarchical military structure within the work-team structures. What is unresolved though, is whether this is a reflection of wider society impacting projects, or a way of society using large construction endeavours, projects, to help unite and structure society itself. Potentially it is a hybrid of the two. The paper provides significant evidence for the construction of the pyramids having been organised along project lines, involving aspects such as learning from experience, teamwork and leadership and approaches to scope and risk management. The evidence is more convincing for the soft skills of PM relating to people and how they are led rather than the harder issues of PM such as formal change control or scheduling. This may be because project records have simply not survived or because these activities were undertaken and recorded in ways that we would not recognise today, whereas the softer skills related to projects are reflected in the records such as those of the Greek traveller recounted by Procter and Kozak-Holland.

The discussion and comparison with the ten characteristics of megaprojects given by Flyvbjerg (2014) suggest that the analysis of past PM case studies

has something to offer the today's PM. Even after a period of more than 4,500 years, the case studies can produce observations and lessons learnt that still have relevance today.

4.5.4 Approaches to the study of historic project management

Having validated the view that today's PM can learn from previous PM case studies, it becomes important to consider how history can be reviewed in order to develop a PM case study.

Procter and Kozak-Holland (2015) outline a number of historical case studies and consider the methods and techniques used. Chief amongst these is to 'gather and integrate existing documentation from different disciplines about well-known case studies and, from this evidence, reinterpret existing knowledge', through a PM lens. (Procter and Kozak-Holland, 2015, P.2). The aim in doing this is to enable today's PMs to appreciate historical case studies and what they can uncover for us regarding the delivery of projects.

In approaching the four case studies outlined in section 4.5, Procter and Kozak-Holland analyse the relationship between epistemology, methodology and method of their studies and formalise it by drawing on the work of Carter and Little, (2007) and reproducing the following diagram, (Figure 4.3):

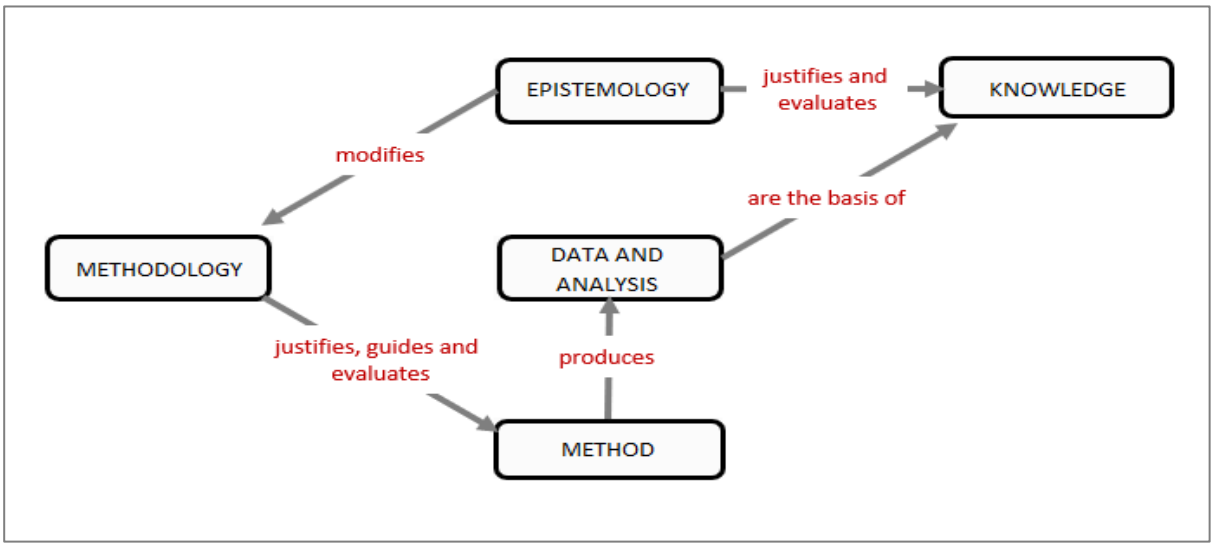


Figure 4.3: The relationship between epistemology, methodology and method (after Carter and Little (2007))

Their view, derived from the diagram at Figure 4.3, is that historical case studies lean towards interpretivism, reflecting that soft skills enable the researcher to work through the actions of people and groups, using an interpretivist approach. (Söderlund and Maylor, 2012). This reflects the view above that the Giza Pyramid research provides evidence which is more convincing for the soft skills of PM than the hard skills which would have suggested a more positivist approach, but for which evidence is far harder to find with the passage of time.

This leaning towards evidence of soft skills, whilst seemingly necessary, is perhaps a weakness of the studies, given that the historical environment of the studies is both so complicated and varied that it makes generalisations difficult to construct. (Gratton, 2008.)

The approach to case study research discussed by Procter and Kozak-Holland (2015) consists of the following research cycles, (Figure 4.4):

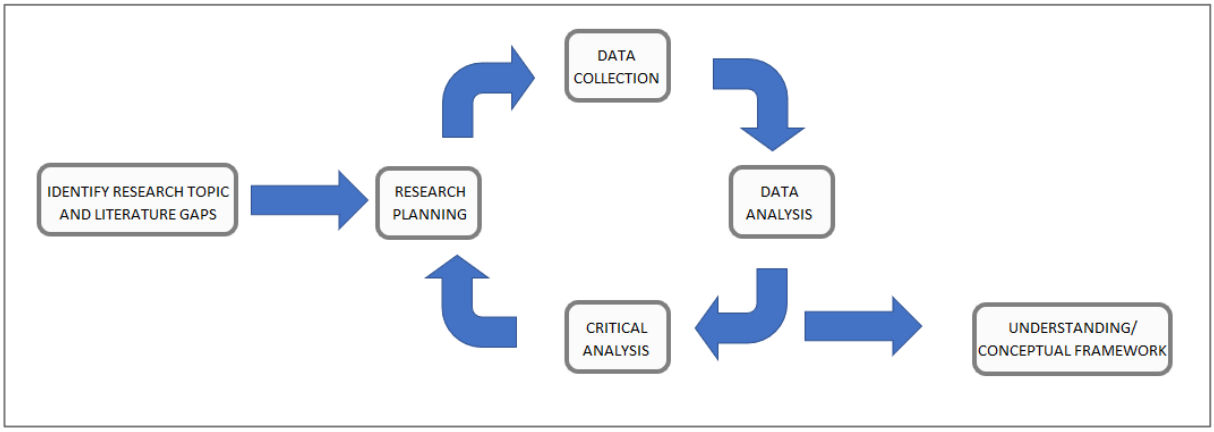


Figure 4.4: Research cycles (after Cepeda and Martin (2005))

Within this process Procter and Kozak-Holland (2015) also discuss the four stages of their methodology, (Figure 4.5):

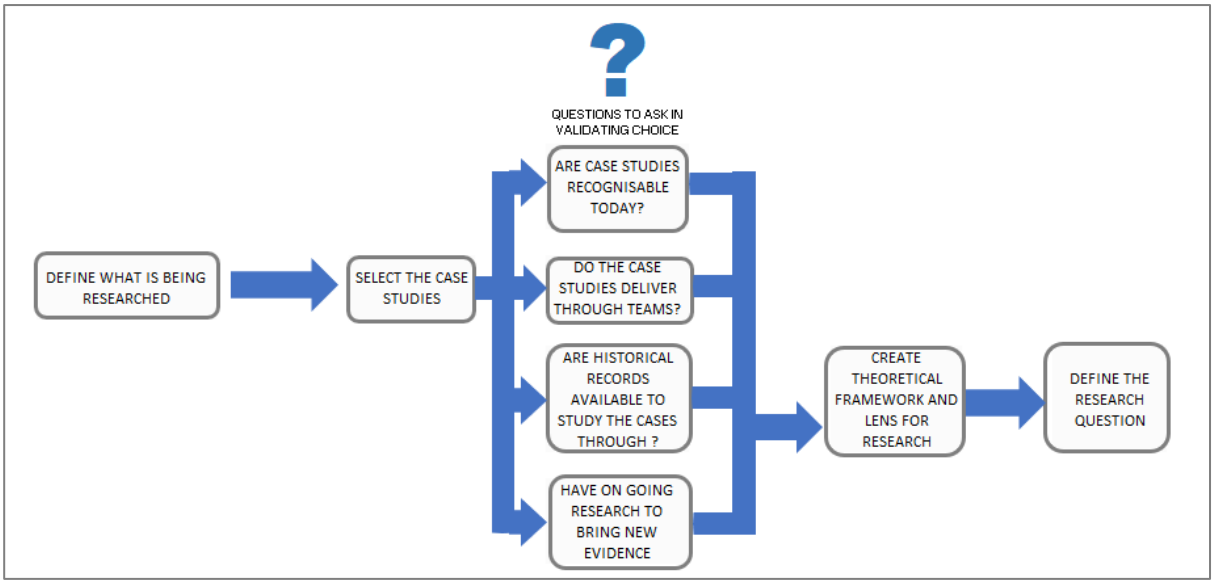


Figure 4.5: Research Methodology process (after Procter and Kozak-Holland (2015))

The final step in Figure 4.5 above is interesting in that in the approach presented by Procter and Kozak-Holland (2015) the research question is not finalised until after the availability of the research material has been assessed, reflecting to an extent the unreliability, or unpredictability, of historical data over time.

The research methodology process described above is used by Procter and Kozak-Holland to justify, guide and to evaluate their chosen research method. The requirement of these research methods was that they 'had to collect the data, synthesis the evidence, and interpret it', (p.15).
Different approaches to the investigation, synthesis and interpretation of the research were taken as shown below in Figure 4.6:

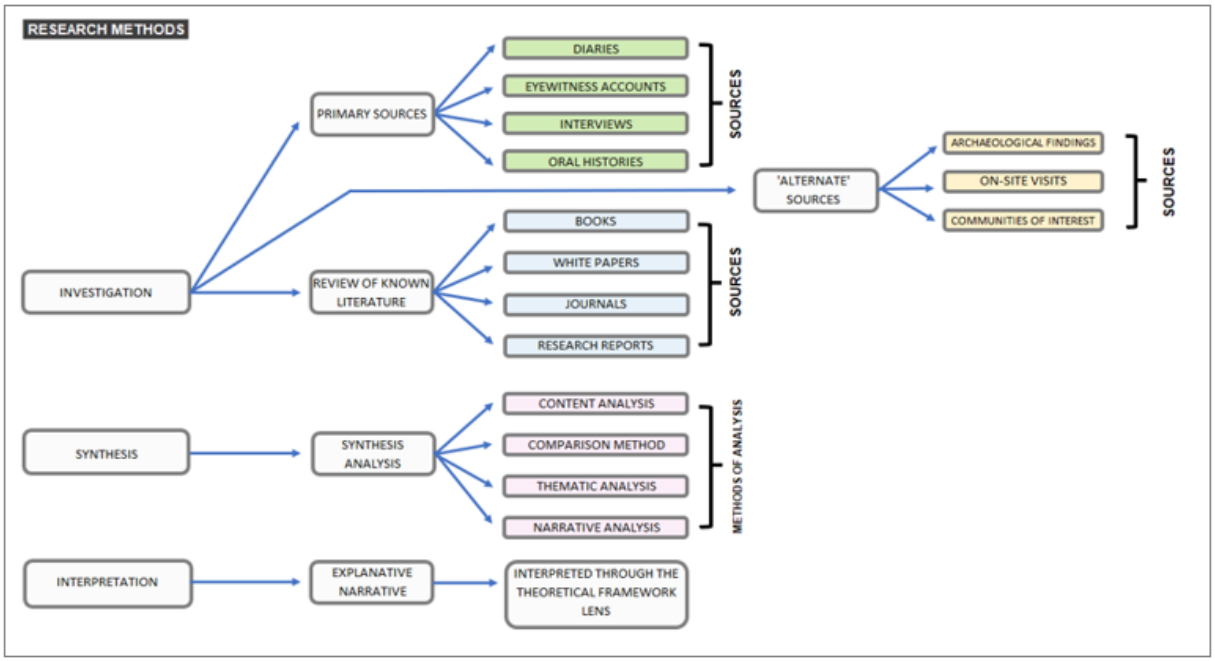


Figure 4.6: Research Methods and Sources (after Procter and Kozak-Holland (2015))

The paper concludes that the approach discussed is of 'significant value to contemporary project management' and 'can contribute significantly to closing the gap between project management theory and practice, and expand our knowledge beyond prescriptive bodies of knowledge.' (Procter and Kozak-Holland (2015, p.21))

4.5.5 Reflections on the relevance of PM History and approaches to it

Section 4.5 posed two initial questions, which reflect directly on the approach taken to this thesis. The impact of this is seen within Chapter 5, which benefits from the direction provided by the papers reviewed here, both in enabling the approach to the research to be adapted and in providing confidence in the method chosen.

The first question, asked if the study of PM historiographies could be of both interest and relevance to today's practitioners?

The second question drew on the four papers examined, and asked if it were possible to find a research approach that enabled the exploration of

PM historiographies and assessed whether the ability to do this varied as the project age increased?

The paper by Jacobsson and Söderholm, (2011) presented a fresh approach which offered a new slant to approaches to encouraging interest from current practitioners in historical research. The way to do this is, they espouse, by challenging old truths and taken for granted assumptions, which supports the approach adopted by the thesis. This we see in the work of Procter and Kozak-Holland (2019) in which the authors call into question previously established 'truths' concerning pyramid construction. The wide audience for these papers within journals such as the International Journal of Project Management bears witness to the appeal and current relevance of such an approach.

Jacobsson and Söderholm (2011) also argue that in order to be of interest to the research community and to contribute to an area of research, research should both describe and reflect the phenomena, or observable facts, of the field being studied. The thesis again takes the recommended approach, focusing the research on observable facts from contemporary records. The thesis should therefore ensure that this angle of research is highlighted and thoroughly exploited. This should help partially to close the gap in our understanding of the actor's practices noted by both Lenfle (2014) and Cicmil *et al*. (2006) by both exposing the detail of management tools and techniques and reflecting the phenomenological factors within projects (Lee-Kelley *et al*., 2003). The work of Jacobsson and Söderholm (2011), suggests that the thesis should focus on the research areas that they describe as being searches for 'inspiration' and 'contribution' in order to widen the audience for which the research is relevant. By providing a greater understanding of the facts or situation surrounding the way in which the delivery of early projects was managed, then the study of project-related issues and their development can be of help to others in advancing PM theory.

The second question asked if it is possible to find a research approach that could be used to explore historical PM case studies. This is answered in similar ways both in the paper by Sankaran and the two papers by Procter and Kozak-Holland. A varied approach to historical project research is suggested, albeit, necessarily, one that is focused on secondary data sources. Noticeably Sankaran does use some primary material, (an interview with a contemporary,) a luxury which is denied to Procter and Kozak-Holland (2019). Procter and Kozak-Holland provide an ambitious attempt to review the construction of the Giza Pyramid as a project. Similarly, this approach is not possible within the thesis as anyone who worked on the project between 1912 and 1915 would be approximately 120 years old today, which would make any potential interviews impossible. Procter and Kozak-Holland do succeed however in demonstrating the existence of PM elements such as the organisational aspect, the securing of resources and the reaction to adversity/ risks and issues without the benefit of primary research.

Some difficulties nevertheless remain in terms of conducting detailed and specific historical research. These centre around two main areas, as discussed, the paucity of primary data, but also the problem of interpreting ancient facts through the lens of our own day, or as Procter and Kozak-Holland (2015, P.11) have it, our tendency to be ‘constrained by the paradigm of the time’. In terms of the thesis, it is important to search for evidence from primary sources for the early Essence of Project Management – namely the actual records of the management of projects. Without them we are left to review secondary accounts which run the risk of having events ‘interpreted’ by the author, or perhaps by the organisation being studied which often commissioned these works. The danger of ‘interpreting ancient facts’ is not as great for the thesis as for Proctor and Holland as it is temporally far closer to us than the construction of the pyramid at Gaza.

Primary, or even secondary data relating to a project that would reflect the components of the APMs BoK (Appendix 2.1) is not likely to survive long

past project completion, even if it had been compiled, since once the project is complete the data, within its own timeframe, has lost the utility and purpose for which it was designed.

The inherent dangers of interpreting ancient facts through the lens of today are discussed by Söderlund and Lenfle (2013, p.657) who view them as two separate issues. The first they define as ‘presentism’ and explain this as the tendency to look for the present in examples of the past. This potential can be seen in some of the claims made by, for example, Procter and Kozak-Holland (2015, P.5) who claim that based on the study of the Giza Pyramid ‘the core areas of Project Management, as defined today, were used extensively in great historical projects.’ Without specific evidence this statement would seem to superimpose our reality onto the activities of the Egyptian builders some 4,500 years previously. The second danger Söderlund and Lenfle identify is that of ‘finalism’ where researchers may try to find the foundations of the processes of today laid directly in the past, thus analysing history as providing a breadcrumb trail from the period studied directly to the processes of today. The thesis needs to be careful to avoid these dangers.

Whilst tempered with a degree of caution, the questions posed at the start of Section 4.5 can both be answered in the affirmative. The analysis of the four subject papers has shown that project historiographies can have many applications, or implications for today’s project manager and offer much to be reflect on in the design stage of the thesis.

4.6 Summary

This chapter describes the current interest in researching historical projects with the aim of informing the development of project management theory and helping to define the professions direction of travel and hence development of PM. The benefits associated with this are detailed in section

4.2 and centre around the greater understanding of both the roots of PM and ‘process tracing’ or pattern recognition that the research can add thereby helping to give a better grounding and to better enable future thought. In respect of this, the strength of history as an enabler of the ‘power of examples’ was also revealed as an output from historical PM research while the study’s ability to help identify practices crucial in terms of project success, and to help document the emergence of key project management practices, tools and techniques was also highlighted. Section 4.5 considers four different potential focuses for PM research. Of these, the focus of ‘Legitimacy’ addresses the aim of broadening the theoretical base of project management but does alert the researcher to the potential problems around both presentism and finalism. Another way to contribute to this theoretical base is through the focus of ‘Inspiration’. Defined as the exploration and observation of projects as observable facts, this is very much an area where this thesis looks to contribute. The discovery and cataloguing of PM records from a period substantially before what is currently available adds significantly to the ‘Contribution’ focus and what has been termed the ‘power of examples’. It is hoped therefore that this research will add to the audience for which PM research is relevant and that by challenging ‘taken for granted assumptions’ and gaining a greater understanding of the facts surrounding the way in which the delivery of early projects was managed, the study can be of help to others in advancing PM theory.

There are however a number of perceived challenges in doing this, such as the potential scarcity of archival PM evidence and the danger that the material that is archived is often chosen by the powerful who have their own version of history to write. It has also been recorded above, that an approach that can be taken in order to give research traction, is to challenge taken for granted assumptions and to question long held assumptions. These do not need to be proved either one way or another, it is the exploration of these factors which adds value and can contribute to the interest of the research. This thesis takes this angle, challenging where the perceived start date for MPM is and as a minimum exploring the early beginnings of the MPM process. In doing so, it describes and investigates

the nascent MPM phenomena, or observable facts with a conscious awareness of the danger of interpreting the facts of yesteryear through the lens of our own day.

The opportunities presented by the study of project management history are summed up by the possibility of widening the scope of project history to beyond the events of the1950s in the belief that they can help to inform what is known about project management today to shape its future and to help ensure that the influence of history on today's profession is not downplayed.

The following chapter builds on the lessons learnt in Chapter 4. It address the questions of exactly how this research was conducted. It considers the approach taken in the search for the historical records required. It then addresses how the validity of these records and their interpretation was assured, while also exploring both how the reliability of the study was ensured and how the results were displayed.

CHAPTER 5

- METHODOLOGY

5.1 Introduction

5.1.1 Purpose and research question

Chapter 3 established the Essence of Project Management and in so doing, defined the parameters of the methodology. The earlier literature review identified three key questions that remain unanswered within the published works to date.

Having defined the Essence of Project Management, the research searches for evidence of the management control processes and documents used in the construction and delivery of the case study, HMS Barham. The processes found are then coded and a sample of this coding verified with a sample of naval PMs of today. Having addressed the questions above, the thesis considers the insights that can be offered in terms of meeting the call discussed in the Literature Review for both greater research into the management of historical projects and the feasibility of this research. (See section 1.2)

In order to look for the existence of Project Management tools and techniques prior to the establishment of MPM, a review of seminal literature was undertaken to establish the Essence of Project Management. This definition can be found in Chapter 3 and this is what has been used to determine whether or not a particular document from the archives provides evidence of a Project Management function.

The way in which the study has approached this is set out in the remainder of this chapter.

5.1.2 Organisation of the Chapter

The chapter begins by restating the purpose of the research in 5.1.1 above. Following discussion on the approach taken to the research in the remainder of Section 5.1, Chapter 5 continues through the following sections:

Section 5.2: addresses questions of the study's ontological, epistemological and methodological position

Section 5.3: considers the type of information required by the study

Section 5.4: considers questions of research design and methodology

Section 5.5: discusses the type of research sample taken by the research

Section 5.6: reviews in greater detail how the data itself was collected

Section 5.7: details how the analysis of this data was approached

Section 5.8: reflects on the study's approach to ethical considerations

Section 5.9: considers issues relating to the trustworthiness of the data gathered

Section 5.10: discusses how the limitations of the study have been addressed

Section 5.11: summarises the chapter

5.1.3 A Qualitative or Quantitative research approach?

Having defined the research area, one of the primary questions to resolve is how this research can best be delivered? This raises issues of which methodology is best suited to delivering the research aims and how it can answer the research question in the most effective manner.

'The essence of methodology is establishing a path along which research can be directed.' (Jonker and Pennink, 2010, p.40). Jonker and Pennink expand on this concept and summarise the research method as:

- 'clearly defined by means of certain (research) steps: the methods and techniques.
- Further finalisation of the method occurs with the help of techniques. Techniques concern the way in which data is generated, collected, classified and analysed
- Choices with regard to methodology, method and technique can be denominated in terms of qualitative or quantitative research.
- Choices result in a research design'

The methodology therefore identifies the main steps and the overall manner in which the research question will be answered. Jonker and Pennink,

(2010, p.33) assert that the purpose of the Methodology is to act as ‘a set of principles and global instructions’, they add that how the research approach is developed ‘with detailed methods and techniques is based on additional considerations, considerations which will depend on (the researcher’s) basic attitude, the question at hand and of course the ‘overall’ methodological approach.’ These are questions that are addressed below in Section 5.2 where issues of Ontology, Epistemology and Methodology are discussed.

Another view is offered by Easterby-Smith *et al*. (1996, p.21). ‘The relationship between data and theory is an issue that has been hotly debated by philosophers for many centuries. Failure to think through philosophical issues such as this, while not necessarily fatal, can seriously affect the quality of management research.’ The relationship between data and theory and the approach that the researcher takes to their research has over the ‘last several decades’ ‘witnessed intense and sustained debates about quantitative and qualitative research paradigms’ (Onwuegbuzie and Leech, 2005, p.267). Indeed Sampson (1996, p.329) says that one of the earliest (1969) definitions of qualitative research from the marketing research sector is that ‘…qualitative work is mainly exploratory, small numbers of respondents are concerned with the investigation, no scientific sampling is undertaken, although ‘selection’ is often important, and no attempts to ‘quantify’ the results is made’ This is in stark contrast to the more quantitative approaches taken such as those often found within the natural sciences environment.

Quantitative and qualitative methods would therefore seem to offer two very different research approaches. Hoepfl (1997, p.1) is of the opinion that ‘qualitative research uses a naturalistic approach that seeks to understand phenomena in context-specific settings’, while ‘quantitative research uses experimental methods and quantitative measures to test generalisations.’ Qualitative research is seen as being characterised by its aims, which relate to aspects of social life. Its methods produce words rather than numbers as data whereas ‘quantitative methods are seen as producing a measure of

something. These definitions suggest that a qualitative approach would be appropriate for this study.

Hoepfl (1997) describes qualitative research as any type of research which does not produce its findings through statistical processes or any other means of ‘quantification’. This study agrees with Hoepfl’s view as an overall assessment, but does not preclude the use of some ‘quantification’ where appropriate. (Some quantitative methods were used for instance, in addressing the question of inter-coder reliability, discussed below in Section 5.8). The contrasting standpoints of the two research approaches have in the past led to accusations that qualitative research suffers from a lack of rigour, often uses too small a sample size and has the potential for bias in the research derived from the researchers own opinions, (Bloomberg and Volpe, 2016).

Qualitative methods do however have potential advantages. Strauss and Corbin (1990) identify some of the advantages of qualitative methods, particularly within research areas where little is known to date, in areas where new perspectives are required, or where greater depth of information is needed that may not be easy to convey in a quantitative way. Qualitative investigation can, they argue, be used initially to provide a future avenue or platform for quantitative research. This view is not however held universally. Morse (2003, p.3) is of the opinion that ‘qualitative research should not automatically mature into quantitative research.’ It is important Morse argues, to consider the strengths and weaknesses of each research paradigm, to allow each to stand alone but to do so without precluding the possibility of merging one with the other.

Alonso and Barredo (2013) say that the qualitative and quantitative approaches focus on opposing aspects of social phenomena, and draw the comparisons between the research approaches shown in the following table (Table 5.1):

TABLE 5.1: Social aspects of qualitative and quantitative approaches in international comparative studies adapted from Alonso and Barredo (2013)

Qualitative methods	Quantitative methods
Comprehension	Check
Description	Prognosis
Interpretative	Empirical
Subjective	Objective
Emic (insider´s perspective of the subject)	Etic (perspective of the observer/scientist)

Table 5.1 suggests that the study is qualitative in nature as it, for example, seeks to comprehend rather then check, and is open to the possibility of some subjectivity in terms of the interpretation of documents found. Lee (1992, p.87) supports this, saying that 'the distinction between quantitative and qualitative research methods in organisation studies is generally perceived as being that while the quantitative approach is objective and relies heavily on statistics and figures, the qualitative approach is subjective and utilises language and description', in line with Hoepfl's view above.

One of the purported strengths of qualitative research is its suitability where the area being researched is relatively unknown. This degree of uncertainty leads Patton (1990) to point out that qualitative research design can be emergent in nature, developing as the research itself evolves. Morse (2003, p.833) supports Patton's view, stating that 'qualitative methods are used when little is known about a topic, when the research context is poorly

understood, when the boundaries of the domain are ill-defined, when the phenomenon is not quantifiable, when the nature of the problem is murky'. Morse continues to say that, in agreement with Patton, this means that qualitative researchers do not always have the necessary information to prepare as precise and detailed a proposal as quantitative researchers might.

This discussion, although having hinted at the suitability of a qualitative approach for this study needs to answer the question of which of these two paradigms qualitative or quantitative is best suited to this study.

'Quantitative researchers generally believe they know what they do not know (i.e. they know the type of knowledge they expect to obtain by doing a study and then they strive to obtain it). A qualitative researcher, by contrast, enters the study 'not knowing what is known', Klopper (2008).

A qualitative approach is therefore more open ended or suitable when, in the words of Klopper, we do 'not know what is known', the nature of the problem is, as Morse would have it, 'murky' and 'the phenomenon is not quantifiable'. As part of this study, research must be undertaken to understand a number of areas, such as what is at the heart of the phrase 'Project Management' and how this was reflected pre-WWII? What exactly is the nature of the evidence being sought through the analysis of the Grand Fleet production management records? What processes governed the production of naval vessels prior to the relatively recent introduction of MPM and before the profession's Body of Knowledge began to crystallise?
The number of unknowns means that the study does not have a strong theory to test from the outset. Instead the picture is 'murky' and unclear in terms of 'knowing what is known'.

The research within this study needs to address these multiple unknowns, to distinguish between the research characteristics put forward by Alonso and Barredo (2013) and to be able to choose between the competing research methods analysed by Jonker and Pennink (2010). The work

required is mainly exploratory, as described by Sampson above, it seeks to 'understand phenomena in context-specific settings', (Hoepfl (1997, p.1) more needs to be known about the subject area before any theories can be established. The nature of research needed by this study is therefore qualitative rather than quantitative.

5.2 Ontological, epistemological and methodological position of the study

The choice between a quantitative and qualitative approach also reflects the manner by which the researcher has arrived at their view of what is known and unknown.
Long *et al*. (2000, p.190) say that a case cannot be made for any research approach independent of the researcher's underlying assumptions regarding the nature of their research.

This brings into debate questions of ontology, epistemology as well as methodology. Addressing them, Long *et al*. (2000) state, will position the research at a point on the continuum between a highly objective, or quantitative approach, and a highly subjective or qualitative method. Bryman and Bell (2003, p.12) support this saying that the choice of approach is reflected in the way that a researcher develops their theories, and that 'an inductive strategy of linking data and theory is typically associated with a qualitative research approach.' These kinds of qualitative research techniques Bryman and Bell say can generate 'interesting and illuminating findings whose theoretical significance is not entirely clear.' This is in contrast to a quantitative approach which takes more of a deductive stance – starting with a theory and looking for evidence, observations or findings to prove or disprove it.

The way in which the information and data is collected, the research methodology, chosen by a study will they say, 'flow naturally from the

previous assumptions' (relating to ontology and epistemology). For instance, if 'one considers the social world to be a concrete network or structure made up of precise connections between its component parts…' and '…that legitimate knowledge of social reality is to be found in these constituent relationships, then one would logically assume that' the research would be conducted through natural science methods or an objective standpoint. (Long *et al*., 2000, p.191). This view however, does not fit this study. There are no known 'precise connections' between different parts of the study, there is no known 'concrete structure'. Rather than looking to the natural science, or quantitative methods, the study was focused towards the qualitative end of the spectrum.

The methodology reflects the researcher's outlook and helps to identify the main steps and the manner in which the research question is addressed. As mentioned above, Jonker and Pennink (2010) see the methodology as a set of principles and instructions to guide the research. They add, (p,33) that 'this does not mean that methodology prescribes what you should do (or not)', but outline how the research approach is developed 'with detailed methods and techniques … is based on additional considerations, considerations which will depend on your basic attitude, the question at hand and of course the 'overall' methodological approach.'

Such a methodological approach therefore shows the main path to the research destination, but does so without specifying the individual steps. This research is in the position of, in the words of Klopper (2008, p.62) 'not knowing what is known' and therefore, as also suggested by Morse (2003) it follows a qualitative or subjective approach. If we can establish what Carter and Little (2007, p.1316) called the 'three fundamental facets of research – epistemology, methodology and method' then this they argue will provide 'the framework for planning, implementing and evaluating' the quality of the research.

5.2.1 Philosophical stance of the study

In endeavouring to establish the research method, it is necessary to confirm some of the key issues that shape the approach taken to the study. Creswell (2007, p.15) says that 'five philosophical assumptions lead to an individual's choice of qualitative research, these are the:

- 'ontology,' (the researcher's stance towards the nature of reality,)
- 'epistemology,' (how the researcher knows what they know,)
- 'axiology,' (the roles of values within the research,)
- 'rhetorical,' (the language of research,) and
- 'methodological', (research methods used).

'The researcher chooses a stance on each of these assumptions, and the choice has practical implications for designing and conducting research'

Table 5.2 below shows how these considerations are reflected within this study. The table is adapted from Creswell (2007) but adds two final columns to enable a dual focus to highlight the different temporal outlooks of the first two questions recorded in Section 5.1.1 above.

The table shows the implication that each of the five philosophical assumptions has on the two main sources of the study's research data. The first of these data sources draws from historical records from the times of the Grand Fleet construction (shown under the 'Historical' heading in the table below,) while the second data source derives from the modern-day arena. This second element will be addressed by testing the purpose of the archival documents with today's naval project managers. (The approach to this part of the research, in the table below, is denoted as 'Modern').

TABLE 5.2 – PHILOSOPHICAL STANCE OF STUDY – adapted from Creswell (2007)

ASSUMPTION	QUESTION	CHARACTERISTICS	IMPLICATIONS FOR RESEARCH PRACTICE	
			'HISTORIC'	'MODERN'
ONTOLOGICAL	WHAT IS THE NATURE OF REALITY?	REALITY IS SUBJECTIVE AND MAY BE MULTIPLE AS SEEN BY 'PARTICIPANTS' IN THE STUDY	RESEARCHER REVIEWS ARCHIVAL DATA AND USES DATA TO PROVIDE EVIDENCE OF APPROACHES. (NEED TO ANALYSE MORE THAN ONE SOURCE/ SHIP/ MANUFACTURER OR PERSPECTIVE.) MANUFACTURER OR PERSPECTIVE.	RESEARCHER USES FEEDBACK FROM MODERN DAY PMs TO ANALYSE HISTORICAL FINDINGS
EPISTEMOLOGICAL	WHAT IS THE RELATIONSHIP BETWEEN THE RESEARCHER AND THAT BEING RESEARCHED?	RESEARCHER ATTEMPTS TO LESSEN THE DISTANCE BETWEEN THEMSELVES AND THAT BEING RESEARCHED	RESEARCHER SPENDS TIME IN MULTIPLE ARCHIVES TRYING TO UNDERSTAND THE MANAGEMENT OF MANUFACTURE PROCESSES FROM MULTIPLE PERSPECTIVES.	RESEARCHER SPENDS TIME WITH MODERN DAY PMs THROUGH FACE TO FACE INTERVIEWS AS WELL AS E MAIL INTERVIEWS TO FULLY UNDERSTAND PARTICIPANTS VIEWS
AXIOLOGICAL	WHAT IS THE ROLE OF VALUES?	RESEARCHER ACKNOWLEDGES THAT RESEARCH IS VALUE LADEN AND THAT BIASES ARE PRESENT	RESEARCHER MAY HAVE OWN VIEWS AND BIASES. THESE NEED TO BE ACKNOWLEDGED BUT PUT TO ONE SIDE TO ENSURE AN EQUITABLE SELECTION OF DATA ELEMENTS FOR INVESTIGATION	IN COMPARING HISTORIC METHODS WITH PRESENT DAY APPROACHES, THERE MAY BE A TENDENCY IN THE MODERN PM TO LOOK FOR 'A PROCESS' RATHER THAN 'A PURPOSE' WITHIN THE DATA GATHERED. THIS SHOULD BE BALANCED.
RHETORICAL	WHAT IS THE LANGUAGE OF RESEARCH	RESEARCHER WRITES IN A LITERARY, INFORMAL STYLE USING THE PERSONAL VOICE AND USES QUALITATIVE TERMS AND LIMITED DEFINITIONS	LANGUAGE USED NEEDS TO FOCUS AWAY FROM THE SOURCE OF THE DATA COLLECTED. INSTEAD OF WORDS LIKE: INTERNAL VALIDITY OR GENERALISABILITY, WORDS LIKE CREDIBILITY OR DEPENDABILITY SHOULD BE USED. WORDS LIKE UNDERSTANDING, DISCOVERY AND MEANING ARE IMPORTANT MARKERS WITHIN THE TEXT.	
METHODOLOGICAL	WHAT IS THE PROCESS OF RESEARCH?	RESEARCHER USES INDUCTIVE LOGIC, STUDIES THE TOPIC WITHIN ITS CONTEXT, AND USES AN EMERGING DESIGN	RESEARCHER WORKS WITH PARTICULARS (DETAILS) BEFORE GENERALIZATIONS, DESCRIBES IN DETAIL THE CONTEXT OF THE STUDY, & CONTINUALLY REVISES QUESTIONS FROM EXPERIENCES IN THE FIELD.	

The link between three of these philosophical assumptions is explored by Easterby-Smith *et al*. (2013). They address the links between ontology, epistemology and methodology and claim that exploring these links will help the researcher in three areas, namely to:

- clarify research designs – ensuring that the chosen research method will provide the required evidence and demonstrate how it will provide answers to the basic questions being researched.
- provide an understanding of which methods will be appropriate through a grasp of the research philosophy. This should help the researcher to avoid going down blind alleys and to comprehend the possible limitations of any chosen approach.

- and to potentially help the researcher to establish new research designs.

5.2.2 Ontology

In terms of considering the ontology, with which this study will be approached, it is useful to consider the spectrum of ontologies shown in table 5.3 below:

TABLE 5.3 – POSSIBLE ONTOLOGICAL STANCES OF STUDY

ONTOLOGICAL SPECTRUM

ONTOLOGY	REALISM	INTERNAL REALISM	RELATIVISM	NOMINALISM
NATURE OF TRUTH	Single truth	Truth exists but is obscure	There are many 'truths'	There is no truth
NATURE OF FACTS	Facts exist and can be revealed	Facts are concrete but can't be accessed directly	Facts depend on the viewpoint of the observer	Facts are all human creations

ADAPTED FROM EASTERBY-SMITH Et Al (2013) p19

The ontological approach to this study focuses towards the left- hand side of the centre of the above spectrum. In relation to the 'Nature of Truth', some elements of the historical research may provide a single 'truth' but this nature may not be clear. The 'truth exists', but it may be clouded or obscured by the experience, or inclination, of the reviewer. Specific facts will be recordable, but some facts may not necessarily be capable of direct assessment. Some may need interpretation and require testing through the use of independent reviewers. This should reveal a validated view of the nature of the facts and hence a view on the nature of the truth established. It is not impossible that the research could reveal fundamentally different truths dependent on the reviewers' viewpoint, but, given the structured nature of PM, and hence the nature of the truth, this is not considered to be a strong possibility.

This research therefore takes an ontological stance of Internal Realism mixed with a small degree of Relativism, reflecting that whilst there is one

truth, the interpretation of some facts may reflect the viewpoint of the observer. Putnam (1987) states that internal realism is a state in which reality cannot be assessed directly and must be assessed through the collection of indirect evidence of what is in itself a fundamental process. This is an approach which this study uses in reaching some of its conclusions with respect to elements of PM processes analysed within the research process.

5.2.3 Epistemology

Having defined the study's ontology, the epistemology can be considered. This focuses on the position of the researcher relative to the material being studied and helps to establish how the researcher determines what they know.

As with the ontology of the study, there is a spectrum of epistemological positions to be considered. The choice, as noted by Long *et al*. (2000) is essentially a point on a spectrum between the extremes of a strong positive standpoint (a view that the world exists external to any research and that its properties should be measured through research into observable facts) and a strong constructionist viewpoint (where reality is not external and objective but is given meaning by people). These extremes have a number of different potential implications for the structure of the research, as Table 5.4 shows.

TABLE 5.4 - POSSIBLE EPISTEMOLOGICAL STANCES OF THE STUDY

EPISTEMOLOGY	POSITIVISM	or	CONSTRUCTIONISM
	← STRONG — WEAK →		← WEAK — STRONG →
(i) THE OBSERVER	must be independent		is part of what is being observed
(ii) HUMAN INTERESTS	should be irrelevant		are the main drivers of science
(iii) EXPLANATIONS	must demonstrate causality		aim to increase general understanding of the situation
(iv) RESEARCH PROGRESS THROUGH	hypothesis and deduction		gathering rich data from which ideas are induced
(v) CONCEPTS	need to be defined so they can be measured		should incorporate stakeholder perspectives
(vi) UNITS OF ANALYSIS	should be reduced to simplist terms		may include the complexity of 'whole' situations
(vii) GENERALISATION THROUGH	statistical probability		theoretical abstraction
(viii) SAMPLING REQUIRES	large numbers selected randomly		small numbers of cases chosen for specific reasons

ADAPTED FROM EASTERBY-SMITH ET AL 2013 (P.24)

The indicators, in Table 5.4, represent the study's position on the spectrum. Within the spectrum two sub-divisions of both positivism and constructionism are often quoted, with the extremes being denoted as either 'strong positivism' or 'strong constructivism' respectively.

The indicators in the table above, show a constructivist position, but not an extreme, or strong, constructivist position. They show a balanced approach with some, although very weak, influences of a positivist philosophy, which is developed from an ontological position of Internal Realism, see Table 5.3. There is therefore a link between the Ontology and the Epistemology of a research study that should be carried forward into the Methodology and study design itself. The following table, (Table 5.5), illustrates the relationships between these three elements and in so doing indicates the most suitable method for this study given its ontological and epistemological starting point.

This constructivist position of the study is supported by Easterby Smith, Thorpe and Jackson (2012) who say that case study research can be both constructivist or positivist but that those from a constructionist epistemology, generally advocate the use of single cases, while those who advocate multiple cases usually fit with a more positivist epistemology. This study focuses on as single case study – HMS Barham, and so aligns with Easterby Smith, Thorpe and Jackson's view of a constructivist approach.

TABLE 5.5 – ONTOLOGICAL, EPISTOMOLOGICAL & METHODOLOGICAL STANCE OF STUDY

ONTOLOGY	REALISM	INTERNAL REALISM	RELATIVISM	NOMINALISM
EPISTEMOLOGY / METHODOLOGY	STRONG POSITIVISM	POSITIVISM	CONSTRUCTIONISM	STRONG CONSTRUCTIONISM
AIMS	DISCOVERY	EXPOSURE	CONVERGENCE	INVENTION
STARTING POINTS	HYPOTHESIS	PROPOSITIONS	QUESTIONS	CRITIQUE
DESIGNS	EXPERIMENT	LARGE SURVEYS/ MULTI CASES	CASES AND SURVEYS	ENGAGEMENT AND REFLEXIVITY
DATA TYPES	NUMBERS AND FACTS	NUMBERS AND WORDS	WORDS AND NUMBERS	DISCOURSE AND EXPERIENCES
ANALYSIS/INTERPRETATION	VERIFICATION/ FALSIFICATION	CORRELATION AND REGRESSION	TRIANGULATION AND COMPARISON	SENSE MAKING/ UNDERSTANDING
OUTCOMES	CONFIRMATION OF THEORIES	THEORY TESTING AND GENERATION	THEORY GENERATION	NEW INSIGHTS AND ACTIONS

ADAPTED FROM EASTERBY-SMITH ET AL (2013) p25

A focus on the two central columns of Table 5.5, shows that there are some similarities between a positivist and constructionist epistemology and the designs, data types and outcomes which they produce.

In respect of the design elements shown in Table 5.5, Rossman and Wilson (1985, pp.630-631) in their discussion around the integration of qualitative and quantitative methods assert that 'surveys provide representative information that is then elaborated through qualitative data, and that surveys often test hypotheses generated through fieldwork.' This study will use the second part of this approach in that the fieldwork, or archival analysis, will

be tested through the surveys and questionnaires with PMs of today. It is the initial search for and subsequent researcher analysis of the archival research within this study that Rossman and Wilson would point to as being qualitative data. The approach, of integrating qualitative and quantitative study elements, whilst focusing primarily on the qualitative approach positions the study in line with Bloomberg and Volpe's (2016, p.190) view of a qualitative study. They state that in a 'qualitative study, quantitative findings are secondary and are used to supplement and/or augment the primary qualitative findings.' This is the approach that this study will take as defined in Section 5.4.

5.2.4 Overview of the study

The main aim of this study is to provide a better understanding of the practices and techniques of managing early projects and to investigate the feasibility of researching historical projects. Specifically, this search was focused within the construction management of the Grand Fleet Dreadnoughts. The Grand Fleet has been chosen since it involved considerable outlay in terms of expenditure, for example the cost of HMS Dreadnought is given by Jane's Fighting Ships (1914) as being £1,797,497 (£189,546,211 in equivalent 2021 £s,) and for the cost of the later HMS Barham, Jane's gives a figure of £2,470,113, (£260,473,626 in equivalent 2021 £s). (The present-day equivalent values were calculated using the calculator posted at: https://www.in2013dollars.com/uk/inflation/1915?amount=2470113). Given that the construction of these ships fit today's definition of a project, that they are at the cutting edge of the technology of their day; and were the subject of large contracts between commercial shipyards and the government, they offer an excellent opportunity to collect relevant evidence.

Section 5.5 below discusses the nature of the Archival Sample that the study took. As an overview of the study it should be noted that the research was not straight forward. There were numerous challenges in conducting the historical search. There was one quite unique problem, namely that many of the organisations that are involved in project delivery were

temporary – ‘they existed for a time and then ceased to exist.’ (Söderlund and Lenfle, 2013, p.656). Once an organisation ceases to exist there is an element of chance regarding what happens to any archive which the company may have kept. It can be shaped by current legislation, by the type, or topic of information which is currently fashionable, or simply the amount, or cost, of storage space.

In attempting to trace records relating to the management of projects in the early part of the 20th Century there are fortunately a number of different sources that can be investigated in an attempt to overcome the central problem identified by Söderlund and Lenfle (2013).

Production management records were produced by the Royal Navy and the various shipbuilding companies contracted by the Admiralty. Many of the companies responsible for the building of the Grand Fleet have long since ceased to trade or have been subsumed in corporate mergers. Companies responsible for building ships within the Grand Fleet such as Palmers and Scotts, disappeared, in their own name, more than fifty years ago and their company records were largely lost with them.

The records of the Royal Navy Dockyards are not neatly stored in one particular place. Investigation has shown that some portion of the records for each ship are stored at the Brass Foundry, within the National Maritime Museum. This portion does not however provide a full picture of each vessel’s construction. The National Museum of the Royal Navy advise that many of these records have been passed to the Brass Foundry, yet the Brass Foundry do not hold everything that might be expected. The Brass Foundry holds extracts from the ‘story’ of the ship from an Admiralty viewpoint and this is, probably, as much detail as could be expected after 100 years and two World Wars. The records are generally held on a ship by ship basis, although they will sometimes be consolidated into a ‘class’ file as in the case of the Queen Elizabeth Class (which contains HMS Barham’s records). What is generally lacking in these records is a detailed record of how shipbuilding as a process was managed.

The Dreadnoughts were at the forefront of Naval Technology at the time of the Grand Fleet, but were not all built in HM Dockyards. Although there was a tendency for the first of a class to be built in HM Dockyards, subsequent vessels were often built in yards such as those owned by private companies, for example, John Brown, Scotts, Palmers, and Beardmore (Brown 1997). Despite the fact, as shown in the records housed at Glasgow University's Scottish Business Archive, that these predominantly Clyde based companies have long since been amalgamated or ceased trading, a number of their records from the time of Dreadnought construction still exist and are held in the Scottish Business Archive. This was proved by a visit to the archives located held at Glasgow University during the course of this study. In addition, there are a number of Company histories written on specific companies, such as Scott's and Beardmore which chart their rise. These corporate histories however, are not an instant panacea in the search for records detailing how, what could be termed 'projects', were managed and delivered in these times. There is a substantial difference between the Corporate Histories presented in records such as Scott (1962) and histories of early Project Management. This in itself is perhaps no surprise given that MPM was, at the time, at best an emerging process. It does illustrate a problem in searching for PM records – the survival rate of records detailing the methods of production management is not high, as these 'every-day' documents were not considered worthy of preservation within the official company records – a problem highlighted by Söderlund and Lenfle (2013).

Söderlund and Lenfle (2013) propose that 'many projects are associated with intentional ambitions to make history.' (p.656.) The authors however continue to say that they consider this to be rare within the corporate setting, although of course, exceptions do exist, but these they consider are truly exceptions. Where it has occurred project organisers, they argue, had an interest in recording details that would help future generations understand how and why decisions were made. Very large projects may even have had information departments charged with storing project information. Whilst this may be true, on an exceptional basis in more recent

times, the utility of this logic becomes more limited the further back in time the study is. It is perhaps found even more wanting in times of an all-consuming focus on alternative objectives such as the production of naval vessels for an impending, or current war.

The size of the contracts, in terms of monetary values, however means that records showing build progress needed to be produced by the private builders. Progress details would have needed to be conveyed to the Admiralty. Each report made to the Admiralty would have necessitated the collection of internal management reports and it is both the search for these records and the evidence contained in them, which this study focused on.

This view of the project fits neatly into one of the areas that Söderlund and Lenfle (2013) categorise in their International Journal of Project Management editorial focussed on Project Management History. They list five distinct fields (see Section 4.4.1), of which this study focusses on ‘landmark project and project narratives’, although a case could be made for the study also reflecting, to a lesser degree, the ‘history of project management practices’.

This study focused on addressing these aspects by using HMS Barham as the unit of study. At the individual ship level, it is possible to study documents produced by both the manufacturers and the Admiralty. Here issues such as ‘decision making, governance, leadership and organisational issues’, may help validate Söderlund and Lenfle’s (2013, p.657) view that there are ‘a lot of cases, that could also constitute a rich base for teaching, remains (sic) to be discovered’.

HMS Barham was built on the Clyde by John Brown & Company (Clydebank) Ltd. and launched in 1914, John Brown’s surviving records for the manufacture of HMS Barham are held at the Glasgow University archive. There are also records for HMS Barham produced from the Admiralty’s perspective, held at the Brass Foundry in Woolwich within the Ships’ Cover focusing on the Queen Elizabeth Class. Records concerning

other contemporary vessels built by John Brown, such as HMS Tiger and HMS Hood, were also reviewed to help address any potential holes left by the passage of time.

Initially primary sources for these artefacts were:

- Company Records held at the Scottish Business Archive, Glasgow University
- Admiralty records held at the National Archives Kew
- Ships Covers held at the Maritime Museum, Brass Foundry – Greenwich

5.3 Overview of information required

5.3.1 Types of Information Required to answer the research question

This section of the study considers the type of information that is needed to answer the research questions. Bloomberg and Volpe (2016) list 4 different types of information - Contextual, Perceptual, Demographic and Theoretical, that qualitative studies draw upon.

Whichever approach was chosen, it was key to ensure that the correct subject matter was being searched for. The study was looking for traces, or evidence, of the Essence of Project Management within the chosen archives.

5.3.1.1 The Essence of Project Management

The research question is founded upon the search for evidence of an earlier than recorded beginning of MPM. In order to fulfil this, it was necessary to identify the core or ‘essence’ behind the purpose of MPM that eventually became known as ‘Project Management’.

The search for the Essence of Project Management is one which is rooted in the literature on the subject, and as such is of a theoretical nature. It is

the subject of Chapter 3 which focuses on, and defines, this one specific area.

The key advantage of having established this theoretical grounding is that the research, rather than looking for the terminology of MPM, which as a post WWII phenomenon is not something we should expect to see in its current guise pre-WWII, the study is able to search for the central tenets of MPM as they might have presented at the time of the Grand Fleet construction.

Morris *et al*. (2006, p.461) show some support for this need as they contemplate 'the intent behind project management BoKs' (Bodies of Knowledge.) They refer to the content of the BoKs as being what 'needs to be managed across the total project lifecycle in order to deliver success to all principal stakeholders.'
This 'intent' as the study goes forward, is what is referred to here as the Essence of Project Management.

5.3.1.2 The study - Types of Information

Once determined, the Essence of Project Management was used to categorise the archival records in order to address the research question and establish the artefacts used within the construction of HMS Barham that could support the function of PM. This took the form of a search for evidence of tools and techniques in use at the time which were consistent with the purpose of the Essence of Project Management.

In looking for this information each of the four types of information (Contextual, Perceptual, Demographic and Theoretical) developed by Bloomberg and Volpe (2016) were used. These are discussed in detail below.

5.4 Research design

This section provides an outline of the approach taken to the design of the research. Before a case study approach was chosen, other approaches were considered. The nature of historical research means that the search for relevant documentation must be focused around something – the 'unit of study' and led to archival research being central. Easterby-Smith, Thorpe and Jackson (2012) list a number of dilemmas in designing a research project, one of these being the identification of the unit of study. Initially, the research began with a less focused search for relevant information. It began by looking for any records from any manufacturer from the Dreadnought era. It became apparent that the records would be difficult to piece together given a potentially disparate grouping of constructors. This led to the narrowing of the unit of study to one particular manufacturer whose surviving records were comparatively intact. Indeed, the number of records found to be surviving enabled the unit of study to be further narrowed to a single ship – HMS Barham. Once data was collected it could have been simply discussed. Reliance purely on the researcher's analysis would have provided weaker conclusions. One approach to strengthening the conclusions was through review with other project management academics. It was considered though that this would not have provided an adequate focus, or knowledge of ship construction. The alternative of using a focus group approach with practicing naval project managers was therefore chosen. The following two sections, 5.5 and 5.6, focus on the approach taken to the data collection method and the data analysis approach respectively.

Epistemology, as represented in Table 5.5 above, can be considered to be the 'theory of knowledge' Carter and Little (2007, p.1317) and how knowledge is modified and justified, or how the researcher knows what they know. This helps shape the research methodology, defined by Harding (1987, p.2) as 'a theory and analysis of how research should proceed' as opposed to methods which Harding defines as the 'techniques for gathering

evidence.' The relationship between all three elements was discussed in Section 4.5.4 and is shown in the Figure 4.3, replicated below (Figure 5.1):

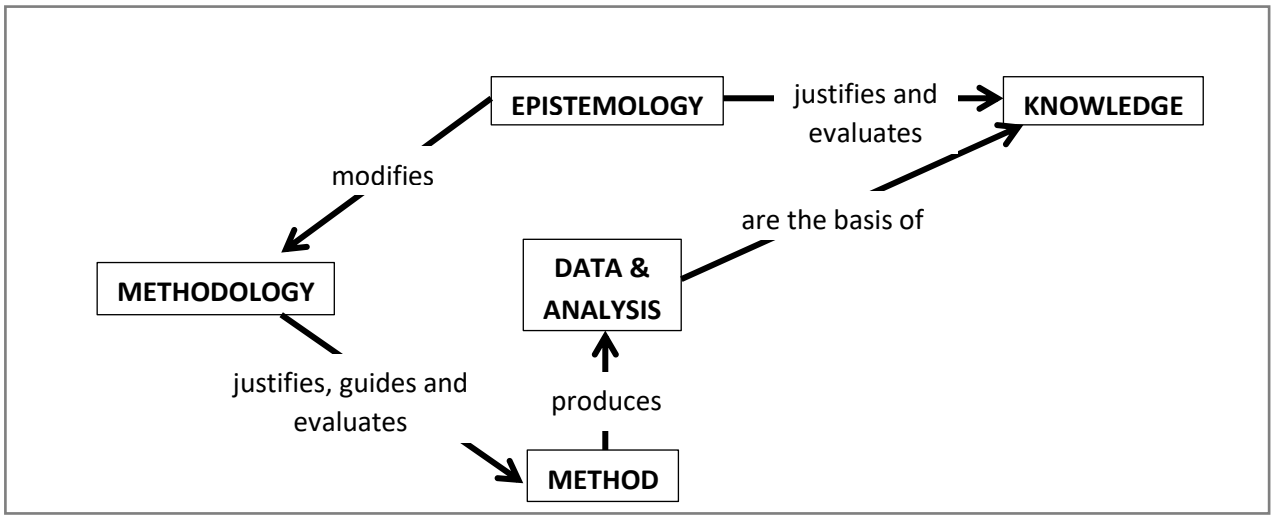


Figure 5.1: relationship between epistemology, methodology & method (from Carver & Little (2007 p1317))

Having discussed Epistemology and Ontology previously in Section 5.2, this section focuses on the design of the research methodology. Taking a wider view of qualitative data, Creswell (1998, p.85) identifies five main 'traditions' of qualitative research. Creswell lists the potential methodologies as:

- Biography
- Phenomenology
- Grounded Theory
- Ethnography
- Case Study

Carter and Little (2007) add their support to Creswell's list. The researcher should,

Kakabadse and Steane (2010) say, use these methodologies to define and interpret phenomena focusing on providing new meaning and insights. Marshall and Rossman (2014) say that the choice of methodology should be made so as to maximise the chance of successfully answering the research question. With this in mind, each of the main approaches identified by both Creswell and Carter and Little are considered and their applicability, in terms of this research, assessed:

Biographical research is a wide field of potential research methods. Denzin (1989 p.2) supported by Stroobants (2005), describes the approach as being where a 'family of terms combines to shape the biographical method…life, self, experience, epiphany, case, autobiography, ethnography, auto-ethnography, biography, ethnography story, discourse, narrative, narrator, fiction, history, personal history, oral history, case history, case study, writing presence, difference, life history, life story, self-story, and personal experience story.'

It is therefore quite wide ranging but with its focus on 'a life' it is judged to be inappropriate as a method for this research which focuses on the identification of process rather than a personal narrative.

Phenomenological research focuses on the attempt to understand people's perceptions, perspectives and understandings of a particular situation (or phenomenon). Reiners (2012) defines the technique as the discovery of knowledge through the interaction between researcher and the participant. Although this research will ask present day project managers their perception of the findings from circa 1912, a phenomenological approach would focus on people's experience in regard to the chosen 'phenomenon' at the time the events occurred and the way in which they interpret those experiences. It concentrates on the experience of the first person and so is not suitable for the historical thrust of this research design.

Grounded theory involves the construction of a theory through the analysis of data. A study using grounded theory is likely to begin with a question, or even just with the collection of qualitative data.

Grounded Theory is an inductive methodology (Timmerman and Tavory, 2012) which is frequently considered to be a qualitative method but can be used for quantitative enquiry. It enables the researcher to establish a theory analytically from systematic research. This study will share some commonality with this approach, it does for example, begin with a question which the research seeks to prove through the collection of data. Grounded

theory is closely associated with the use of interviews as a method. This study will use focus groups rather than interviews while the main part of the study will be centred around the interpretation of archival records. Whilst having some common elements with Grounded Theory, this study does not follow the Grounded Theory approach in that it does not seek to establish a theory but instead it seeks to uncover some fundamental observations and facts around the beginnings of MPM.

Ethnographical research involves the researcher completely immersing themselves in the lives or situation that they are studying, consequently this means that the studies are usually long term and involved. Fusch and Ness (2017) describe an ethnographical approach as using an in-depth study of the participants every day behaviour to provide a detailed study of an organisations culture. This approach is not possible in the sense of immersing the researcher into the day to day lives of HMS Barham's construction workers. It is however possible in terms of the section of the research addressing the plausibility of researching this subject from records of a hundred years old, (see questions 4 and 5 see Section 1.2, Table 1.3) to this extent the research does partially have an ethnographical aspect.

Case Study research is described by Yin (1984) 'as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used' (Yin, 1984, p.23).
Surrey University (2017) provide further details on the nature of case study:

1. 'Case study research is a methodology which can take either a qualitative or quantitative approach
2. In the qualitative approach, case study refers to the in-depth analysis of a single or small number of units
3. A case study unit may include a single person, a group of people, an organisation or an institution

4. Some case study research may involve the research of a series of cases
5. One of the criticisms of the case study method is that the case under study may not be representative of a wider social setting and therefore it is argued that the results of the research cannot be used to make generalisations. Therefore, the purpose of case study research is to describe that particular case in detail and take learning from that and develop theory from that approach - it is particularistic and contextual.'

This study is aligned with all five of these points, (it does not involve a series of cases, but point 4 does not mandate this,) and will therefore be conducted primarily as a Case Study of one ship built by one of the Dreadnought constructors, and will research a sample of archival sources as discussed in Section 5.2.1 above. This approach is supported by Andrade (2009) and Baxter and Jack (2008) as well as Yin (2014) who all consider a case study approach to be suitable for the investigation of operational links between, and reasons behind, events over time.
Creswell (1998) makes an interesting observation as to how each of the five approaches to research relate to the data collection process (Figure 5.2):

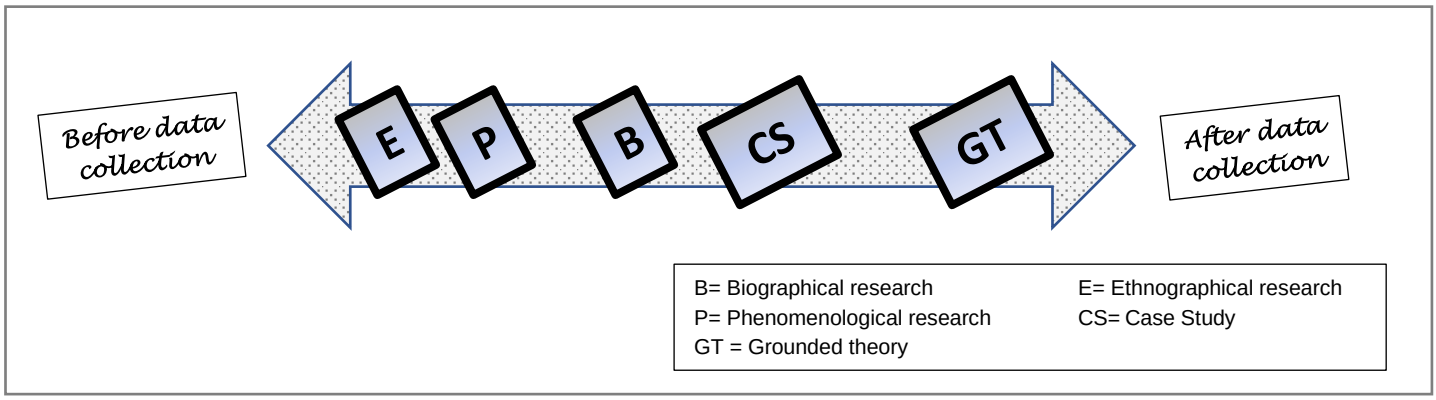


Figure 5.2: Temporal Relationship of Research Tradition to data collection. (Taken from Creswell (1998)

Figure 5.2 shows where in relation to the collection of data, analysis is begun. For example, it shows that ethnographical research involves the

researcher completely immersing themselves in the lives or situation being studied. Hence the research needs to begin before the data starts to be collected so that the researcher can be ‘in place’ to gather the data. Grounded theory on the other hand involves the construction of a theory through the analysis of data, so it can only begin after the data is collected.

As a case study, this study is positioned towards the right-hand end of the spectrum in Figure 5.2 and reflects that the analysis of the archival data began partially as it was collected. Some analysis was done during the collection period to confirm that the full, necessary, scope of data has been collected and to understand what type of records were being discovered, while most was undertaken, for instance the review with practicing PMs, after the data had been collected.

5.4.1 Contextual Information

The context within which the historical data was collected has been explained above in Section 5.2. other data was created as part of the detailed research design and is described below.
The expert respondents involved in the validation of coding work primarily for DE&S, the main government agency tasked with delivery of naval ship construction projects. Projects are delivered in a culture in which an APM based methodology is mandated.

Table 5.6 below summarises the history/ vision/ services/ and business strategy of the organisation. These are important factors to be aware of, since as long ago as 1935, Lewis (1935) reminds us that these are factors that can influence behaviour.

TABLE 5.6 DE&S History/Vision/Services and Business Strategy. Source: DE&S Website

Category:	
HISTORY	DE&S began in April 2007 following the merger of the. Defence Procurement Agency and the Defence Logistics Agency. DE&S is a bespoke trading entity, and arm's length body of the Ministry of Defence,
VISION	The then Defence Secretary Philip Hammond outlined a vision that DE&S would be a customer-facing, match-fit organisation, providing a robust public sector
SERVICES	Defence Equipment and Support (DE&S) is responsible for managing a vast range of complex projects to buy and support all the equipment and services that the UK military need to operate effectively in order to equip and support the UK's Armed Forces.
BUSINESS STRATEGY	DE&S, as part of the MoD, aims to be a higher performing delivery organisation, which able to deliver vital equipment and support to the front line, on time and at the agreed price.

5.4.2 Demographic Information

The demographic information, or participant profile information, describing the nature of the naval Project Managers who reviewed the sample of archival materials can be discussed in broad terms. This can be useful information when assessing the suitability of a respondent to answer a particular question with authority. Table 5.7 below shows anonymised data relating to job titles, length of time in present position, current involvement with RN projects and principal job functions, all respondents held degrees and/ or Master's degrees in Project and Programme Management:

TABLE 5.7 – Demographic nature of Naval PMs

Respond -ent	Outline of job title:	Length of time in present position	Are you currently working directly with the delivery of naval vessels?	What is the principal PM function of your job?
1	Project Manager for an element of a Naval Capability Programme	3 – 5 years	Yes	Project Management
2	Team Leader for a naval warship project	> 5 years	Yes	Overall Project Management
3	Programme Manager for a Naval Capability	> 5 years	Yes	Programme Management
4	Team Leader for delivery of PM Capability within DE&S	> 5 years	No	Programme Management

(An example of the form used to gather this detail is included at Appendix 5.4)

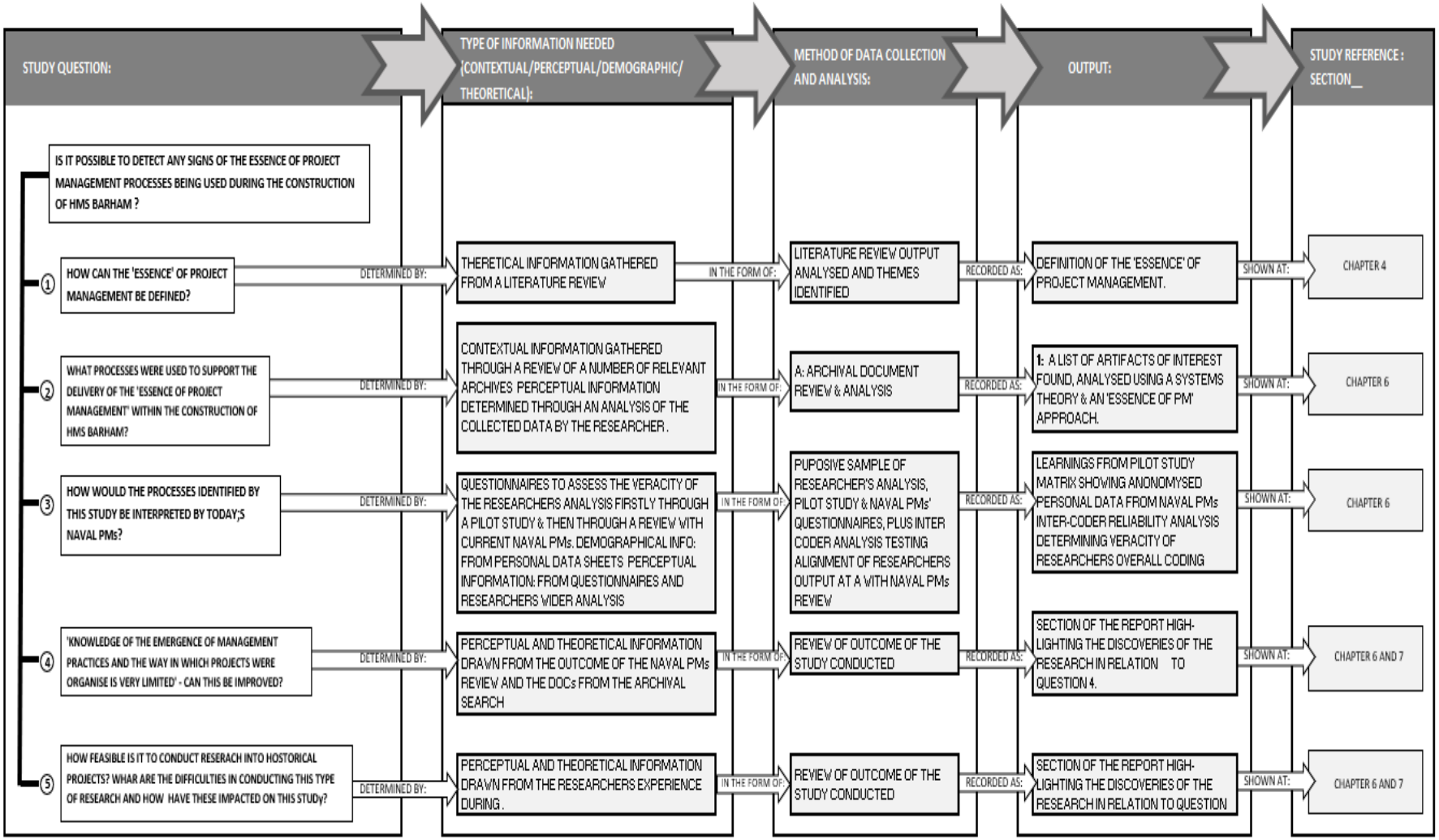
5.4.3 Perceptual Information

Perceptual information refers to both the researcher's and the respondents' perceptions relating to the subject of research. This section of the Methodology aimed to uncover, through a focus group approach, the RN Project Managers observations and views relating to the aspects of PM that they saw evidenced within the sample documents from the archive research – in other words their perceptions. A copy of the template used to collect this information is included at Appendix 5.1. (The Appendix shows one copy of the form which was used multiple times to review each archive slide shown in Appendix 5.2.)

The overall outline of the research is shown in Table 5.8.

TABLE 5.8

DIAGRAMATIC REPRESENTATION OF STUDY METHODOLOGY AND ANALYSIS:



5.5 Data collection

5.5.1 Data Collection Methods

The previous section discussed the approach to the research from the point of research philosophy. This section details the way in which the data was collected.

Chapter 2 provided a detailed review of the literature pertaining to the topic of this study. Whilst the literature informs the data that is required to be collected, it does not in itself form part of the study data collected.
A method of study within the History of Management is given by Grattan (2008, p.175) and shown at Figure 5.3 below.

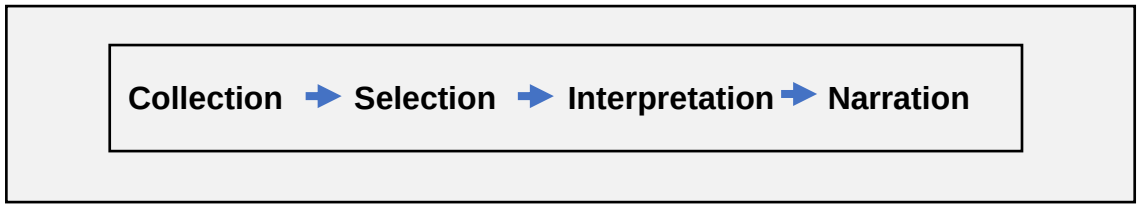


Fig 5.3: A Method of Historical Study - Author's own diagram (drawing on Gratton 2008, p175)

This does raise the important point of both 'collection' and 'selection' of the study material. Any selection of material to be studied, together with the method of selecting that material, is open to debate. Kieser (1994) says however, that given the potentially endless quantity of historical material available, a selection has to be made. Any study must therefore be able to demonstrate that its method of selection is robust and defendable. The approach that will be taken by this study is outlined below in Section 5.5.2.

5.5.2 Study Design

The design of the research strategy used within this study is informed by the traditional research approach documented by Creswell (1998) and represented in the Figure. 5.4.

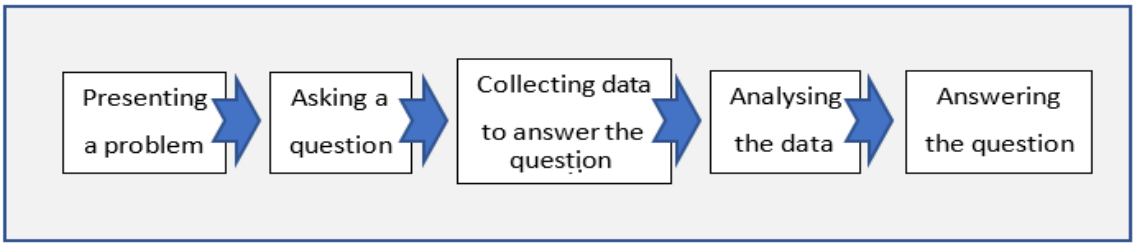


Figure 5.4: - A Traditional Research Approach Author's own diagram, from Creswell (1998).

The diagram (Figure 5.4) shows a traditional view of how a study might address a problem. A key stage of this process is 'collecting the data to answer the question'. This section of the study shows how the data was collected to address the question presented by this study.
The steps taken in collecting and verifying the data were:

1. Establish the types of records searched for
2. Identify where relevant archives were held
3. Review online catalogues of archives where possible
4. Visit archives
5. Establish that there is sufficient archival coverage for the chosen case study
6. Collect the data
7. Data categorised by the researcher
8. Conduct a pilot test to test suitability of documents for review with naval PMs
9. Review researcher's categorisation with naval PMs.
10. Conduct intercoder reliability test
11. What does the conclusion of the above steps say about our ability today to study historical projects?

The steps are expanded as below:

<u>Step 1 – Characteristics of the data searched for.</u>

Before the search began it was necessary to establish exactly the nature of the records being sought.

The case study is focused on naval shipbuilding, or more specifically construction at the time of the Dreadnoughts, so this helped categorise both the potential list of constructors involved and the time period for the search. The required characteristics searched for within the documents are the subject of Chapter 3.

Step 2 – where are the relevant records held?

Advice was taken from two experts in naval history as described below in Section 5.6.1 which details how the search for relevant documents was undertaken.

Step 3 – what do the online archive catalogues contain?

Some of the selected archives were found to have better online catalogues than others. The content however was often found to be superficial and open to the interpretation of those compiling the catalogues.

Glasgow University has perhaps one of the better online catalogues and this is arranged into various categories. One part of this is the 'Ship Building, Ship repair and Allied Industries.' (Glasgow University 2018). This lists a number of archives for companies which built the Dreadnoughts. The companies were:

- William Beardmore & Co Ltd
- Scotts of Greenock
- and John Brown Shipbuilding & Engineering Co Ltd (Within the 'Upper Clyde Shipbuilders Ltd Clydebank Division' collection.)

The John Brown records were comparatively complete. They were taken to the Glasgow University archives following the 1971 liquidation of Upper Clyde Shipbuilders (UCS).

The National Archives has a good online catalogue but tends to focus on records not directly associated with ship construction. For example, the operational angle of naval business is contained primarily in the ADM 1, ADM116 and ADM 137 series of records. These have been used widely to

compile a history of naval activity during the first world war, but contain little reference to construction and construction processes. Due to the everyday nature of the records being searched for and the time that has passed since these records were compiled, little is listed in a way that would easily identify it as a construction record. A search of the online catalogue (http://www.nationalarchives.gov.uk/search/) using the Admiralty file prefix ADM reveals a list of 201 results – none of which had a main, or identifiable focus on Dreadnought construction.

Records at the Brass Foundry are generally catalogued by the ships name – the 'ship's cover'. Detail beyond the name of each class of vessel or ship is hard to find on line.

Cambridge University (CU) holds a number of 'business archives'. The CU website links to a listing of Vickers records at https://janus.lib.cam,ac.uk/db/node.xsp?id=EAD%2FGBR%2f0012%2FMS%20Vickers these records however do not contain a detailed list of contents.

The nature of the online catalogues meant that the best way to ascertain the contents given the particular nature of the study's enquiry was to visit the archive and review the files in person.

Step 4 - Archival visits and searches.

Following steps 1,2 and 3, four archives were visited by the researcher as follows:

Vickers Archive – Cambridge University – July 2015
National Archives – Kew between June 2016 and June 2018
Brass Foundry – Woolwich – May 2014 and October 2016
Scottish Business Archives – Glasgow University – 10-13th August 2016

All of the above archives had some detail online as to their contents, but more detailed catalogue information was generally available either through a physical catalogue held at the archive or through the knowledge of the archive staff.

From the contents list of each archive, relevant files were requested and reviewed for relevant and useful records.

Step 5 - Establish that there is sufficient archival coverage for the chosen case study

When collecting historical data, it can be difficult to define when enough has been collected. The study was initially focused on collecting sufficient evidence to validate the use of HMS Barham as the case study. Through visits to the four archives the study was able to obtain copies of multiple contemporary documents which initially, but without full analysis, shared similarities with a number of aspects of the Essence of Project Management, or with elements of a systems theory approach as defined earlier in this study.

Enough evidence focusing on HMS Barham was found to justify Barham as the unit of study.

One issue with historical data is that a continuous, gap free, record does not always survive. Therefore, data was collected that, for instance, showed a process in existence both before and after a specific date relating to the case. Where this happened, it was judged reasonable to assume that the process, although not fully evidenced, continued without a gap across the complete period.

Step 6 - Collecting the data

Having identified relevant archival records, photographs were taken of any record of interest. This often took the form of a digital photograph of a page within a ledger, or shipyard document. A record was kept of which archive and which file the digital photograph record related to in order to maintain traceability. In determining whether or not a particular record was relevant to the study, the definitions established in Chapter 3 relating to the Essence of Project Management and its link to System Theory were critical. Each record found was reviewed and assessed in terms of whether or not it represented, or had a link, with either the Systems Theory model or the Essence of

Project Management, as defined in Chapter 3. The final categorisation of the record was done at a later stage. (A sample of these records is presented in Chapter 7.)

The records were kept in computer files referenced firstly by the name of the source archive and then by the archival file reference. They were stored on a dedicated removable USB and all files were password protected.

Step 7 - Data categorised by the researcher

Steps 7, 8 and 9 were all delivered through a similar process of coding documents. Step 7 represents the researcher's coding of the data, step 8 details the pilot test with students, and step 9 which was used to verify the validity of the researcher's coding involved coding by experts.

Details of how the data was coded by all parties are given in Section 5.6. Appendix 6.1 shows a total of 101 files from the three archives mentioned below in section 6.1, and from one further archive that was visited and then excluded. Of the 101 files shown in Appendix 6.1, only 91 have been used in this research. The remaining 10 files were taken from the Vickers Archive held at Cambridge University. This archive was one of the first visited, and did not hold any records that proved to be relevant to the study, it is mentioned only in passing to illustrate that not all archival searches were successful, despite promising beginnings. The records held at the Vickers Archive were insubstantial in terms of production method records and therefore less relevant than the records from John Brown & Co. Ltd. which were reviewed later at the Scottish Business Archive at Glasgow University. The unit of study chosen was HMS Barham after both the Cambridge University records and the John Brown records were reviewed, this was due to the significantly more complete nature of the John Brown archives. The utility of the Cambridge University records is therefore limited and is discussed merely as a comparison.

Step 8 - Conduct a pilot study to test suitability of documents for review with Naval PMs

The method chosen to substantiate the researchers coding was to cross-test a sample of the files with current day naval PMs. It was necessary to use a sub-sample as there was a limited amount of time with the naval PMs – about two hours each and this prohibited them reviewing all files.

A purposive sub-set of files was therefore selected from the archive files reviewed under step 7. The chosen files covered a wide range of both the Systems Model elements and the Essence of Project Management components. Twelve files were selected from three different archives – the Brass Foundry, the National Archives and the Scottish Business Archive. The sample is shown in Appendix 5.2. It includes some newspaper cuttings as a method of checking the overall quality of the responses within the focus group. The cuttings should score significantly lower than the documents from the other files as although they are connected with Dreadnought construction, they are not constructor's records.

A pilot study was carried out with Project and Programme Management Masters students from a defence background. It used exactly the same sample as described above to test the proposed method and to hone it where necessary. It tested a number of different aspects of the methodology:

- The researcher's ability to explain the process to the respondents (a short power-point presentation was given explaining the Systems Model and Essence of Project Management characteristics which the respondents were being asked to measure the records by. Details of how the forms should be filed out was also given.) (For full details of the research introductory slides used see Appendix 5.5.)
- The suitability/ understanding of both the process and the documents used
- The ability to ensure that the information gathered as a result of the test would enable meaningful results to be drawn from the study.

The pilot study was run with eight Project and Programme Management Masters students. The questionnaire used can be seen in Appendix 5.3.
At the end of the review, respondents to the pilot study were asked for their views and understanding of the analysis process. The outcome and learnings from the pilot study are discussed below in Section 5.5.3.

Step 9 - Review researcher's categorisation through a focus group held with Naval PMs.

Having noted the output from the pilot study and made the necessary amendments, a focus group was set up consisting of participants actively, and currently, engaged within naval ship building project management for the MoD. The purposeful sampling of such a specific group meant that the population was extremely small, yet those in attendance represented a third of the population and ranged from the most senior to more junior ranks. This is shown in more detail in section (See Section 5.4.2 for details of the focus groups makeup, and section 5.6.4 for details of the focus group size and population.)

Step 10 - Conduct inter-coder reliability test

Once the data had been cross checked as detailed in step 9, the independent views of the respondents across the sub sample of analysed archival data were used to establish whether or not the researcher's own analysis was suitably and reliably conducted. Comparisons were drawn between the researcher's categorisation of the data sub set and the analysis of the same data produced by the respondents. The chief statistical method used was Cohen's Kappa which provides a measure of inter-coder reliability.

Step 11 – Considerations and limitations of studying historical projects

As the research was conducted a series of paper-based notes were collected recording the difficulties and limitations, as well as the positive side of undertaking historical based project research. These were then recorded in Section 6.8 of the study.

5.6 Archival research sample

With its focus on the early roots of MPM, in order to maximise the possibility of records having been retained, the study concentrated on a large enterprise which would have ensured careful planning and delivery and required thorough records to be both made and kept, at least during the time of construction. In approaching the study one important question addressed is whether or not the production of the Dreadnoughts fits within the classification of a project.

The defining characteristics of a project are given by Turner (2006 a, b and c) in a series of articles for the International Journal of Project Management as being:

- A temporary organisation
- A project produces an output
- A project produces benefits for the owner of the outputs
- The project work is non-routine
- A project involves uncertainty
- A project has a lifecycle and hence a pre-established start and finish date.

The construction of the ships within the Grand Fleet meets these criteria. In addition, the Dreadnoughts within the Grand Fleet were at the cutting edge of design, so much so that it would be said that they made the rest of the fleet obsolete. HMS Barham as part of this class of ships, therefore had uniqueness. It was more advanced than previous naval ships, and the only Queen Elizabeth class Dreadnought built by the John Brown workmen. Due to the revolutionary design, the build also involved uncertainty and risks. In addition, there was a clearly stated end date for the output and a traceable start date, with commercial contracts being placed to enable active service at the earliest possible point.

The construction of each individual ship within the Dreadnought class offers an example of what we would today consider to be a major project, whose size, public profile and sheer cost and importance provided the prospect of detailed construction management records remaining intact.

5.6.1 Nature of the sample and sample population

This section of the study considers and defines the research sample and describes the population from which the sample is drawn. In defining where to search for the sample documents advice was taken from the author of 'The Shipbuilding Industry: a guide to historical records' (Ritchie, 1992) and the Head of Research at the National Museum of the Royal Navy, at the time, a Senior Research Fellow at the University of Portsmouth. The study recognises the direction they both gave.

During the time covered by the study, naval shipbuilding, outside of HM Dockyards, was concentrated in two large areas – the Tyne Tees and Wear yards producing approx. 36% of output and the Clyde yards producing approx. 31% of output (Ritchie, 1992).

Construction records were searched for from two separate directions. Firstly, Admiralty records covering the period were researched, including the privately constructed ships. These are largely located at the Brass Foundry (part of the National Maritime Museum). Secondly, records were also sought from the manufacturers' perspective by investigating their production management records from the period. These are, where still traceable, held in a number of UK Business Archives, (see Table 5.9 below.)

TABLE 5.9 – LIST OF KNOWN PRINCIPLE ARCHIVE RECORDS FOR PRIVATE DREADNOUGHT CONSTRUCTORS
(From Ritchie, 1992.)

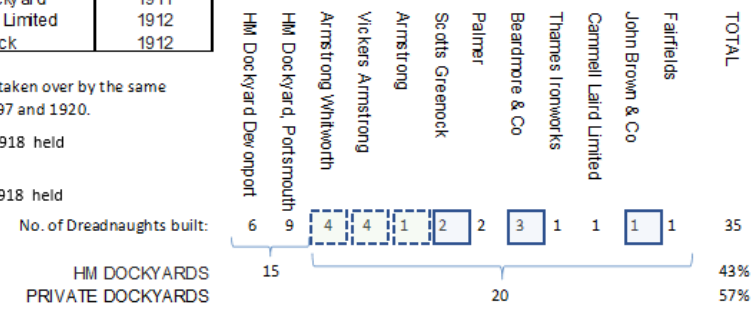
COMPANY	CURRENT LOCATION OF RECORDS
Vickers plc. Armstrong Whitworth & Co. Ltd	Cambridge University Library
Beardmore, William & Co Ltd;	Scottish Business Archive Glasgow University Library
Scotts Shipbuilding & Engineering Co Ltd;	Scottish Business Archive Glasgow University Library
John Brown Shipbuilding, within Upper Clyde Shipbuilders Ltd records	Scottish Business Archive Glasgow University Library
Fairfield Shipbuilding & Engineering Co Ltd	The Mitchell Library, Glasgow City Council
Palmer	Held privately and at Tyne and Wear Archives
Thames Ironwork	London Metropolitan Archives: City of London
Cammell Laird and Co	Wirral Archives Service

In order to use this second approach and to validate Table 5.9 in terms of each individual company's output, the number of individual Dreadnoughts built by each constructor was determined. This list is shown in the Table 5.10 below:

TABLE 5.10 – DREADNOUGHTS BUILT BETWEEN 1906 AND 1916 SHOWING MANUFACTURER AND LAUNCH DATE. (Source DK Brown 2010)

SHIP	Built at:	Launched
HMS Dreadnought	HM Dockyard, Portsmouth	1906
Bellerophon Class:		
HMS Bellerophon	HM Dockyard, Portsmouth	1907
HMS Superb	Armstrong Whitworth*	1907
HMS Temeraire	Devonport Dockyard	1907
St Vincent Class:		
HMS St Vincent	HM Dockyard, Portsmouth	1908
HMS Collingwood	Devonport Dockyard	1908
HMS Vanguard	Vickers Armstrong*	1908
Neptune Class:		
HMS Neptune	HM Dockyard, Portsmouth	1909
Colossus Class:		
HMS Colossus	Scotts Greenock	1910
HMS Hercules	Palmer	1910
Orion Class:		
HMS Orion	HM Dockyard, Portsmouth	1910
HMS Monarch	Armstrong Whitworth*	1911
HMS Conqueror	Beardmore & Co	1911
HMS Thunderer	Thames Ironworks	1911
King George V Class:		
HMS King George V	HM Dockyard, Portsmouth	1911
HMS Centurion	Devonport Dockyard	1911
HMS Audacious	Cammell Laird Limited	1912
HMS Ajax	Scotts Greenock	1912

SHIP	Built at:	Launched
Iron Duke Class:		
HMS Iron Duke	HM Dockyard, Portsmouth	1912
HMS Marlborough	Devonport Dockyard	1912
HMS Benbow	Beardmore & Co	1913
HMS Emperor of India	Vickers Armstrong*	1913
Originally intended for other navies:		
HMS Agincourt	Armstrong	1913
HMS Erin	Vickers Armstrong*	1913
HMS Canada	Armstrong Whitworth*	1913
Queen Elizabeth Class:		
HMS Queen Elizabeth	HM Dockyard, Portsmouth	1913
HMS Warspite	Devonport Dockyard	1913
HMS Barham	John Brown & Co	1914
HMS Valiant	Fairfields	1914
HMS Malaya	Armstrong Whitworth*	1915
Revenge Class:		
HMS Revenge	Vickers Armstrong*	1913
HMS Royal Sovereign	HM Dockyard, Portsmouth	1915
HMS Royal Oak	Devonport Dockyard	1914
HMS Resolution	Palmers	1915
HMS Ramillies	Beardmore & Co	1916



HM DOCKYARDS
PRIVATE DOCKYARDS

* These companies all merged or were taken over by the same corporate entity between the years 1897 and 1920.

Archives for the period 1906 – 1918 held at Cambridge University Archive

Archives for the period 1906 – 1918 held at Glasgow University Archive

Table 5.10 above shows that of the thirty-five Dreadnoughts built within the period, fifteen, (or 23%) were constructed by HM Dockyards, either at Portsmouth (9) or Devonport (6). The remaining twenty were built by a variety of private constructors.

Of the twenty commercially built Dreadnoughts launched prior to the end of WWI, nine (45% of the commercially built Dreadnoughts, or 25% of the total number of commercial and HM Dockyard Dreadnoughts built) were built by Vickers (or associated companies,) whose archives are now held at Cambridge University. Six (30% of the commercially built Dreadnoughts, or 17% of the total number of commercial and HM Dockyard Dreadnoughts built) were constructed by companies whose archives are held by Glasgow University. By analysing the archives held at both Cambridge and Glasgow

Universities there was the potential that the records held for three quarters of the commercially built ships could be researched. With Scotts, Beardrmore & Co. and John Brown being responsible for six out of the seven Clyde built Dreadnoughts, the records held in the Glasgow University Archives were central to this study.

A personal conversation with the National Museum of the Royal Navy revealed that they believed all construction production management records relating to Dreadnoughts built in HM Dockyards, had been forwarded to the Brass Foundry or to the National Archives

Records of the Naval Dockyards are therefore located at two main sites, the National Archives in Kew or at the Maritime Museum, or more specifically at the Brass Foundry (part of the Maritime Museum) in Woolwich which holds what are known as the 'Ships Covers'. Ship Covers are held for each of the 35 Dreadnoughts. Some of the records consist of just the one volume per ship while others, for example the Queen Elizabeth Class, are filed as a class and have as many as six volumes.

The following diagram (Figure 5.5) represents the population, from which the sample was drawn.

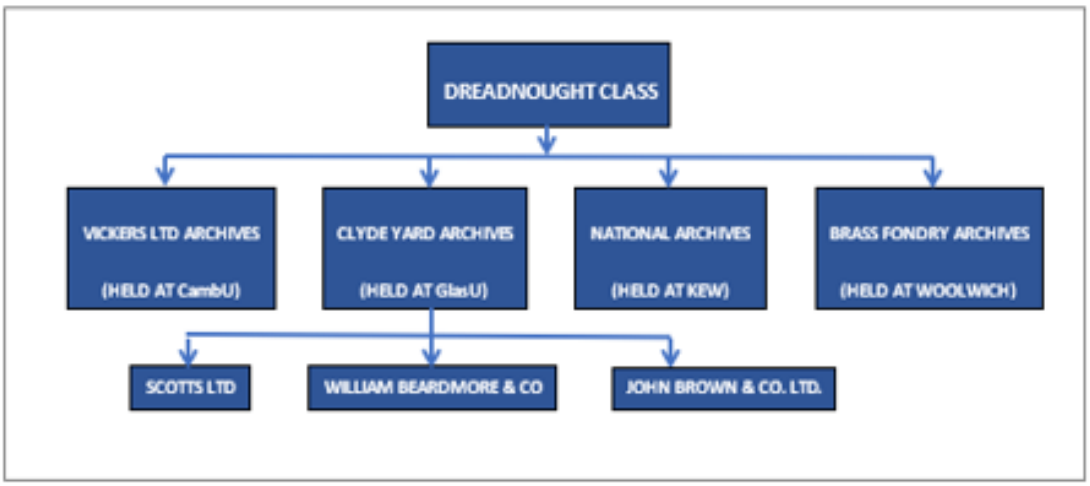


FIGURE 5.5: ARCHIVAL RESEARCH FOCUS – author's own.

The records were reviewed and HMS Barham was chosen to act as a case study. The review showed that whilst records were largely of the same level of completeness for each of the ships at the Brass Foundry, they were largely composed of detail from the customer side of the process rather than the manufacturing side. Whilst this information was useful overall it lacked specific detail of production methods.

The records held by Cambridge University relating to Vickers were largely focused on the company's own history as opposed to the history of day to day manufacturing, as such they yielded little information of note.

The National Archives held interesting information concerning day to day running and commissioning of ships. Relevant information from these archives, from Admiralty records, was included in the study. There was however nothing found filed specifically and focused on ship construction records.

The most useful archive was that of the Clyde Shipbuilders held at Thurso Street as part of Glasgow Universities Business Archives. Of the four shipbuilders listed in diagram Figure 5.5 above, the John Brown & Co. Ltd. archive was by far the most complete in terms of retained production records.

Within the ships built by John Brown, the Glasgow University Archive holds a comparatively large amount of information about the construction of HMS Barham, one of the Queen Elizabeth Class Dreadnoughts and this was therefore chosen as the central case study for the research.

5.6.2 The Sampling Strategy

Patton (2015) states that when undertaking qualitative research, the sample is of a purposeful nature. Patton (1990, p.169) says that the 'logic and power of purposeful sampling lies in selecting information-rich cases for study in depth. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research, thus the term 'purposeful sampling'. Glaser (1978, p.37) discusses 'selective

sampling' which he defines as referring to 'the calculated decision to sample a specific locale according to a preconceived but reasonable initial set of dimensions (such as time, space, identity or power) which are worked out in advance for a study.' This he says is different to the use of theoretical sampling in that here 'the analyst who uses theoretical sampling cannot know in advance precisely what to sample for and where it will lead him' and hence the 'dimensions' required by Glaser (1978) as part of the selective sampling definition are not present within this study.

As seen in Section 5.6.1, the study did not use a theoretical sampling approach. Coyne (1997, p.625) describes this as 'the process of data collection whereby the researcher simultaneously collects, codes and analyses the data in order to decide what data to collect next. Deciding where to sample next according to the emerging codes and categories is theoretical sampling.' This approach was not suitable for this study as the study's approach to sampling a particular location was made according to a 'preconceived but reasonable initial set of criteria.' (Again, see Section 5.2.1.) This, Glaser (1978) states, defines a selective sampling rather than a theoretical sampling approach. It differs dramatically from the theoretical sampling approach as the population and hence possible sample was undeniably determined up front, as opposed to being selected by the researcher as the work of coding and analysis progressed. It could be argued that the sample here was 'purposeful' rather than 'selective' but this would imply that there was a wide range of possible samples that could have provided the required data. This was however not the case, so from this angle the sampling strategy can be said to be purposive, or indeed even a census sampling approach given the limited range of possible material.

Patton (1990, p.169) approaches the question from a slightly different angle. Qualitative Research he asserts will potentially use a number of different types of sampling. All of them however may be encompassed under the broad term of 'purposeful sampling'. He states that 'qualitative inquiry typically focuses in depth on relatively small samples, even single cases, selected purposefully'. Merriman (2009) also refers to this approach as

purposive sampling, while Gay *et al*. (2006) refer to it as judgement sampling. Section 5.5.1 above details how the case study of HMS Barham was selected for this study, and to the extent that the records were relatively few in number, it can be argued that those chosen were chosen with a purpose in mind.

Given the analysis of the location of both the construction management records of the Shipbuilders and the Royal Navy detailed in Section 5.6.1, the study sample focused directly on the records held at the Brass Foundry, the Glasgow University Business Archives, and the National Archives in Kew and the Vickers Archive at Cambridge University Library, (although, as already mentioned in Section 5.2.1, this last archive was found to be of limited help due to a lack of relevant documents.)
Bloomberg and Volpe (2016, p.148) support Patton, quoted above, and say that 'the logic of purposeful sampling lies in selecting information rich cases, with the objective of yielding insight and understanding of the phenomenon under investigation.'

This enabled the study to fulfil one of the key features of qualitative research in that it described 'a particular context in depth and (did) not generalise to another context or population.' The sampling approach taken has none of the random sampling approaches often designed to prevent sample bias representative of a quantitative approach. Bloomberg and Volpe (2016) continue to say, however, that the use of a purposeful sampling approach can add value for the researcher, enabling them to focus on discovering new information, due to them being able to look at a particular case in depth. Reybold *et al*. (2013) support Bloomberg and Volpe's view that purposeful sampling allows the researcher to gather a depth of information that is difficult to match through a random sampling approach and as such it is one that fits well with the aims of this study.

A purposeful sampling approach was therefore selected for this study
Following examination of the material contained in both the Cambridge University Vickers Archive and the Glasgow University Business Archives the

most relevant records were to be found in Glasgow. Here in Glasgow, it was found that of the three shipbuilding companies whose records were held, the records of John Brown and Co had by far the largest quantity of everyday production management records. This meant that although it was by no means the only case available for study, HMS Barham, the Dreadnought built by John Brown & Co., became the focus for the study as records could be accessed both from the constructor's side and the customer or Admiralty side. Other ships built by John Brown such as HMS Tiger and HMS Hood (although not Dreadnoughts,) also provided some useful information as did the general yard records.

5.6.3 The Pilot Study findings

Thabane *et al.*, (2010) have described the purpose of a pilot study as being to enhance the probability of success of a full-scale study and to help, where ever possible, to avoid the main study's failure.

The authors draw on work by both Last (2001) and Everitt (2006) to expand on this definition. They report that one of the key deliverables of a pilot study is to test the methods and procedures which the researcher plans to use on the larger scale study. The suitability of these methods and procedures will be evidenced through the results of the pilot study and its ability to demonstrate that the methods and procedures are suitable, effective and capable of delivering the data required.

5.6.3.1 Pilot Study Design

The pilot study was designed to select a purposive sample from the recorded archive records (Appendix 6.1) that had the potential to cover most, if not all, the System Theory elements and the components of the Essence of Project Management. It was also selected to give coverage of each of the three main archives reviewed (The National Archive, the Brass Foundry at The National Maritime Museum, and Glasgow Universities Scottish Business Archive.) The sample is shown at Appendix 6.2.

After the sample was selected, the pilot study itself took the following form:

1. The sample was used to populate a power-point presentation which was used to introduce the study to the audience and to describe what it was that the participants were required to do. The presentation is available at Appendix 6.3.
2. The power-point slides were presented to a group of eight students studying for a Masters level Project and Programme Management degree.
3. Feedback forms were provided to the students (see Appendix 6.4).
4. The students were asked to view the slides and complete the feedback forms as in the power-point slides.
5. The feedback forms completed by students were collected and reviewed both with the students and by the researcher alone to establish how well the procedures and method performed and their suitability for the main study. Some key points were noted and adjustments made before the main study was conducted.

5.6.3.2 Learnings from the Pilot Study

Having reviewed the results of the Pilot Study a number of adjustments were made to the data collection form so that it more closely matched the description of the terms within the Systems Model and the Essence of Project Management. The revised form is included at Appendix 6.5.

Other learnings from the Pilot Study highlighted the importance of the researcher providing clear explanations to the participants of each of the six areas shown in the Systems Model and introducing the elements within the Essence of Project Management fully. Of equal importance was the need to ensure that instructions given to the main study participants with regard to the analysis process and the use of the feedback sheets were clear. The general need to spend more time at the start of the presentation was noted and the slides were adjusted to reflect these findings. These revised slides are included at Appendix 6.6.

5.6.4 The focus group - sample design and testing

Once the archival information above had been collected, analysed and coded, the research model involved a third-party review to test the reliability of the researcher's initial coding. This was done by comparing the researcher's analysis of a purposefully selected subset of data, (selected to cover a wide range of different PM purposes), with analysis of the same sample of documents provided via a survey of current project managers working within Defence Equipment and Support (DE&S). DE&S is part of the Ministry of Defence and is charged with, amongst other things, delivering equipment and support to the Royal Navy. Within this remit DE&S are tasked with overseeing the construction and delivery of the two new Aircraft Carriers. Heading this, DE&S have a number of specialist project managers each dedicated to one of DE&S's six 'internal business areas' (Defence Equipment & Support, 2019). The research information was validated with PMs from one specific area of the 'internal business areas' – those involved in naval ship construction.

The population of these project managers is small, there are only 12 within DE&S who deal with ship construction on a daily basis. The sample size used to validate the researchers own findings is a third of the population. A sample size of 50% of the population was expected but on the day of the survey, two potential respondents were called away at the last minute leaving a sample size of 33%.

The focus group consisted of a review of the slides presented in Appendix 5.3.

The researcher's findings were then compared against the DE&S verdicts and inter-coder analysis was used to evaluate the researcher's coding and to validate the coding of the complete set of archival data.

5.6.5 The Unit of Study

HMS Barham was the unit of study. This was chosen as it fitted the requirements of the study – its construction was a large endeavour from the period being studied, that would be described as a 'project' in today's terms.

Crucially the production records found in Glasgow Universities Business Archives, (John Brown & Co.) were comparatively complete, more complete than those of other Dreadnoughts in either the Glasgow Archives or the Vickers Archive. HMS Barham is also included within the Queen Elizabeth Class of ships within the National Maritime Museum's Brass Foundry collection of Ship's Covers. Other records/ sources were included in the review where they added value, but they were treated as secondary in terms of importance. The study covered the period from order to delivery, in other words a Project Lifecycle, as far as the records allow. It did not include the in service or disposal phases of the Extended Project Lifecycle.

The documents found were catalogued chronologically, establishing patterns that enabled the research to incorporate both Robson's (1996) and Yin's (2014) views that at the heart of the case study, is the idea that it should be studied in its own right, and not merely as a sample from a population.

The sources of the data are principally primary sources. McDowell (2002, p.55) when defining historical records, describes a primary source as a 'written record, such as a letter, diary or report, which was compiled at the time specific events occurred'. He continues to say that those sources written at the time the incidents occurred have a 'higher status' than those secondary sources which are mostly written long after the event and by authors not present at the event being described and hence tend to reflect the writer's own interpretation.

Historical primary sources can cover a wide range of material such as unpublished documents, letters and diaries, memoirs, autobiographies, oral evidence, official publications, business records, newspapers, paintings and maps, photographs and films, (McDowell, 2002).

The research materials gathered by this study come from historical records written during the period of the Grand Fleet Construction, and so draws on the list of primary sources cited by McDowell. This is beneficial, as McDowell (2002, p.55) says, 'it is to the primary sources that you must turn to extend

the boundaries of…knowledge.' The material being studied is previously unpublished. McDowell (2002, p.56) says that this type of unpublished evidence is 'often regarded by historians as providing a more accurate record of past events than that outlined in other printed sources, such as published reports'. He goes on to state that this however, depends upon *who* wrote them, *why* they were written and *when* they were compiled. 'The minutes of a company …(or) government department may provide a more accurate record of events than published…reports because the former are circulated to a more restricted audience and not intended to be seen by the public.'

Having discussed the way in which the data was collected, the following section considers how this data was used.

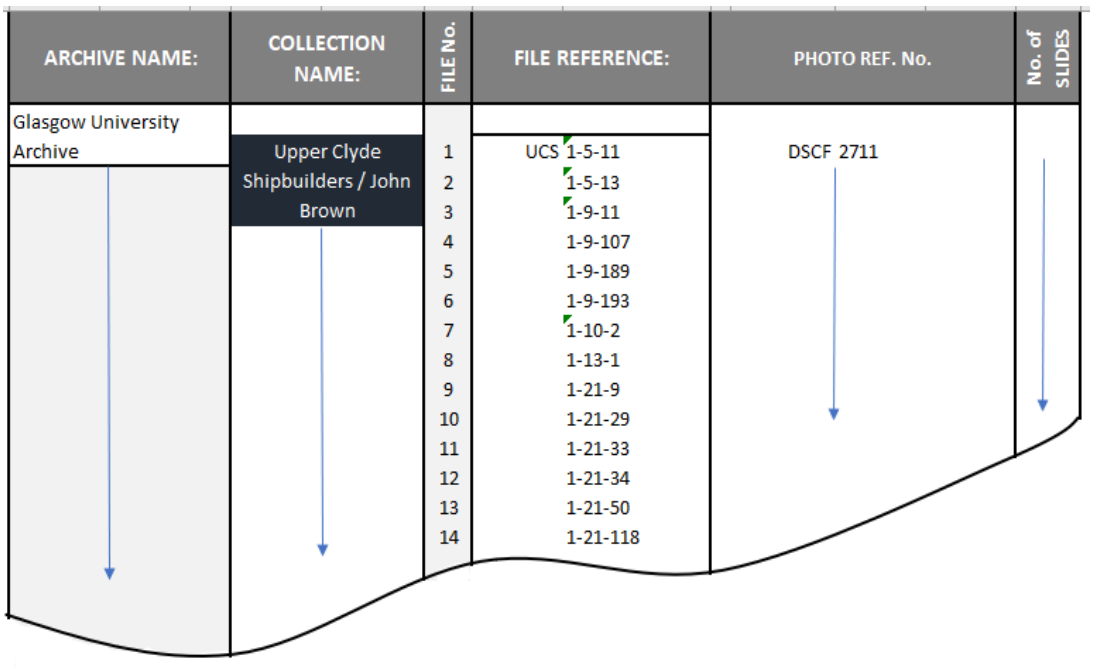
5.7 Data organisation and synthesis

Following discussion of how the archival data was collected, this section of the Methodology details how the data has been managed, organised and analysed in order for the findings to be reported later in Chapter 6 and 7.

5.7.1 How the data was managed and organised prior to analysis

The applicable archive data was collected by photographing each record relevant to the research question, (with the exception of a few records from the National Archives which were scanned). Each time a new archival file was opened a photograph was taken of the file itself, recording its file number and archive identity before any of the records inside were photographed. Where this was not possible, a photograph was taken of a plain sheet of paper with the file identity information on it. The photos were recorded on an SD card and transferred to the password protected secure drive at the earliest opportunity.

This enabled the data to be organised in ‘blocks’ relating to the archive and file in which they were found. The files, or blocks, were recorded according to the archival file reference, using the following file structure (Figure 5.6):



ARCHIVE NAME:	COLLECTION NAME:	FILE No.	FILE REFERENCE:	PHOTO REF. No.	No. of SLIDES
Glasgow University Archive	Upper Clyde Shipbuilders / John Brown	1	UCS 1-5-11	DSCF 2711	
		2	1-5-13		
		3	1-9-11		
		4	1-9-107		
		5	1-9-189		
		6	1-9-193		
		7	1-10-2		
		8	1-13-1		
		9	1-21-9		
		10	1-21-29		
		11	1-21-33		
		12	1-21-34		
		13	1-21-50		
		14	1-21-118		

Figure 5.6 – Extract from details of Archival File Records – see Appendix 6.1 for full details

The management of the data involved the use of Microsoft Excel, but beyond this no computer software packages were used. Various programs exist to help the researcher manage their data, but as supported by Merriman (2009), this can lead to a loss of flexibility due to the mechanical handling of the data and so given the preferences of the researcher and type of data involved, was not further pursued.

5.7.2 How the Data was Analysed

Due to the largely photographic nature of the data collected, it was not possible to use a computer package such as for instance, word search programmes, to analyse the data. Instead the data was coded and reviewed by several parties, in sequence, as follows:

1. The researcher coded all data records
2. A pilot study involving the coding of a sub-set of the data in 1, above, was undertaken by Programme and Project Management Masters students. The sample was taken purposively to include data from each of the 3 main archives visited by the study: The National Archive, The Brass Foundry (National Maritime Museum) and the Scottish Business Archive (Glasgow University). Samples were also chosen so as to cover all elements of both the Systems Model and the Essence of Project Management.
3. The same sub-set of data used in 2 above was reviewed and coded by individuals currently employed in project management within the field of present-day naval ship building projects.

Miles *et al.* (2014) report that there are up to twenty-five different methods or approaches to coding data. They describe sixteen of them in some detail. The coding in this study took a predominantly 'process coding' approach. This tended to focus the archival document on the process which the document demonstrated, or suggested, to the reviewer. One other approach to coding that Miles *et al.* (2014) suggest is described as a 'holistic coding approach'. Here a value is given to a large unit of data, rather than it being coded line by line.

This study takes both a process coding and a holistic coding approach to the analysis, where for instance the 'file' of archival records presented multiple iterations of the same type of information. A monthly expense ledger is an example of this with multiple pages of the same information shown for each consecutive month.

5.7.3 Researcher coding:

The researcher reviewed each archival record and then analysed them using the headings shown below in Figure. 5.7.

Initially the records were analysed slide by slide but with approx. 1,847 slides collected from 61 different archive files containing an average of 30 slides per file which could show similar material, but potentially for a different month of

the year, it was decided to analyse the records on a file by file basis. The right-hand column in Figure 5.7 was added to detail whether the content of each file was consistent across all the slides within it. Where there was a clear variation in the content, a sub file was established using the same file number but suffixed by an a, b or c etc.
As discussed in 5.6.2 above, the study codes the data using a mainly process coding approach.

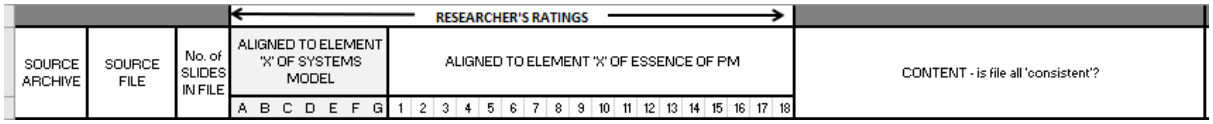


Figure 5.7 – details of the way in which the analysis of the archive records were recorded

Figure 5.7 shows that the records were first analysed by reference to the Systems Model, (Fortune and White, 2006) and then by the elements of the Essence of Project Management as defined in Chapter 3.

Fortune and White describe the Systems Model as having six key components. These are shown in Figure 5.8 below and show how each of the artefacts, assessed as part of the document shown at Figure 5.7, (these were also part of the questionnaire shown at Appendix 5.3,) were analysed in terms of the Systems Model.

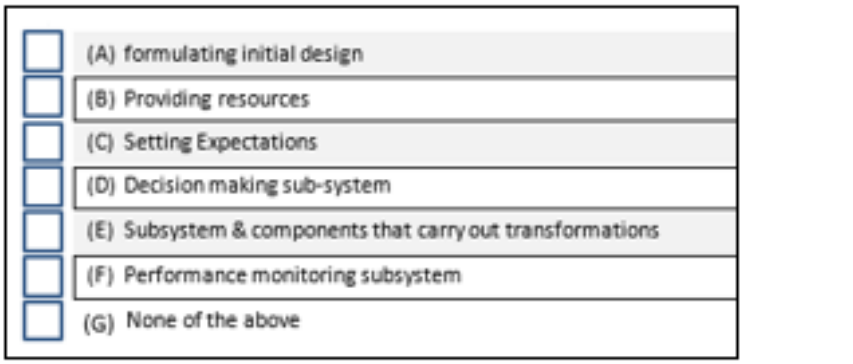


Figure 5.8 – details of the systems theory elements relating to A-G shown in Figure 5.6.

Figure 5.7 also shows that the records were also analysed in terms of how they reflected the Essence of Project Management. This was recorded in the fifth column along of Figure 5.7 each of the values between 1 - 18 equated to the data in Figure 5.9 and indicated which of the elements of PM the records were aligned with. In analysing the Systems Model elements, the researcher marked a maximum of two areas of the Systems Model A-G. This is because a focused approach was required and this enabled the strongest associations to be noted. The same method of analysis was used by the pilot study and the naval PMs (the review with the naval PMs took the form of a focus group as opposed to a questionnaire, see section 5.6.4), and the questions were focused on identifying the areas of the Systems Model most strongly associated with each individual archive record.

When the Essence of Project Management was analysed, no limit was placed on the number of boxes that could be ticked (as detailed in Figure 5.9 below,) because it was felt that this part of the analysis should flow freely from the Systems Model analysis.

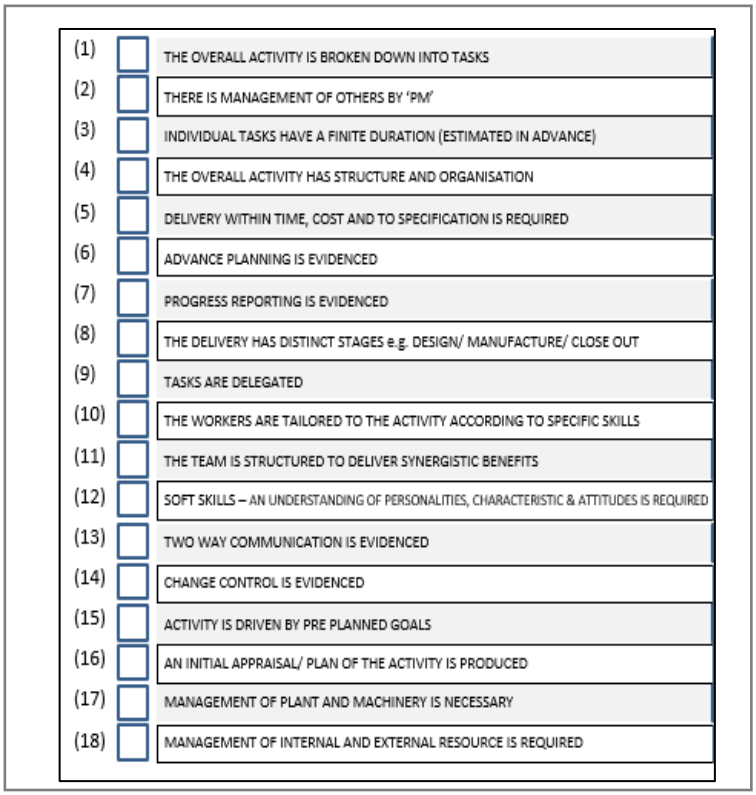


Figure 5.9 – details of the elements of the Essence of Project Management relating to 1-18 shown in Figure 5.7.

The strength of each of the ratings made in response to Figures 5.8 and 5.9 was also recorded, indicating how strongly the respondent felt the association was. A Likert scale ranging from very weak (1) to very strong (5) was used. The full list of questions can be seen in Appendix 5.1. (Appendix 5.1 shows a series of 5 questions which were asked in respect of each of the archival records reviewed (- the 'Slides'.) The Appendix shows that in addition to asking the strength of association between the sample and the Systems Model and the Essence of Project Management, there was the opportunity to add free text to explain what the respondent was thinking when answering (see Q2 and 4 within the list of questions).

There was also an additional area for free text (Q5) which asked: 'Do you think that the slide suggests the use or existence of any project process not outlined in Q3 above. What does this show or how could it be used to demonstrate a link to other PM processes?' The aim of this question was to enable the respondents to express a view, where appropriate, other than those directed by the list of questions.

Prior to conducting the Pilot Test, the researcher completed the above list of questions for each of the files within the archival data base, a total of 91 files containing 1,847 slides. The files consisted of repeated set of data for different time periods. A file containing for instance accounting records would contain the same set of information for each calendar month.

5.7.4 How was the Pilot Test analysed?

The same process discussed in 5.6.3 was used to conduct the Pilot Test. The analysis sheets were reviewed at the end of the pilot test. They were looked at in terms of completeness as well as the degree to which relevant responses had been made.

Lastly the views of the pilot study respondents were studied to see how the archival review process could be improved before the review was conducted with the naval PMs on which the study depends for its confirmation of the researchers coding.

5.7.5 How was the Naval PM focus group data analysed?

Following the Pilot Test, the amended process (see Appendix 5.1) was used to review the data with the naval PMs and to record their responses. The detail from the focus group was taken and consolidated into one sheet. This consolidated data was analysed firstly to give an initial impression as to the degree to which MPM was evidenced within the naval PMs' coding.

The naval PMs' coding was then compared with the researcher's analysis on a case by case basis to investigate the overall consistency, and recorded using a matrix display. This gave an indication as to whether or not there was any agreement between the two codings. Given there was not a complete match of the codings a more robust measure was used to check how likely it was that the level of agreement could have arisen by chance. This was done using Cohen's Kappa.

5.8 The Use of Cohen's Kappa.

Von Eye and von Eye (2005) state that Cohen's Kappa (K) is the most popular measure of rater agreement and it indicates the degree to which two raters agree beyond chance. Warrens (2010, p.673) agrees with this confirming that it is 'a popular descriptive statistic for summarizing the cross classification of two nominal variables with….identical categories.'

K is a quantitative measure of reliability for two raters that are rating the same events or data, corrected for how often that the raters could agree by chance.

Cohen (1960) sets out a method for analysing whether 2 sets of data, coded by two different coders are both reflecting the same phenomena – inter-coder reliability. Cohen does this, as shown at Figure 5.10 below, by comparing the number of times each set of codings agree as a proportion of the total number of possible agreements, the total number of samples, but makes an adjustment for the number of agreements that could happen by chance.

$$\text{Cohen's Kappa} = \frac{\text{the proportion of units in which the judges agreed} - \text{the proportion of units where agreement is expected by chance}}{1 - \text{the proportion of units where agreement is expected by chance}}$$

Figure 5.10 – the equation used to calculate Kohen's Kappa as a measure of inter-coder reliability

When reviewing the researcher's rating of the full set of 91 files (see Appendix 6.1) the research needed to judge how reliable this rating is. By using K and extending it past the simple two by two matrix example given below, it is possible to see how much of the coding of the subset of files (shown in Appendix 6.2) agrees with that undertaken by the independent coders – the practicing naval PMs.

5.8.1 Evaluating Cohen's Kappa

If there is a level of agreement between the two raters then the value calculated will be between 0 and 1, where a value of 0 would mean that there is only a random level of agreement and a score of 1 would indicate complete agreement between the raters. Drawing on the work of McHugh (2012) and Landis and Koch (1977), this is shown in Table 5.11.

Table 5.11 – Meanings of Cohen's Kappa values – from McHugh (2012) and Landis and Koch (1977)

Cohen's Kappa (K) value	Meaning of K value
0.81< K < 1.0	Indicates an **almost perfect** level of agreement between data sets.
0.61< K < 0.80	Indicates a **substantial** amount of agreememt between the data sets
0.41< K < 0.60	Indicates a **moderat**e amount of agreememt between the data sets
0.21< K < 0.40	Indicates a **fair** amount of agreememt between the data sets
0.01< K < 0.20	Indicates **no** agreement **to slight** agreememt between the data sets
k<0	Indicates **no** agreement between the data sets

Both the papers from Von Eye and Von Eye (2005) and Warrens (2010) draw on the original work of Cohen (1960). Having taken note of the popularity of K as a measure of inter coder reliability, this research reviewed Cohen's original 1960 paper in order to measure intercoder reliability.

Cohen himself (1960) says that it is often the case in research that it becomes necessary to determine the extent to which two sets of judgments, or codings, are reproducible, i.e., reliable. Cohen notes that the very simplest way of doing this is to 'count up the proportion of cases in which the judges agreed, and let the issue rest there'. (P.38). This simplistic approach is illustrated below:

5.8.2 Cohen's Kappa a worked example:

The way in which K is calculated is best illustrated with an example. Suppose we have two raters who are asked to review data and can rate each piece either as having a value of 1 or 2. The data is binary and so must be one value or the other.

In Figure 5.11 , a 2 x 2 grid has been used to record the results of the raters coding.

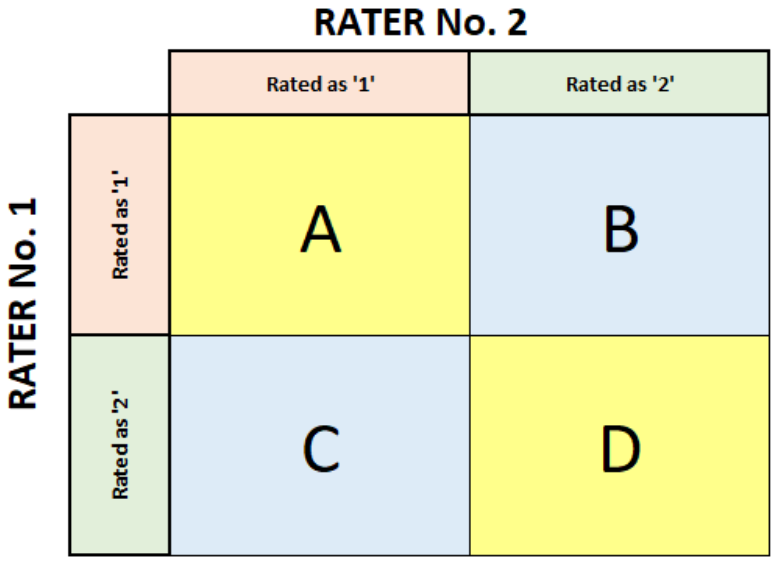


Figure 5.11: Cohen's kappa demonstration grid.

In the grid, values have been assigned from A – D.

A is the total number of instances that both raters rated as ‘1’. Hence, both raters agree.
B is the total number of instances that rater 1 said ‘1’ and rater 2 said ‘2’. The raters disagree.
C is the total number of instances that rater 1 said ‘2’ and rater 2 said ‘1’. The raters disagree.
D is the total number of instances that both raters rated as ‘2’ .Both raters agree.

A basic calculation of agreement can be made looking purely at the proportion of ‘agreements’; compared to the total population:

Total no. of agreements / by the total number of codings, = (A + D)/(A + B+ C+ D).

This, as a measure of agreement, is subject to a weakness identified by Cohen (1960) in that it includes a measure of agreement purely due to chance which could be expected in any such rating. This measure of random agreement can be calculated by looking at the following sum:

1. the no. of times that Rater 1 said ‘1’ divided by
2. the no. of instances, multiplied by
3. the no. of times that Rater 2 said ‘1’ divided by
4. the no. of instances, added to
5. the no. of times that Rater 1 said ‘2’ divided by
6. the no. of instances, multiplied by
7. the no. of times that Rater 2 said ‘2 divided by
8. the no. of instances.

Cohen in his original (1960) paper gave the formula for calculating K as:

$$\text{Cohen's Kappa} = \frac{\text{the proportion of units in which the judges agreed} - \text{the proportion of units where agreement is expected by chance}}{1 - \text{the proportion of units where agreement is expected by chance}}$$

To calculate K from Figure 5.11, the following variables therefore need to be calculated:

1. The total number of samples
2. The proportion of samples for which the judges agree
3. The proportion of samples where agreement by chance is expected

The values of 1-3 above can be calculated as follows:

1. The total number of samples is given by: (A + B+ C+ D).

2.

$$\text{The proportion of samples for which the judges agree} = \frac{\text{no. of samples for which the judges agree}}{\text{The total number of samples}}$$

The total proportion of agreements is therefore given by:
(A + D)/(A+B+C+D).

3.

The number of agreements that could occur by chance is given by the proportion of times each rater gave the answer '1' (X) and then the proportion of times each rater gave the answer '2', (Y) and then considering the chance of these two events occurring at the same time (equals X times Y).

The probability of agreements happening by chance is therefore given by:

$$\left[[(A+B)/(A+B+C+D)] \times [(A+C)/(A+B+C+D)]\right] + \left[[(C+D)/(A+B+C+D)] \times [(B+D)/(A+B+C+D)]\right]$$

It can be seen that in relation to Figure 5.11, the calculation of each of the variables is now known and given values for A, B, C and D, a value for K could be calculated using the formula replicated below:

$$\text{Cohen's Kappa} = \frac{\text{the proportion of units in which the judges agreed} - \text{the proportion of units where agreement is expected by chance}}{1 - \text{the proportion of units where agreement is expected by chance}}$$

Figure 5.12 (Figure 5.10 reproduced) – the equation used to calculate Kohen's Kappa as a measure of inter-coder reliability (Cohen 1960).

This method was used to judge whether the sub set of documents coded by the naval PMs was consistent with the coding produced by the researcher. If it can be shown that this is true for the subset of files in respect of the researcher's coding, then the researcher's coding as a whole, across all 91 files, can be regarded as valid.

5.9 Cohen's Kappa calculation in respect of the survey data collected

Cohen's Kappa (K) has been used to measure intercoder reliability, and to verify that the researchers coding of full set of 91 files (see Appendix 6.1) is reliable. K was calculated both for the Systems Theory elements of the files reviewed with the naval PMs, who acted as 'raters' and the elements of the Essence of Project Management.

To do this a subset of the 91 files, as described in sections 6.4.1 and 6.4.2 and shown in Appendix 6.2, was selected. The 91 files were reviewed by the researcher and rated in terms of Systems Theory and the Essence of Project Management. (Appendix 6.1)

The subset (Appendix 6.2) was then analysed by a panel of practicing naval PMs who rated each file in terms of Systems Theory and the Essence of Project Management. (These results are shown in Appendices 6.7. and 6.8.

5.9.1 Application of Cohen's Kappa within the research

Within this study, K is first applied to the statistics describing the archival data's reflection of the Systems Theory Model and secondly to evaluate the degree of reliability between the codings of the Essence of Project Management.

The first of these results can be seen below at Section 6.3.

5.10 Post the inter-coder reliability tests, how was the full data set analysed?

Having established the level of validity within the researcher's original coding, further qualitative analysis was carried out on the primary data, using a number of different methods of qualitative analysis.

Leech and Onwuegbuzie (2008) report that there are eighteen techniques for analysing qualitative data. Each was described and its suitability for use within this study was assessed in Table 5.12.

Table 5.12 – Qualitative Data Analysis Techniques – taken from Leech & Onwuegbuzie (2008).

	DATA ANALYSIS TECHNIQUE	DESCRIPTION	SUITABLE FOR USE IN STUDY?
1	CONSTANT COMPARISON ANALYSIS	SYSTEMATICALLY REDUCING DATA TO CODES & DEVELOPING THEMES FROM THE CODES	NOT SUITABLE FOR STUDY - IT IS USUALLY USED WITH TALK AND/OR OBSERVATION BASED DATA
✓ 2	KEYWORDS IN CONTEXT	IDENTIFYING WORDS & UTILISING THE SURROUNDING WORDS TO UNDERSTAND THE UNDERLYING MEANING OF THE KEYWORD	COULD BE USED TO LOOK AT WHAT THE PATTERNS WITHIN THE ARCHIVAL TEXTS OR QUESTIONNAIRES COULD REVEAL
✓ 3	WORD COUNT	THE FREQUENCY OF A WORDS OCCURRENCE REFLECTS ITS IMPORTANCE FOR THE RESEARCH SUBJECT.	COULD BE USED TO ANALYSE FREE TEXT PARTS OF THE QUESTIONNAIRE RESPONSES.
4	CLASSICAL CONTENT ANALYSIS	INVOLVES THE SYSTEMTIC AND OBJECTIVE DESCRIPTION OF THE CONTENT IOF COMMUNICATION.	NOT SUITABLE FOR THIS STUDY AS TALK WAS NOT INCLUDED IN THE METHODOLOGY
5	DOMAIN ANALYSIS TAXONOMIC ANALYSIS COMPONENTIAL ANALYSIS	THESE THREE ARE ALL TYPES OF ETHNOGRAPHIC ANALYSIS INVOLVING THE SYSTEMATIC ANALYSIS OF A PARTICIPANTS WORDS AND ENVIRONMENT.	NOT SUITABLE FOR THIS STUDY AS TALK AND OBSERVATIONS WERE NOT INCLUDED IN THE METHODOLOGY
6	CONVERSATION ANALYSIS	FOCUSES ON WHAT THE PARTICIPANTS SAY IN THE CONVERSATION AND THEIR MOTIVES FOR DOING SO.	NOT SUITABLE FOR THIS STUDY AS COVERSATIONS WERE NOT INCLUDED IN THE METHODOLOGY
7	DISCOURSE ANALYSIS	INVOLVES SELECTING SECTIONS OF THE INTERVIEW TRANSCRIPT & EXAMINING THEM IN DETAIL.	NOT SUITABLE FOR THIS STUDY AS INTERVIEWS WERE NOT INCLUDED IN THE METHODOLOGY
8	SECONDARY ANALYSIS	ANALYSING DATA OR ANALYSIS USED FROM PREVIOUS STUDIES	NOT SUITABLE FOR THIS STUDY AS NO SECONDARY INFORMATION, AS DEFINED BY THIS, WAS USED
9	MEMBERSHIP CATEGORISATION ANALYSIS	CONSIDERS THE LABELS AN INDIVIDUAL MIGHT BE GIVEN WITHIN THE RSEARCH AND THE EFFECT THAT THAT HAS ON THE ANALYSIS	NOT SUITABLE FOR THIS STUDY AS INDIVIDUALS WERE NOT GIVEN LABELS AS PART OF THE METHODOLOGY
10	NARRATIVE ANALYSIS	CONSIDERS THE WAY STORIES TOLD ABOUT SUBJECTS CAN REVEAL/ GIVE MEANING TO THEM	NOT SUITABLE FOR THIS STUDY AS THERE ARE NO STORIES/ NARRATIVES TO ANALYSE.
11	QUALITATIVE COMPARATIVE ANALYSIS	REPRESENTS A SYSTEMATIC ANALYSIS ACROSS CASES OF BOTH SIMILARITIES AND DIFFERENCES.	NOT SUITABLE FOR THIS STUDY AS ONLY ONE CASE IS STUDIED.
12	SEMIOTICS	THE SCIENCE OF SIGNS OR SYMBOLS WITHIN THE NARRATIVE OR TALK OR TEXT, ASSUMING NO MEANING CAN BE ATTACHED TO ONE INDIVIDUAL TERM.	NOT SUITABLE FOR THIS STUDY AS NARRATIVES / INTERVIEWS WERE NOT INCLUDED IN THE METHODOLOGY
13	MANIFEST CONTENT ANALYSIS	USED TO DESCRIBE OBSERVED (OR MANIFEST) ASPECTS OF COMMUNICATION.	NOT SUITABLE FOR THIS STUDY AS OBSERVATIONS WERE NOT INCLUDED IN THE METHODOLOGY
✓ 14	LATENT CONTENT ANALYSIS	UNCOVERING THE UNDERLYING MEANING OF TEXT	COULD BE USED TO LOOK AT WHAT THE PATTERNS WITHIN THE ARCHIVAL TEXTS COULD REVEAL.
✓ 15	TEXT MINING	ANALYZING NATURALLY OCCURING TEXT IN ORDER TO DISCOVER SEMANTIC INFORMATION.'	COULD BE USED TO LOOK AT WHAT THE PATTERNS WITHIN THE ARCHIVAL TEXTS REVEAL.
16	MICRO-INTERLOCUTOR ANALYSIS	ANALYSING FOCUS GROUP INFORMATION CONCENTRATING ON NON -VERBAL COMMUNICATION	NOT SUITABLE FOR THIS STUDY AS FOCUS GROUPS WERE NOT INCLUDED IN THE METHODOLOGY

Leech and Onwulegbuzie (2008) also analyse the suitability of each of these methods, dependent on the type of data and data sources that have been obtained. They give four types of qualitative data sources – talk, documents,

observations and drawings/photographs/video. Setting aside the quantitative list of questions data used in the inter-coder reliability testing, as at this point it has served its purpose in validating the initial coding, the data collection methods of this study, as described earlier, lean primarily to archival documents (the photos taken were of documents so aren't considered a separate category) and the written answers to the list of questions in terms of free text comments.

From the diagram at Figure 5.13 below, showing which methods of analysis are suitable for document analysis, and combining this with the information in Table 5.12 above, a list of possible methods of analysis was drawn up.

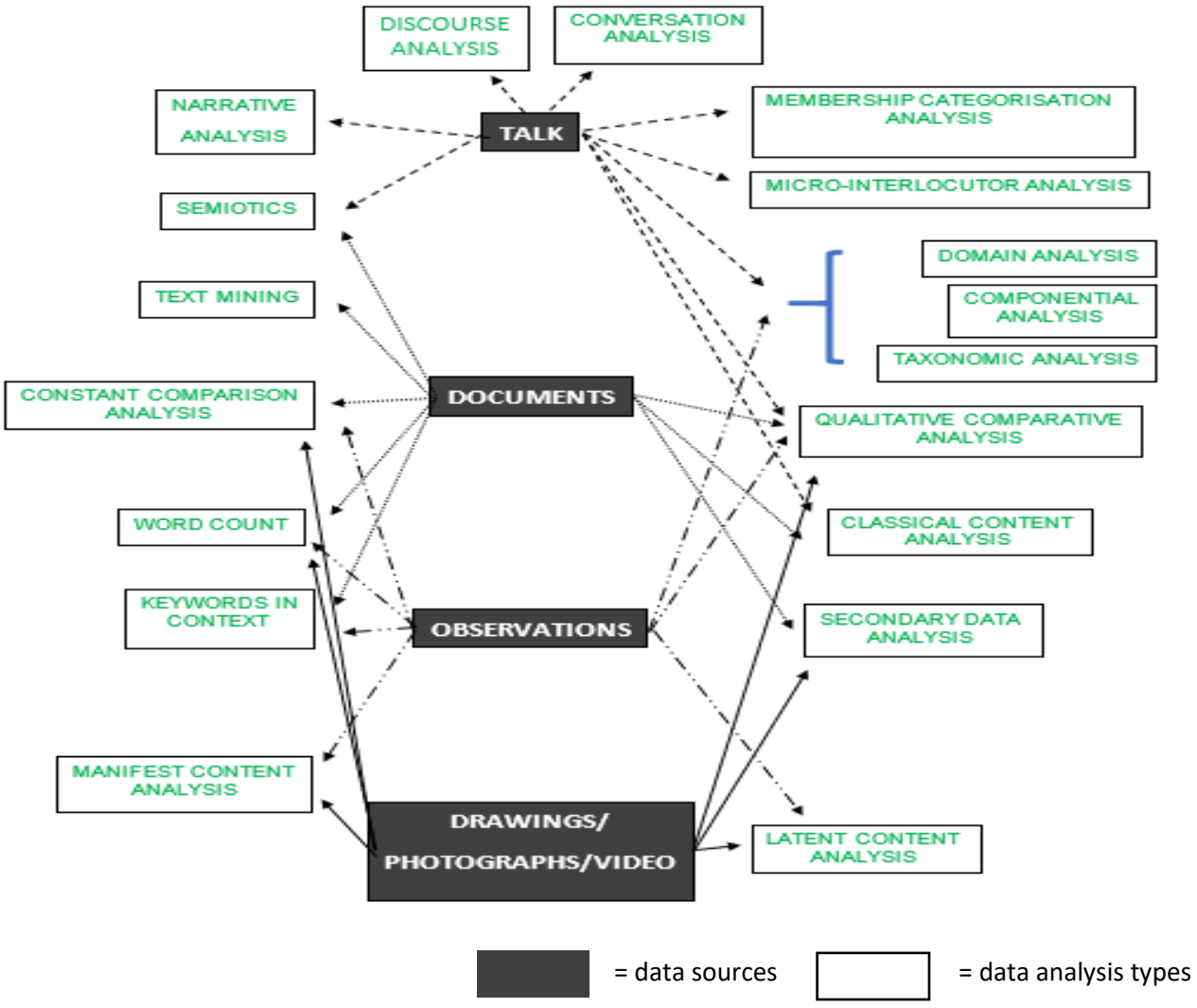


Figure 5.13 – Qualitative Data types mapped to Analysis Techniques – author's own, taken from Leech & Onwuegbuzie (2008),

Qualitative Comparative analysis	*X*
Classical Content Analysis	*X*
Secondary Data Analysis	*X*
Keywords in Context	✓
Word Count	✓
Constant Comparative Analysis	*X*
Text Mining	✓
Semiotics	*X*

'Keywords in Context', 'Word Count' and 'Text Mining' are all suitable methods and as such were used within the study. The 'odd technique' out perhaps is 'Latent content Analysis'. The researcher considers that this could be a technique used within this study, but Leech and Onwulegbuzie (2008) consider it to be a technique suitable for data gathered only from observations or pictorial data sources. The reason behind this anomaly is that it is similar in approach to 'Text Mining' with the exception of having a different data source. (It applies to pictorial rather than textual sources.) As a type of analysis, it is therefore ruled out as the primary data source within this study is documental.

5.10.1 How was the analysis of the data displayed?

Miles *et al.* (2014) describe how 'descriptions' and 'displays' can both help to present and analyse the information. Three separate methods or 'displays' mentioned by Miles *et al.* (2014) had resonance with this study: a narrative description, a matrix display and a network display. These and their use within the study are described in more detail below:

5.10.2. Narrative Description.

Two narratives were written.

The first narrative was written drawing from the free text comments from the naval PMs. The focus of this was to pull together threads of the emerging picture and support them using direct quotes from the completed focus groups. This combines the analysis of the First Cycle coding with the field

data. This approach enabled the study to outline the functions and processes being used using both the primary and secondary research data.

The second narrative focused on the question of whether or not it was possible to undertake historical project research and the challenges that the researcher might face. This was compiled using the experience gained researching this study, reflected in a series of analytical memos with particular reference to:

- the study's research questions
- points highlighted in the relevant section of the literature review (Chapter 3)
- cross references to material in other parts of the data set
- potential difficulties within the study
- emergent patterns or themes
- future directions for the study

5.10.3 Matrix Display.

Matrix displays are presentation of data in a tabular form, including the coding data, that can be used for analytical purposes. They present the data in an easily digestible 'at-a-glance' format enabling both reflections and conclusions to be formed.

The primary matrix was divided into two halves, one centred on the Systems Theory elements and the second focused on the Essence of Project Management. Plotting the data in the form of a matrix display gave a clear indication of which elements were heavily represented within the data sample and also those which were less well represented. This gave further information to reflect upon and fed into the narratives written.

5.10.4 Network Display.

A network display was constructed. A Network display focuses on a process or a 'network' of how processes transform a situation over time. The network analysed each process found in the archives against a timeline reflecting the lifecycle of HMS Barham's construction.

This display has the advantage of illustrating the development of the processes as a whole and to quickly view which processes were one-offs and where they occurred in the lifecycle. This assessment could then be compared with today's best practice so that any commonality/ changes in the way processes were/ are used could be highlighted.

5.10.5 Triangulation.

Triangulation is a term used at sea for navigation purposes. It uses bearings from two or more landmarks to calculate and fix the position of a ship. Within research, it refers to the use of two or more methods of analysis to 'fix' and substantiate the analysis. Leech and Onwulegbuzie (2008, p.588) recommend the use of multiple data analysis tools to do this. They believe 'it is important to increase triangulation not only by using multiple data collection tools but also by utilising multiple data analysis tools'. Reflecting this, the study used both archival research and focus groups as forms of data sources and Keywords in Context, and Text Mining as analysis methods together with those methods of Narrative Description, Matrix display and Network Display discussed by Miles *et al.* (2014). Flick (2004, p.178), Wilson (2014) and Thurmond (2001) all agree that triangulation can be performed through the use of multiple methodological approaches, but also highlight 'triangulation of data', 'investigator triangulation' and 'theory triangulation' as possible approaches. The first two of these approaches are relevant to this study. The first focuses on the combination of data from a number of different sources, from different locations. The second uses multiple 'investigators' to provide the data, this approach uses the results from the multiple investigators to balance any outlying views. The study has fulfilled the criteria for both these approaches, firstly through the collection of data from multiple sources and locations and then secondly through the 'investigation' or analysis of this data through multiple viewpoints, validated through use of Cohen's Kappa. (See Section 6.3.)

5.11 Ethical considerations

The ethical basis of the study was originally considered in line with Portsmouth University's Ethics Policy guidelines. This was prior to the thesis being moved from Portsmouth University and submitted to the University of the West of England (UWE). The ethical approval conducted by Portsmouth University was ratified, at UWE, by the Chair of the Faculty Research Ethics Committee UWE on 7th January 2021. (Application number: FET.21.01.021 - see appendix 5.6).

The principal data gained from the archives is approximately one hundred years old, and consequently, there are few ethical issues since those involved with the activities involved in the records and in the compilation of them are no longer with us, indeed even the company John Brown & Co. which contributes many of the records has long since ceased trading.

The area of research for which the study did need to ensure a thorough and ethical approach to, was the reviews of the archival data with the current naval Project Managers. The Ethical Approach taken to this part of the study adhered fully to the Portsmouth University Ethics Policy guidelines, and is detailed in Appendix 5.6. It includes a range of documents as detailed in the Ethics Approval list of Appendices submitted to Portsmouth University in satisfaction of its Ethical Review. The full list of Ethics Application Form and associated Appendices are shown in Table 5.13:

Table 5.13 – List of Appendices included in the study's Ethics Application.

Document	*Version*	*Date*
Application Form	1	31/05/18
Appendix 1 – Research ethics and Integrity Course Certificate	2	16/05/18
Appendix 2 – Primary and Secondary Research Questions	2	25/05/18
Appendix 3 – Consent Form	3	31/05/18
Appendix 4 – Voluntary Participation form	4	31/05/18
Appendix 5 – Confidentiality and Anonymity form	2	24/06/18
Appendix 6 – Draft Survey Questionnaire	3	25/05/18
Appendix 7 – Approach to Transparency	4	25/05/18
Appendix 8 – Invitation to take part in research	2	24/06/18

Ethical approval was sought from the University and obtained in full, as evidenced in Appendix 5.6.

5.12 Researcher bias and issues of trustworthiness

With regard to qualitative research Mays and Pope (1995, p.109) offer the following view:

> 'The most commonly heard criticisms are, firstly, that qualitative research is merely an assembly of anecdote and personal impressions, strongly subject to researcher bias; secondly, it is argued that qualitative research lacks reproducibility - the research is so personal to the researcher that there is no guarantee that a different researcher would not come to radically different conclusions; and, finally, qualitative research is criticised for lacking generalisability. It is said that qualitative methods tend to generate large amounts of detailed information about a small number of settings. The pervasive assumption underlying all these criticisms is that quantitative and qualitative approaches are fundamentally different in their ability to ensure the validity and reliability of their findings.'

Given the views recorded by Mays and Pope, it was important for the study to demonstrate that the approach taken by the study is a true reflection and interpretation of the situation researched. It needs to be able to demonstrate

that the data and conclusions produced are trustworthy. To do this, two key terms must be considered – the credibility and dependability of the research.

The dependability of the research measures whether the research outcomes accurately reflect the views of the participants. This needs to be evidenced and was done using the following approach:

The study acknowledges that researchers are seldom unbiased. Bias can be defined as any influence that can distort the results of a study (Galdas, 2017). A number of biases can potential be introduced by the researcher. It was the researcher's belief prior to the study that, as a very minimum, it was likely that it would be possible to trace a number of tools and techniques capable of delivering the Essence of Project Management to a time before the beginnings of MPM. This could have taken the shape of early forms of these processes or it might have represented them in full. Any tendency to infer attributes which were not evidenced was checked through the independent analysis presented by the focus groups undertaken as outlined in Section 5.2.2 above. The use of a focus group was key in acting as a verification strategy for establishing the reliability and validity of the analysis and hence addressing any potential bias, as outlined by Morse *et al.* (2002)

Prior to the focus groups, it was recognised that the researcher could be unaware of their potential research biases, and hence unable to appreciate potential problems with the approach to the focus group, leading to the potential for difficulties both in using and/or displaying the output from the focus groups. An approach often used to minimise this risk (Chenail, 2011) is to include the use of a pilot study within the research design. This enables the researcher to trial their proposed methods to see if the planned procedures perform as envisioned and to identifying potential researcher biases. The approach taken to the pilot study and the results gleaned from it are described above in sections 5.6.3.1 and 5.6.3.2.

Norris (1997, p. 174) lists some potential causes of researcher bias relevant to this study:

1. selection biases including the sampling of times, places, events, people, issues, questions and the balance between the dramatic and the mundane;
2. - the availability and reliability of various sources or kinds of data, either in general or their availability to different researchers;
3. - the ability of researchers, including their knowledge, skills, methodological strengths, capacity for imagination;
4. - the researcher's need for resolution, conclusion and certainty

The first two of these refer to how the data was found or selected, while the third and fourth refer to the researcher's predisposition. Sections 5.6.2, 5.6.3.1 and 5.6.4 deal with the way in which the focus groups were constructed and the approach to how the selection of the documents for the focus group review was determined. These sections detail measures to reduce bias such as the selection and use of a wide range of document sources and focuses.

The case study choice could arguably be considered biased as described by Points 1 and 2 above, However the selection is not claimed to b e representative of all projects, but it is claimed to show evidence of PM practices, the study seeks to demonstrate the existence of the practices and not their prevalence. This is reflected in the discussion of the study's limitations later in the paper.

Points 3 and 4 above focus on the potential researcher bias. The researcher, having been involved in project management for over 20 years, had the requisite project management skills and was supervised through the construction of the research to ensure a strong method. This could however introduce a weakness – a lack of imagination or ability to step away from project management norms. The design of the focus groups mitigated this as a questioning approach and open dialogue was possible in a way that it would not be within the confines of, for example, a questionnaire. The need for a conclusion, a result from the study, as related by Norris (1997) above, could have put pressure on false or rushed conclusions being drawn. The independent input of the focus group and the wide range of sources used in defining the Essence of PM within chapter 3, helped to mitigate these risks.

Multiple sources of information are included in the research which enabled these sources to be compared and through triangulation, support any research findings. Seale (1999, p.472) says that ‘the idea of triangulation derives from discussions of measurement validity by quantitative methodologists’. He goes on to describe it as ‘the use of several methods at once so that the biases of any one method might be cancelled out by those of others.’ Flick (1998, p.230) sees triangulation as a means through which the ‘scope depth and consistency’ of the study can be improved, an idea supported by Hammersley (2008, p.23) who says ‘The original usage of ‘triangulation’, within the literature of social science methodology, referred to checking the validity of an interpretation based on a single source of data by recourse to at least one further source that is of a strategically different type.’ Hammersley relates how triangulation may take the form of comparing interview data from multiple interviewees or from data produced through different data gathering techniques. Both of these approaches have the same end purpose – to reduce the chances of a study producing false conclusions. If a variety of different sources confirm the conclusion drawn from the original data, then that conclusion can be established with a greater degree of confidence than previously.

One of the potential weaknesses within the approach of triangulation however, is that it assumes that, just as there is only one precise position that a navigator should plot through the use of triangulation at sea, there is just one truth to be discovered within the research. This is more in line with the positivist approach rather than the constructivist approach often found within social research. Work done by Erzberger, and Kelle (2003) however, takes a different view. They state that: ‘the use of different methods to investigate a certain domain of social reality can be compared with the examination of a physical object from two different viewpoints or angles. Both viewpoints provide different pictures of this object that might not be useful to validate each other but that might yield a fuller and more complete picture of the phenomenon concerned if brought together’. This study takes this approach in order to increase the trustworthiness of its results.

Reliability considers whether the processes and procedures used to track collect and assess the data can be validated. The study uses the following approaches to help ensure dependability:

a) An audit trail was provided showing where the data was collected from, be it archival or from the subsequent interviews, and also how the data was analysed. Although not all data collected has been included in the study report, all data is available for review should other researchers wish to see it.
b) The independent coding has been done by a number of different 'coding raters' in order to establish and ensure inter-rater reliability. Details of the analysis of this process are shown in Chapter 6, Section 6.3

5.13 Limitations and delimitations

The question of the study's limitations addresses the elements and approach within the study design and methodology that may affect the interpretation of the research findings. Any limitations to the study will have an effect on the transferability of the study's conclusion and on the ability of the findings to be employed in different scenarios and applications.

The study, concentrates on a type of endeavour, or project as we would call it today, that required very large amounts of both money and resources to deliver it. This focus proved to be fertile ground in terms of the search for evidence of the Essence of Project Management. Because the study deals with one end of the project spectrum, (large, in terms of cost), the findings of the research cannot be deemed to necessarily apply to all endeavours of a project nature at the date researched. Similarly, where the records allow only a sample of the Dreadnought constructers to be researched, the findings cannot be used to imply that all constructors operated in the same manner. What they do illustrate however, is the methods that were in existence, at

least at John Brown & Co. Ltd., and the similarities that can be drawn between these methods and those of MPM. The study increases our understanding of, to quote Söderlund and Lenfle (2013 p.660), how past project practices ‘might inform our responses to current challenges’, how ‘particular practises create paths that determine the future of project management’. Transferability for the study therefore exists at a methodological or theoretical level.

This study is limited to a review of surviving documents. Whilst this is a weakness, it does mean that the study is forced to focus on larger project endeavours, where more records were likely to have been produced and potentially retained. This is not altogether a detrimental aspect as the processes being researched are both more likely to have been developed in these larger undertakings and also more likely to have survived the passage of time, due to the greater relative importance that their size and expense bestows on them. There is, therefore, a weakness in that there isn’t full information on some aspects that were considered either less important to record or to keep. This is however a weakness by archival research in general and was borne in mind in the interpretation of the archives analysed.

The study helps to establish what was important at the time of the construction of HMS Barham and how the management of these activities were delivered. There is a very wide range of potential fields, or areas, where this research could be done. Kozak-Holland and Procter (2014) for instance review the construction of the Florence Duomo by Filippo Brunelleschi in the fifteenth century. (see Section 3.1). The paper produced did not review in any detail the production management methods, but rather concentrated on the construction techniques used. Undoubtedly the five hundred years in between the paper and the construction of the Duomo have some part to play in the lack of process evidence presented. This study has a sharper focus on the management processes and so has researched a large and comparatively recent undertaking in order to be more certain of retrieving the required level of detail.

The time period chosen for the study, as mentioned above, predates the recorded start of MPM sufficiently so as to represent a different era and to have the possibility of revealing different 'project' approaches. The period of construction is some three years long (1912-1915) which provides a long enough duration for the document search to be made, with some confidence of success.

The official nature of naval construction means that records would have been made and kept both by government and the private constructors in order to generate various reports and costings etc. This makes it a good choice of research area – little else of this level of technology and size of contract was being constructed during this period.

The methods of enquiry themselves are drawn from standard qualitative approaches. Other than the archival research approach reviewed above, validation is provided through focus groups conducted with current naval PMs as described in Section 5.6 above. Clearly the selection of current naval PMs is a relatively small population. It is however a purposeful one and gives access to a high degree of expertise, as the nature of the project focuses on military ship production.

The counter argument to this could be that the population selected is too narrow and hence misses out on some wider learnings. All respondents work in the same organisation and could therefore be deemed to be constrained by the practices of their organisation. This is partly the price that needs to be paid in order for the study to take advantage of this degree of specialist knowledge. It was however, necessary to have a very focused and knowledgeable sample in order to have as close as possible comparator group for this study.

5.14 Summary

This chapter has detailed the study's approach to establishing its research methodology. A qualitative research method was chosen to investigate the possible roots and nascent beginnings of MPM in the construction of HMS Barham between 1912 and 1915. This was founded on archival research, centred around a case study approach, the coding of which was tested using a focus group approach. The sample population for this testing was drawn from practicing naval PMs and the sample taken was purposeful and targeted at a range of current projects and expertise within those naval projects. The credibility and dependability of the research was assessed and addressed through a variety of strategies including triangulation of both sources and methods.

The following two chapters detail the research results .
Chapter 6 provides a high level description of the data found and assesses the extent to which it covers aspects of the Essence of Project Management and how it reflects Systems Theory. It assesses too the validity of the codings made using Cohen's Kappa.

Chapter 7 presents a detailed review of the archival documents found and also addresses the relevance of the research conducted on future historical PM research.

CHAPTER 6

- ANALYSIS OF DATA FOUND

6.1 Introduction

The previous chapter outlined how the research methodology was established, and justified both the case study approach taken to the research and the archival nature of the research. The data coding process was laid out and issues of ethics and data integrity were addressed.

The qualitative research method chosen yielded a large amount of data both from the evaluation of the historical archives and from the review of a sample of the information conducted with a panel of naval PMs.

This chapter attempts to make sense of the data collected in order to answer the research questions posed and meet the research objectives. In order to facilitate this and to reflect the research questions presented in Section 1.1, the chapter is laid out as follows:

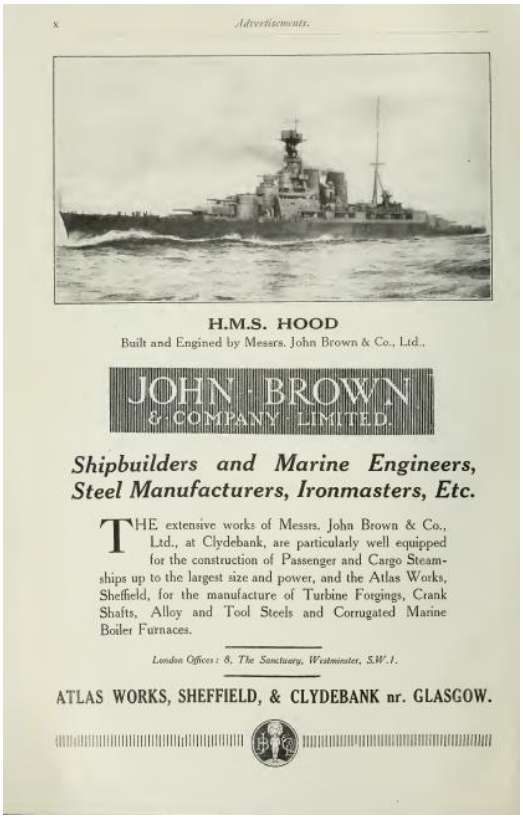
6.1 Description of the archive data found
6.2 The Analysis of the archive Data
6.3 The validity of the data analysis - Cohen's Kappa Results
6.4 Data found - conclusions

6.1.1 Description of the Archive Data Found

The data collected came from three main archives, the National Archives in Kew, the Ships' Covers which are held at the National Maritime Museum (Brass Foundry, Woolwich,) and the John Brown & Co Ltd company archive held as part of the Scottish Business Archives at Glasgow University.

A 'Ship's Cover' is a file containing all the client-side records that are archived and kept at the National Maritime Museum Archive at the Brass Foundry in respect of each vessel or class of vessel commissioned by the Royal Navy. These records are, in the case of the Dreadnoughts, written from an Admiralty perspective. As well as material which is of interest to this study, detailed below and covering some construction related issues, they can contain details such as manning levels, which ship in class should be fitted as a flag ship and sundry letters to sub-contractors. The exception to this

complete record held under Ships Covers are the detailed construction plans for vessels. Construction plans can be as large a scale as 1:48 and hence these, at anything up to approx. 20 ft long, are kept in a separate storage area at the Brass Foundry, (see photographs 7.2 and 7.3 for examples). Secondly the John Brown archives were selected as being relatively well preserved and offering the chance to review a commercial constructors daily/weekly and monthly records. This archive, alongside the records held at the Brass Foundry, give both the contractor and customer sides of the same ship construction. John Brown & Co. Ltd. was a substantial company in the first half of the 20th Century as the copies of the company's advertisements shown at Photographs 6.1a and 6.1b below would suggest:



Photographs 6.1a and b – John Brown & Co ltd advertisement from 1915 and 1923

The John Brown company records, (Files: UCS 1-5-13, UCS 1-13-1, UCS 1-59-1, 2, 3 and 4,) held at Glasgow University's Scottish Business Archive, show that the company was responsible for building a number of well-known civilian ships, such as the RMS Lusitania, RMS Queen Mary and the Queen

Elizabeth 2 and undertook work for many foreign governments such as those of Brazil, Chile, Russia and Argentina.

John Brown & Co. were a well-regarded constructer as shown by Figure 7.33 (a letter of thanks from HM Government relating to their war work, dated April 1918). This view is further supported in that they were able to construct twenty-seven Destroyers and Leaders for the war effort between August 1914 and April 1918.This was 29% of the 93 of these types of ships produced on the Clyde in the period. The other 71% were produced by the five other Clyde based constructors of the day, including Fairfield, Scotts and Beardmore (Brown, 1997).

Amongst the naval ships built by John Brown around the time of this study were: HMS Recruit (launched: 1896), HMS Bacchante (1901), HMS Inflexible (1907), HMS Bristol (1910), HMS Tiger (1913), HMS Hood (1918) and of course HMS Barham (1914), all of which demonstrates the degree of experience and expertise which John Brown and Co. Ltd. had in this area of construction (Brown, 1997).

The third archive used by the study was the National Archives at Kew. This provided useful background information contained in its ADM (Admiralty) series of files. These records reflected the functions of the Admiralty rather than taking either a specifically client/ contractor side view. A good example of these, was the ADM 1-8435-297 file which detailed the annual Admiralty warship building programme linking them to delivery dates. These records are discussed and shown later in Chapter 7.

The nature of each of the documents within the files found in the three archives, detailed above, was often similar. The 91 files consisted largely of hand-written or typed documents. These ranged from individual documents such as Figure 7.11, which is a one-off document recording the need for secrecy surrounding the build, through a more formal structured document such as File UCS 1-59-1, Figure 7.7, which shows formalised hand-written documents recording the numbers of trades working on HMS Barham at any time, to formal printed forms such as Figure 7.16 and 7.17 which are completed with hand-written details. Noticeably, one additional type of record

stands out - the large-scale ships plans shown at Photographs 7.1 and 7.2. The overall picture produced by the documents uncovered, in terms of HMS Barham's construction lifecycle, can be found in the next chapter at Figure 7.8, while Figures 6.1 and 6.3 within this chapter, display the number of times each part of the Systems model and the Essence of Project Management respectively, are evidenced in the documents.

6.2 The analysis of the archive data

In this section, the data will firstly be assessed to determine the degree to which it evidences the different parts of the Systems Model, (section 6.2.1). and then secondly, how closely it reflects the Essence of Project Management, (section 6.2.2).

6.2.1 The Systems Model

The first of the steps shown in the Methodology Section was for the researcher to code all the data records collected from the archives.

This was done and is shown in full at Appendix 6.1. The data was first analysed to assess how the archival records aligned to the elements of the Systems Model. Figure 6.1 below shows the results of this analysis in respect of the different aspects of the System Model.

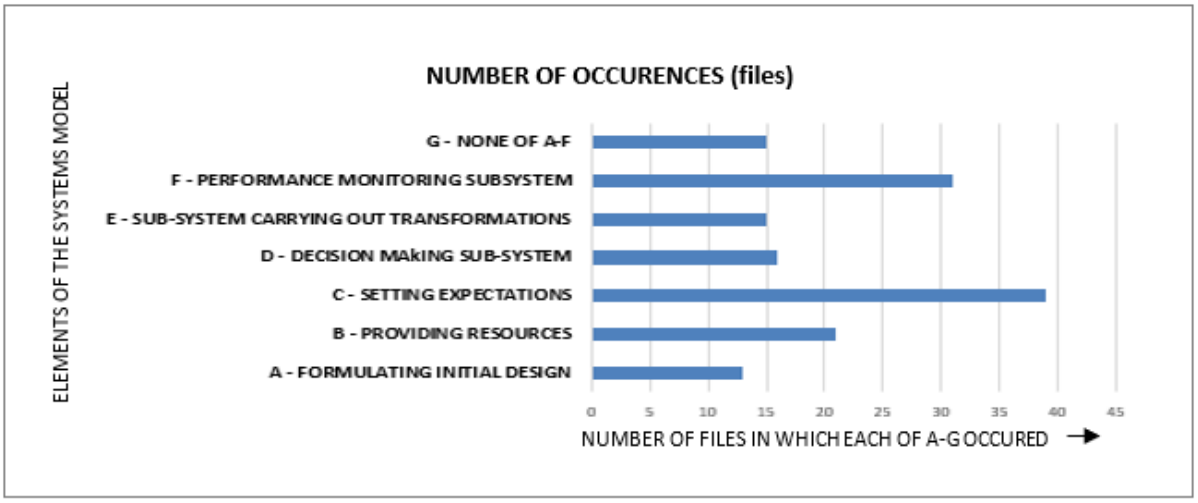


Figure 6.1 – The number of archival samples aligned to one of the elements of the Systems Theory Model

This shows the frequency with which the 91 sample files aligned with each area of the Systems Model. Some files aligned to two areas which means the total of alignments recorded in Figure 6.1 exceeds 91.

Figure 6.1 shows that all parts of the Systems Model are well represented within the initial analysis of the documents. Of the records relating to the Systems Model, (which excludes the 15 analysed as relating to 'G – None of A-F', in other words not aligned to any of the elements of the Systems Model,) half (54%) relate to each of the 'Wider System' and half (46%) to the 'System'. Figure 6.2 below shows how the 'Wider System' and the 'System' relate to one another.

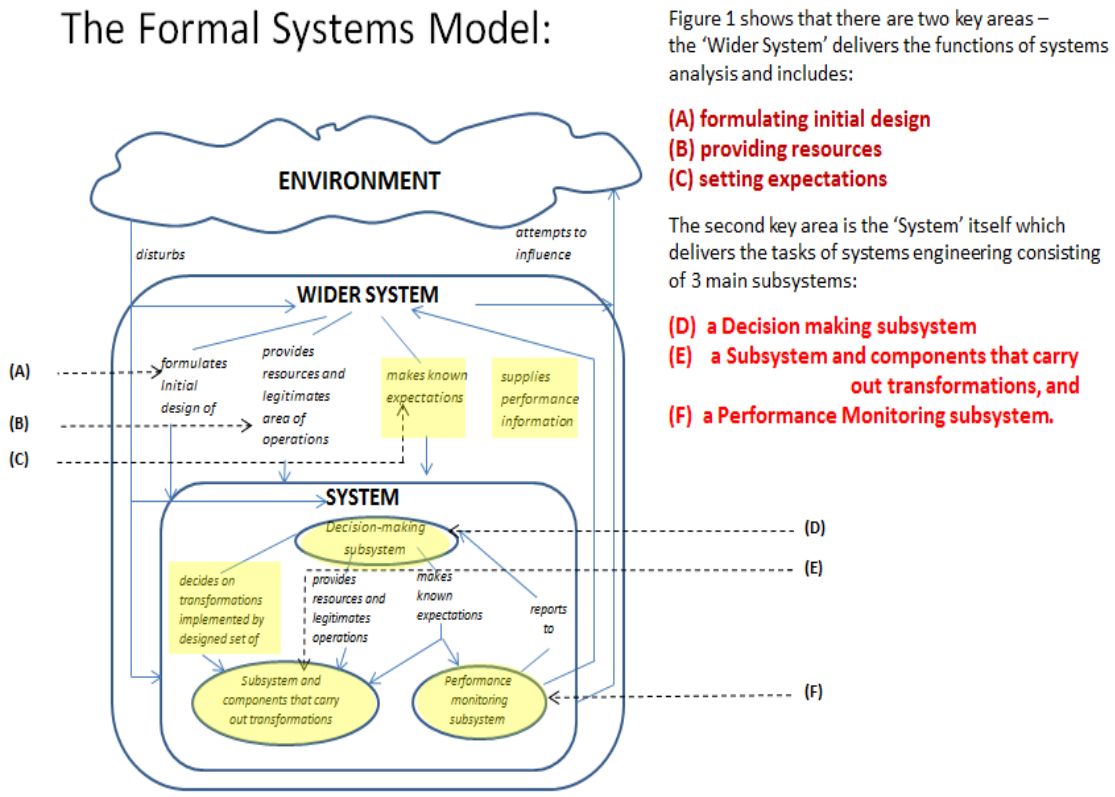


Figure 6.2 – The Systems Model adapted from (Fortune & White, (2006) (previously shown at Figure 4.1)

.

6.2.2 The Essence of Project Management

The Essence of Project Management was defined earlier in the study (see Chapter 3). In addition to being reviewed against the elements of the Systems Model the archive documents were also assessed to determine the

degree to which they reflected the various elements of the Essence of Project Management.

This is shown below in Figure 6.3. The sample was categorised by the researcher as covering sixteen of the eighteen different categories, shown below in Figure 6.3. The two elements that weren't covered were those that evidenced the organisation using/ delivering:

1. 'synergistic benefits' and
2. 'soft skills'

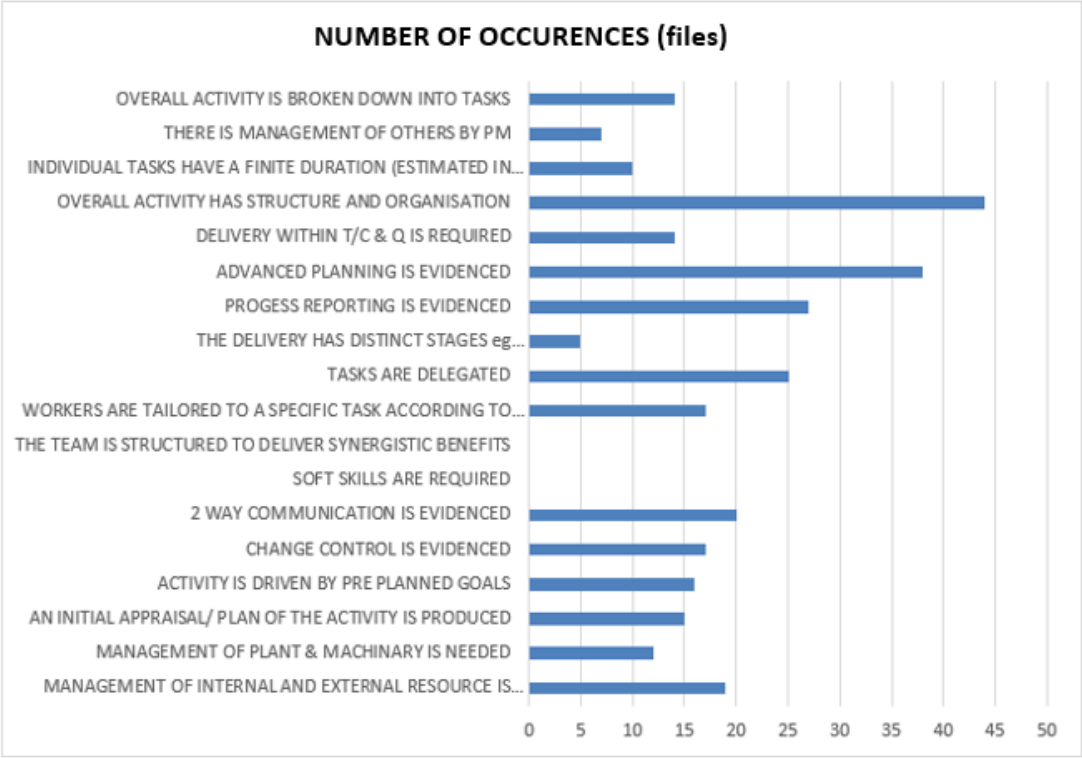


Figure 6.3 – The number of archival samples aligned to one of the elements of the Essence of Project Management

The absence of these is not altogether unexpected as soft skills and synergistic benefits, are relatively intangible. Soft skills are not usually written down or evidenced in any material way, they are, as Muzio, Fisher, Thomas and Peters (2007, p.30) state 'universally recognized as being critical to successful project management' but 'methods of measuring' these skills 'are to date largely subjective and non-systematic'. It is therefore not too

surprising that these two areas are not represented amongst the surviving detail to a significant level.

Some evidence that ‘the team was structured to provide synergistic benefits’ was found. Figure 7.16 shows that the yard was structured in a logical manner allowing progression of the ships that would have aided construction through, for example, the siting of the various cranes and relative positioning of the on-site machine shops and sheds. The interaction of the various trades and professions was far better evidenced at the Royal Dockyards in the set of instructions issued and referenced (see Figure 7.9).

Some evidence is provided for soft skills and is recorded in the Shipyard Diary. On 31st December 1914, for instance, to mark HMS Barham being launched ‘in addition to the luncheon for guests, a luncheon was provided in the Moulding Loft for foreman and several members of the staff’. Whilst this is limited and did not allow all workmen to celebrate the launch of the ship, it does suggest that some of the softer skills elements were present, reflecting the frequent end of Project Completion celebrations of today. It does not though, demonstrate an appreciation of these issues across the whole company.

A third area which was found to be underrepresented was the management of others by a ‘Project Manager’. When examining the documents, no evidence of the term ‘Project Manager’ was found. With hindsight it can be assumed that this was because the term ‘Project Manager’ had yet to come into common usage. (See Gaddis, (1959) for the first time the term was used in print). The study did not recode the data analysis to directly reflect the function rather than the title of ‘Project Manager’ It was however, noted that there was considerable evidence of tasks being delegated and progress being ‘managed’ or reported by employees of John Brown Ltd, but unsurprisingly never in the name of a ‘Project Manager’. The function was therefore evidenced, but embodied in a management role under a different name, and so could be understated.

The remaining elements identified within the definition of the Essence of Project Management are well represented with an average of four and a half documents attributed to each element.

Having carried out the initial analysis and coding, the next step within the methodology was to validate the researcher's categorisation against categorisation by industry experts.

6.3 The validity of the data analysis – Cohen's Kappa results.

The validation study was carried out as described in the Methodology, Section 5.7.5. The full results obtained in relation to the Systems Model are detailed in section 6.3.1 while those relating to the Essence of Project Management are shown in Section 6.3.2.

The key purpose of the validation study, was to obtain an independent evaluation of the archival data collected. Due to the amount of data obtained it was not possible to test it all using an impartial and autonomous panel therefore a representative sample of the data was validated and then used to corroborate and confirm the interpretation given to it by the researcher. This approach is outlined in Section 5.8 where the choice of Cohen's Kappa as a measure for judging inter-coder reliability is discussed and established. This approach was taken so that confidence in the researcher's coding could be established before looking at the findings in detail. Section 6.5 addresses the issue of affirming confidence in the researcher's coding.

6.3.1 Cohen's Kappa applied to the Systems Theory Ratings

In this part of the analysis, the 'raters' (The naval PMs) were asked to code a subset of the files found at the archives visited. The files consisted of a number of photographs or slides of the content of the files. The slides in each file could potentially be quite numerous but largely had similar information on them. Where a file contained detail relating to monthly payments made the

slides could be, for example, ‘January’s payments’ ‘February’s payments’ etc. In cases such as this, there was nothing to be gained by asking the raters to review all the slides and so a slide for a representative month was chosen and shown to the raters. (The slides shown are detailed in Appendix 6.2).

The raters were then asked to rate the slide as to whether it represented a part of the Systems Model (A-F in Figure 6.4) or was unrelated (G).

The ratings were recorded using the list of questions shown at Appendix 6.5. These were then transferred to an excel spread sheet (Appendix 6.9) an extract is provided in Figure 6.4 below:

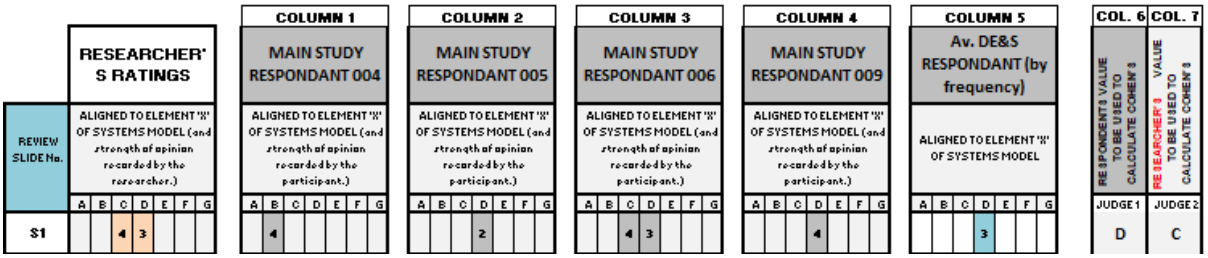


Figure 6.4 – an extract from Appendix 6.9 showing calculation of average codings

The Figure above shows how each of the respondents’ ratings were converted into a modal average (Column 5 of Figure 6.14) to give a value to be used along with the highest strength of alignment given by the Researcher’s rating, to calculate Cohen’s Kappa.

The modal average was calculated by taking the element (A-G) with the highest frequency of ‘hits’. The Columns 1-5 show a measure of the strength of alignment. Where there were two elements with an equal frequency of selection, another method of selecting the strongest alignment was found. In this case, the element used to calculate Cohen’s Kappa was selected firstly by (i) then (ii) then (iii):

(i) If there was a tie in terms of frequency the element with the highest strength of alignment as selected by the respondents was selected. (This happened twice – slide 7 and 12.)

(ii) If (i) was also equal, then the element with the highest individual score was selected. (This did not prove to be a useful method of selection – no slides were selected using this method.)

(iii) If (ii) was also equal then Cohen's Kappa was calculated using both possible answers and a value at the mid-point of the two calculations was selected. (This happened once – Slide 16.)

Columns 6 and 7 in Figure 6.4 show the figures for 'Judge 1' and 'Judge 2' the values used to calculate Cohen's Kappa in respect of the Systems Model.

The number of times each potential set of ratings occurred is shown in Table 6.1 below. Under each potential 'pair' of ratings, for example 'Judge 1: B Judge 2: B' or 'Judge 1: C Judge 2: D' values of 2 and 1 are recorded denoting that the pairings occurred twice and once respectively.

Table 6.1 – Calculation of Cohen's Kappa input values where the answer to SLIDE 16 is taken as 'C'

JUDGE 2: RESEARCHER's SCORE	JUDGE 1: Av. RESPONDENT SCORE A	B	C	D	E	F	G	TOTAL	total as a proportion of sample:
A	1	0	0	0	0	0	0	1	0.06
B	0	2	0	0	0	1	0	3	0.19
C	0	0	4	2	0	0	0	6	0.38
D	0	0	1	1	0	0	0	2	0.13
E	0	0	0	1	0	0	0	1	0.06
F	0	0	0	0	0	2	0	2	0.13
G	0	0	0	0	0	0	1	1	0.06
TOTAL	1	2	5	4	0	3	1	16	
total as a proportion of sample:	0.06	0.13	0.31	0.25	0.00	0.19	0.06		
AGREEMENT:	1	2	4	1	0	2	1	11	

In Table 6.1 above, the diagonal from AA to GG represents the number of times both sets of judges agreed on each possible pair of codings. The sum of this diagonal adds up to 11 – the total number of agreements.

The column or row labelled ‘Total’ represents the number of times a judge coded a slide for each possibility A-G. This number = 16 = the population or number of samples.

The column or row labelled ‘total as a proportion of sample’ shows how many times each judge recorded either of A-G as a proportion of the number of samples. For example, Judge 1 recorded ‘C’ 6 times. 6/16 = 0.38 (rounded to two decimal places.) The sum of these figures across A-G for both judges total 1.0 representing the values recorded for 100% of the sample.

These figures can now be put into Table 2 below and as described previously (Section 5.8) can be used to calculate the number of agreements that could occur by chance:
(Note it is calculated twice given the detail at (iii) above.)

Table 6.2 – Calculation from Table 6.2 of the proportion of agreements that could occur by chance where the rating given to Slide 16 is taken as ‘C’

BY CHANCE:		A	B	C	D	E	F	G		
1. JUDGE 1 proportion of sample:		0.06	0.13	0.31	0.25	0.00	0.19	0.06		
2. JUDGE 2 proportion of sample:		0.06	0.19	0.38	0.13	0.06	0.13	0.06		
1 X 2		0.00	0.02	0.12	0.03	0.00	0.02	0.00	=	**0.20**

From the above tables values for each of the elements in the formula for Cohen’s Kappa are known, and Kappa can be calculated:

$$\text{Cohen's Kappa} = \frac{\text{the proportion of units in which the judges agree} - \text{the proportion of units where agreement is expected by chance}}{1 - \text{the proportion of units where agreement is expected by chance}}$$

So, using the data from Table 6.1 and Table 6.2, Figure 6.5 shows:

$$\text{Cohen's Kappa} = \frac{11/16 - 0.2000}{16/16 - 0.2000} = \frac{0.6875 - 0.2000}{1.0000 - 0.2000} = \frac{0.4875}{0.8000} = 0.6094$$

Figure 6.5 – Calculation of Cohen’s Kappa value where the answer to Q 16 is taken as ‘C’

A value for Kappa of 0.61 (2 decimal places), indicates that there is a substantial amount of agreement between the two sets of codings.
As stated, within the analysis there was one Slide – Slide 16, where the evaluation of the raters' data could not initially differentiate between two possible answers, between C and D within the analysis there was one Slide, Slide16, where the evaluation of the data could not differentiate between two possible answers – 'C' and 'D' in respect of Slide16. In order to proceed, Cohen's Kappa was calculated twice in respect of the Systems Theory ratings.
Using 'C' as the answer to Slide16, Cohen's Kappa gave a value of 0.6094 (Figure 6.5). When the answer to Slide 16 was taken as 'D' instead of 'C' the value and calculation for Cohen's Kappa, using the same process as described above, is shown below.

Table 6.3 – Calculation of Cohen's Kappa input values where the answer to Slide 16 is taken as 'D'

		JUDGE 1: Av. DE&S SCORE								
		A	B	C	D	E	F	G	TOTAL	total as a proportion of sample:
JUDGE 2: RESEARCHER's SCORE	A	1	0	0	0	0	0	0	1	0.06
	B	0	2	0	0	0	1	0	3	0.19
	C	0	0	3	3	0	0	0	6	0.38
	D	0	0	1	1	0	0	0	2	0.13
	E	0	0	0	1	0	0	0	1	0.06
	F	0	0	0	0	0	2	0	2	0.13
	G	0	0	0	0	0	0	1	1	0.06
TOTAL		1	2	4	5	0	3	1	16	
total as a proportion of sample:		0.06	0.13	0.25	0.31	0.00	0.19	0.06		
AGREEMENT:		1	2	3	1	0	2	1	10	

Following on from Table 6.3, the number of agreements that could occur by chance can be calculated:

Table 6.4 – Calculation from Table 6.3 of the proportion of agreements that could occur by chance where the rating given to Slide 16 is taken as 'D'

BY CHANCE:		A	B	C	D	E	F	G		
1. JUDGE 1 proportion of sample:		0.1	0.1	0.3	0.3	0	0.2	0.1		
1. JUDGE 2 proportion of sample:		0.1	0.2	0.4	0.1	0.1	0.1	0.1		
1 X 2		0.00	0.02	0.09	0.04	0.00	0.02	0.00	=	**0.19**

The figure of 0.19 can then be used as the 'the proportion of codings where agreement is expected by chance' in the following calculation (Figure 6.6):

$$\text{Cohen's Kappa} = \frac{10/16 - 0.1900}{16/16 - 0.1900} = \frac{0.6250 - 0.1900}{1.0000 - 0.1900} = \frac{0.4350}{0.8100} = \underline{\mathbf{0.5370}}$$

Figure 6.6 – Calculation of Cohen's Kappa value where the answer to Slide 16 is taken as 'D'

The calculations above provide two values for Cohen's Kappa relating to the Systems Theory elements, depending on the answer given to Slide16. The values are 0.54 (2d.p.) shown in Figure 6.6 and 0.61 (2 d.p.) given in Figure 6.5. An average figure of 0.58 , suggests that there is a good degree of similarity between the values given by the codings derived from the Main Study and the researcher's own analysis. This is on the cusp of moderate/ substantial level of agreement as given by the interpretation of Cohen's Kappa values presented in (Table 5.11)

6.3.2 Relating to the Essence of Project Management

The same process was followed to establish the degree of inter-rater reliability between the two sets of codings in relation to the Essence of Project Management.

In doing this is noted that there was only time enough with the naval PMs to look at the 16 slides. Two records or slides had no ratings from the coders in

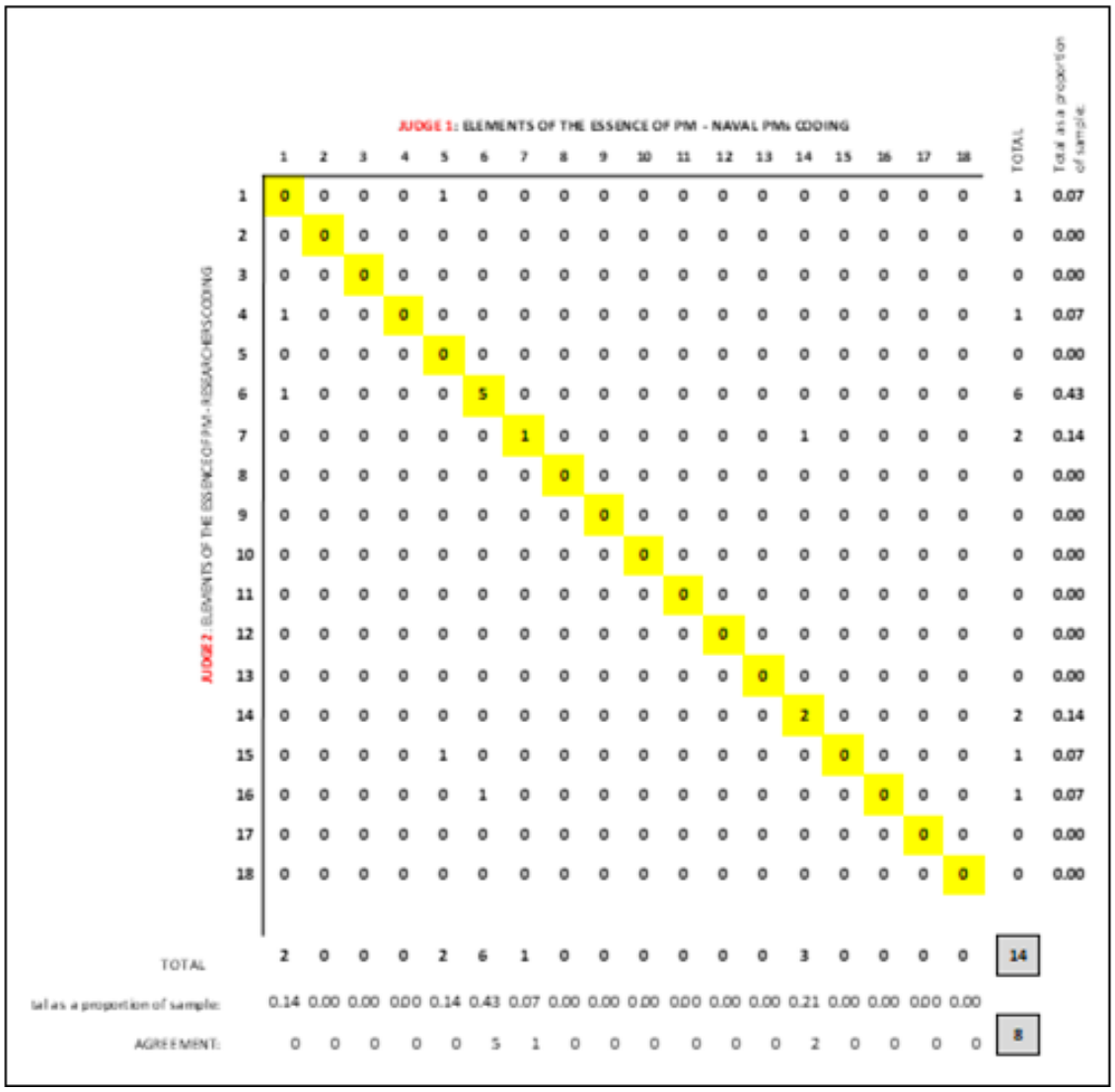
respect of the Essence of Project Management. These were Slide 15 – UCS 1-64-1 and Slide 17 – 3595.

Slide 1-64-1 was included as a test of the process. This slide showed a newspaper cutting relating to late delivery of ships (see Appendix 5.2) and so was expected not to register against the Essence of Project Management elements. It wasn't included in the calculation of Kappa, as although there was conclusive agreement, between the naval PMs and the researcher, that it did not represent any element of the Essence of Project Management, 'none of the above' was not recorded as an option in the study feedback form (Appendix 6.5). Although there was agreement it was not documented and hence was excluded from the calculation.

Slide 17 from file DSCF 3595 was recorded by respondents in respect of Systems theory, but in light of perceived similarity to DSCF 3510 and the number of records being looked at, respondents did not answer the questions in terms of the Essence of Project Management. This can be seen in the summary of raters' responses in Appendix 6.8. The result of this is that two of the 16 slides were not answered and so have been excluded from the calculation of Cohen's Kappa for the Essence of Project Management elements.

In assessing the alignment of the elements of PM with those evidenced in the completed feedback from the individual raters, there were occasions where two or more elements of the Essence of Project Management were scored equally. This is shown in Appendix 6.8. Where this happened, and in order to calculate Cohen's Kappa which requires one answer in order to calculate Kappa, the free text comments from the raters were reviewed along with the relevant slide and a judgement was made. Where the same issue impacted the researcher's ratings the relevant slides were reviewed and the key element was selected. This is shown in Appendix 6.8.

Table 6.5 – Calculation of Cohen's Kappa input values for the Essence of PM.



JUDGE 2: ELEMENTS OF THE ESSENCE OF PM - RESEARCHERS CODING	JUDGE 1: ELEMENTS OF THE ESSENCE OF PM - NAVAL PMs CODING																		TOTAL	Total as a proportion of sample:
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.07
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.07
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
6	1	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	6	0.43
7	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	2	0.14
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
14	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0.14
15	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.07
16	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0.07
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
TOTAL	2	0	0	0	2	6	1	0	0	0	0	0	0	3	0	0	0	0	14	
tal as a proportion of sample:	0.14	0.00	0.00	0.00	0.14	0.43	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00		
AGREEMENT:	0	0	0	0	0	5	1	0	0	0	0	0	0	2	0	0	0	0	8	

Following on from Table 6.5, the number of agreements that could occur by chance can be calculated as previously:

Table 6.6 – Calculation from Table 6.5 of the number of agreements that could occur by

BY CHANCE:		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
1. JUDGE 1 PROPORTION OF SAMPLE:		0.07	0.00	0.00	0.07	0.00	0.43	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.07	0.07	0.00	0.00		
2. JUDGE 2 PROPORTION OF SAMPLE:		0.14	0.00	0.00	0.00	0.14	0.43	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00		
1 x 2		0.01	0.00	0.00	0.00	0.00	0.18	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	=	0.23

The value for Cohen's Kappa relating to the Essence of Project Management is given below in Figure 6.7 using the same formulas as used in Figures 5.14 and 5.15 above.

$$\text{Cohen's Kappa} = \frac{8/14 - 0.2300}{14/14 - 0.2300} = \frac{0.5714 - 0.2300}{1.0000 - 0.2300} = \frac{0.3414}{0.7700} = \underline{\mathbf{0.4434}}$$

Figure 6.7 – Calculation of Cohen's Kappa relating to the Essence of Project Management data.

The value given for Cohen's Kappa is 0.44 (2d.p.), which from Table 5.11 indicates there is a moderate level of agreement between the researcher's initial coding and the coding obtained through the Main Study.

The Cohen's Kappa value of 0.44 given in respect of the Essence of Project Management is lower than that provided by the Systems Model data.

This may be due to the nature of the categories given within the Essence of Project Management. When looking at the Essence of Project Management data there is a wider potential range of answers and viewpoints which the respondents could take. The archival documents are open to a degree of interpretation. For example, if a project accountant were to look at the UCS 1-74-6 document, (see for example Appendix 6.11), they might well see the costs involved and begin to consider the pricing of the ship. If it were viewed by someone involved in ship design, they would be likely to see a fledgling ship design. Both of course are correct but the information reported is qualitative and dependant on the viewpoint and experience of each rater. The key point from this evaluation though, is that for the Systems Model and Essence of Project Management analysis conducted by the researcher, the values for Cohen's Kappa of 0.58 and 0.44 respectively, give confidence that the coding and analysis conducted by the researcher is reliable and trustworthy when compared with the panel of PMs. It provides reassurance that the researcher's coding is at least moderately consistent with that of the expert reviewers. It supports the analysis within the extended sample of data,

representing all ninety-one files collected, as being valid and providing suitable information from which to draw conclusions in relation to this study.

The alignment of the two sets of findings can be seen in the graph below, Figure 6.8, which demonstrates the relationship between the two sets of data. It presents the sample of slides reviewed by both the researcher and the respondents and compares the average number of times each of the eighteen elements of the Essence of Project Management was identified by each. It shows the average respondents score (the total divided by four) in order to enable a scalar comparison to be made.

It can be seen that the number of times each element is identified follows a similar pattern suggesting a degree of alignment, which supports the more scientific approach given by the analysis of Cohen's Kappa, (Figure 6.7).

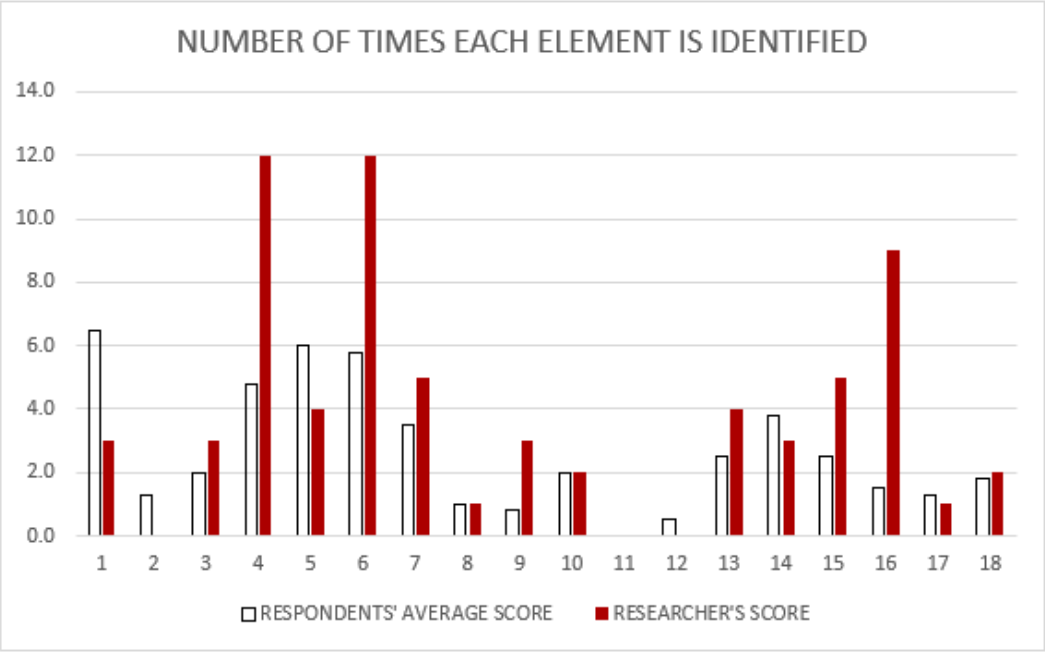


Figure 6.8 – the number of times each element of the Essence of PM was identified

A further way of analysing the differences between the responses of the researcher and the respondents is to compare the total number of times each element of the Essence of Project Management was recognised and chart

the relative percentage contributions made to these figures by both the researcher and the respondents.

Figure 6.9 does this:

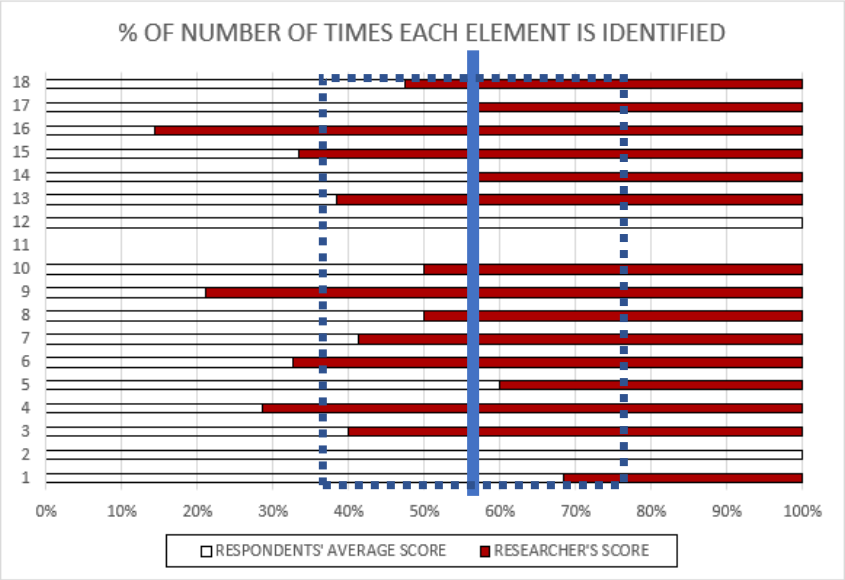


Figure 6.9 – the % share of times each element of the Essence of Project Management was

The thick vertical line in Figure 6.9 shows the midway point or the 50% mark. This indicates the point that would signify that both sources, the average of the respondents and the researcher, had identified the particular element of the Essence of Project Management (1-18) the same number of times. The dotted rectangle surrounding this midpoint allows for some natural variation and indicates an acceptable range of discrepancy, so that those elements with the greatest divergence between the two sources (respondents and researcher) are highlighted.

Figure 6.9 shows that whilst the share for most elements is fairly even, there are a few outliers. These elements, taken from the list of questions (appendix 6.5) are numbers 2, 9, 12 and 16, - 'management of others by the 'PM'', 'tasks are delegated', 'Soft Skills' and 'Initial Plan of the activity' respectively.

Element 2 and 12 ('management of others by the 'PM'' and 'Soft Skills') show as being 100% due to the respondents identifying it as being present. These each occurred a low number of times. The researcher however did not

identify them at all, hence Figure 6.9 shows them as being 100% identified by the respondents.

Element 11 (‘The team is structured to deliver synergistic benefits’) was not identified at all, hence the relevant row in Figure 6.9 is blank.

Elements 9 and 16 show as being more strongly identified by the researcher than the respondents. These elements represent the ‘delegation of tasks’ and the ‘Initial Plan of the activity’.

These differences may be due to the nature of the categories defined within the Essence of Project Management. When looking at the Essence of Project Management data there is a wide potential range of answers and viewpoints which the respondents could take. The archival documents are open to a degree of interpretation. For example, if a project accountant were to look at the UCS 1-74-6 document, (see Appendix 6.11), they might well see the costs involved and begin to consider the pricing of the ship. If it were viewed by someone involved in ship design, they would be likely to see a fledgling ship design. Both of course are correct but the information reported is qualitative and dependant on the viewpoint and experience of each respondent. The key point from this evaluation though, is that for the Systems Model and Essence of Project Management analysis conducted by the researcher, the values calculated for Cohen’s Kappa give confidence that the coding and analysis conducted by the researcher is reliable and trustworthy when compared with the panel of PMs. It provides reassurance that the researcher’s coding is consistent with that of the expert reviewers. It therefore supports the analysis within the extended sample of data, representing all ninety-one files collected, as being valid and providing suitable information from which to draw conclusions in relation to this study.

6.4 The data found

This Chapter has described the three main sources of archival data found and the perspectives from which the material was written.

In relation to the Systems Model Analysis discussed in Section 6.3.1, the chapter has shown that all areas of the System Model are well represented in the data collected. Similarly, in respect of the Essence of Project Management, discussed in Section 6.3.2, strong evidence was found of all components with the exception of three comparatively intangible elements.

Using Cohen's Kappa, the analysis was able to demonstrate a moderate to strong level of agreement between the researcher's and the expert third-party coding of the data sub-set. This demonstrates that the Researcher's coding overall is reliable, enabling confidence in the researcher's coding of the full data set, not just those shared with the third parties, to be established.

Having established the reliability of the coding, the following chapter investigates the data in more depth and discusses the findings of the research in greater depth. The analysis contained in Chapter 7 uses some of the free text comments obtained from the present-day naval PMs to enhance and add to the researcher's analysis and to help contextualise it within the modern project management environment.

CHAPTER 7

ANALYSIS OF ARCHIVAL DOCUMENTS

7.1 Introduction to the analysis of the archival documents

Chapter 6 outlined the three main sources of archival data used in the study and established the reliability of the data coding.
Chapter 7 analyses in greater depth, individual archival documents and their project management functions.
The chapter itself is laid out as follows:

A series of data matrices and networks are used to display the evidence of project management processes found within the construction records of HMS Barham.

7.2 Quantitative analysis of the coded data

Having established the validity of the researcher's coding of the full dataset – this section presents quantitative analysis of the statistical properties of the coded data in terms of the systems model and the Essence of Project Management.

7.2.1 Initial findings relating to Systems Theory

The analytical method used in examining the data collected relating to the Systems Theory was coded and displayed as described by the matrix in Section 5.6.3. The distribution of the archival documents between the various areas of the Systems Model was shown in the introduction (Figure 6.1) but this initial analysis does not take any account of how strongly each archival record was felt to reflect each element of the Systems Model.

The graphs below (Figure 7.1 and 7.2) use the same source data as that used in Figure 6.1. They show (Figure 7.1) how the overall strength of alignment is reflected in the files (given by the total of the scores allotted each time a systems model attribute is recognised within an individual file). The second graph reflects the number of times each aspect of the systems model is represented within a file (Figure 7.2).

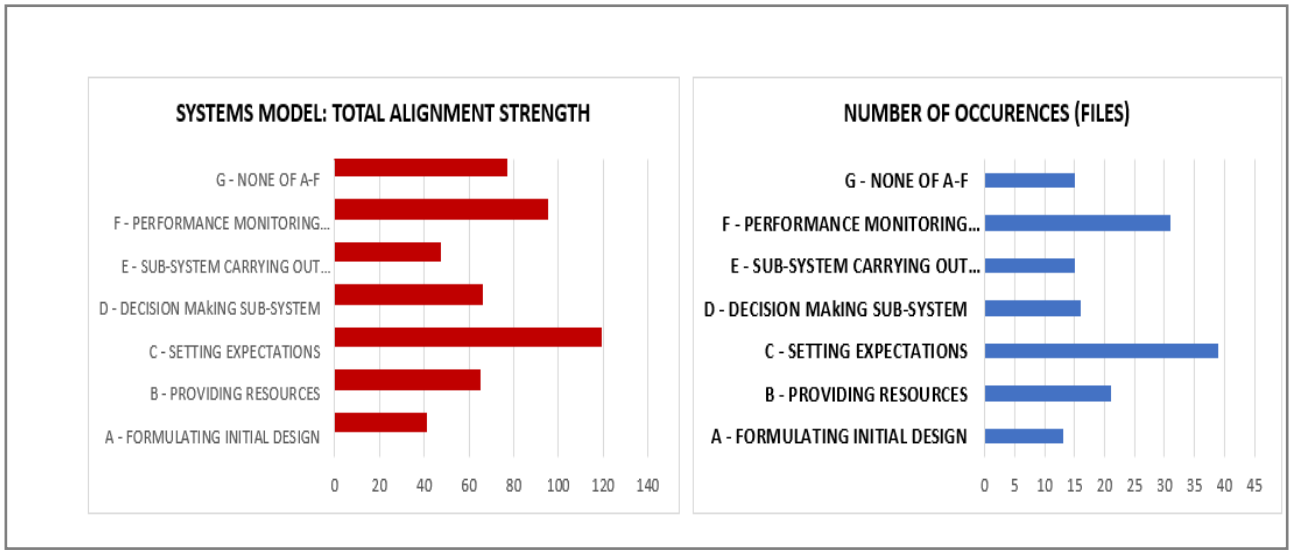


Figure 7.1 – Comparison of Systems Model Model responses – total strength of alignment occurrences

Figure 7.2 – Comparison of Systems responses - no. of

The graphs at Figure 7.1 and 7.2, clearly show that the movement of the two variables is in tandem, which also suggests a fairly consistent measure of average ‘strength of alignment’ for each category, (calculated as ‘total strength of alignment‘ /’number of occurrences’). More persuasive evidence of this can be seen in Table 7.1 where the average strength of alignment is shown along with the number of times each element of the Systems Model is evidenced within the data sample.

Table 7.1: Range and average Strength of Researcher's Systems Model ratings

		COLUMN: A					B	C	D
		RANGE OF STRENGTH OF ALIGNMENT RECORDED					TOTAL STRENGTH (No. OF OCCURENCES X STRENGTH RATING)	NUMBER OF OCCURENCES (FILES)	AVERAGE STRENGTH OF ALIGNMENT (= B / C)
	STRENGTH RATINGS - 1-5:	**1**	**2**	**3**	**4**	**5**			
No. OF OCCURENCES FOR EACH SYSTEMS ELEMENT (A-F) AT EACH STRENGTH RATING.	A - FORMULATING INITIAL DESIGN	2	1	4	3	3	43	13	3.31
	B - PROVIDING RESOURCES	4	5	3	8	1	60	21	2.9
	C - SETTING EXPECTATIONS	5	7	7	17	3	123	39	3.15
	D - DECISION MAKING SUB-SYSTEM	0	0	7	9	0	57	16	3.56
	E - SUB-SYSTEM CARRYING OUT TRANSFORMATIONS	1	2	5	6	1	49	15	3.27
	F - PERFORMANCE MONITORING SUBSYSTEM	1	9	14	6	2	95	32	2.97

This shows a very similar average strength of evidence for all elements of the Systems Model. All have a mean average rating of 2.9 or above. (Values for 'G' - 'None of A-F' have been excluded from the table as the values could only be '5' and as such without meaning. From Table 7.1 it can be seen that there is strong evidence within the documents reviewed (a rating of 4 or 5) for the full range of Systems Model features

As discussed in two of the main archives, Glasgow University's Business Archive and The National Maritime's Brass Foundry, the collections held are taken from two essentially different perspectives – the constructor and the customer/client respectively. Figure 7.3 shows how these two sets of archive records compare in terms of the elements of the System Model.

The graph at Figure 7.3 shows that each repository had a different focus in terms of the number of records retrieved from each part of the Systems Model. In Section 3.4 the Systems Model was discussed and elements A, B and C were identified as part of the 'Wider System' while elements D,E and F were identified as the 'System'. These, Koskela and Howell (2002) categorised respectively as those process, that specify the project product (A,B and C) and those that initiate, plan and execute the output of the project (D,E,and F). Section 3.4 suggested that of the two archives, the Brass

Foundry's archival content could be expected to lean towards elements A,B and C, while Glasgow University's Business Archive could be expected to contain a higher percentage of records covering elements D, E and F. This split is largely borne out in Figure 7.3 below:

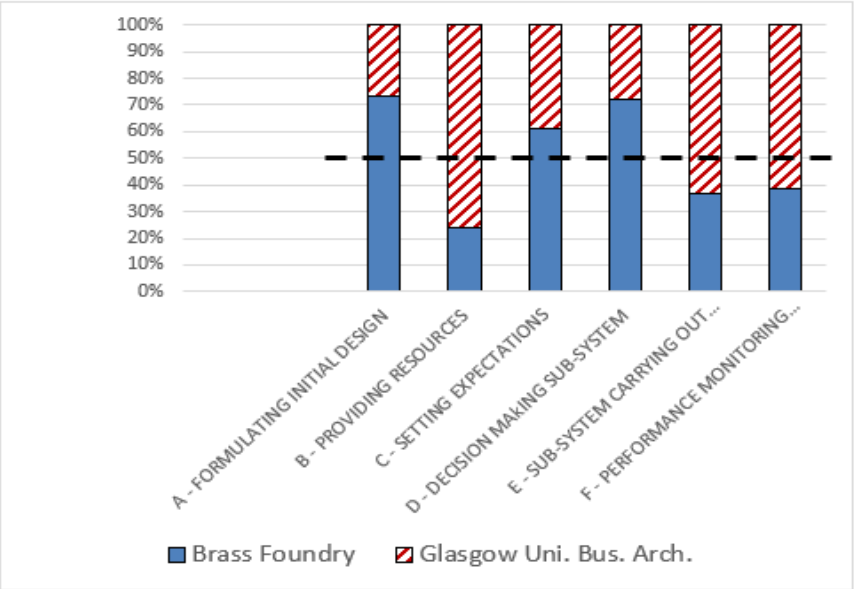


Figure 7.3 – Comparison of Systems Model ratings showing % of documents in each archive from each Systems Model element (A-F) contrasting Glasgow University's Business Archives & the Brass Foundry Archive.

The horizontal dotted line in Figure 7.3 represents an even split between the archives in terms of System/ Wider System content.

Element A for example shows that a greater % of documents reflecting the 'formulating of initial design' were found at the Brass Foundry, which would be expected as the Admiralty as customer would drive this part of the project. The same is true of element C 'setting expectations'. Element B the provision of resources shows that the Glasgow Business Archive, consisting of the constructor's records provides a significantly higher percentage of the records in this area. Closer inspection shows that this is due to provision of, for example, labour being analysed within this category as well as the provision of 'initial' resources such as the original project budget.

Considering the production 'system' itself then a higher percentage of these records would be expected to be found at the Glasgow archive where the

constructors records are stored. This is true of elements E and F, but the higher proportion of records focused on the decision-making sub-system (C) found at the Brass Foundry would suggest that the Admiralty maintained a firm hold on the decisions being made, perhaps reflecting the purpose of the asset being constructed and the critical state of the nation at time of war.

The Brass Foundry provides most records in both categories A and C. This indeed would be expected from an archive with a focus on the 'Wider System' or customer side. The formulation of the initial design is well documented in the Brass Foundry archives. The Queen Elizabeth Class of Dreadnoughts consisted of five ships (HMS Queen Elizabeth, HMS Warspite, HMS Valiant, HMS Barham and HMS Malaya.) The first two were built at HM Dockyards Portsmouth and Devonport respectively. HMS Barham was laid down five months after these first two and consequently the 'formulation of the initial design' would have been established both in principle and in practice before Barham construction began. It is therefore unsurprising to see a larger number of documents on this subject being found at the Brass Foundry, which inherited the records from HM Dockyards, as opposed to the Glasgow archives based purely on the subsequent contactors' records. Similarly, the relatively large amount of experience which the Admiralty as the customer brought to discussions is reflected in the balance of documents analysed under the 'setting expectations' category. The 'providing resources' category reflects the financial resources provided by the customer but tilts in favour of the contractor due to the documentation of the provision of labour and materials. File UCS 1-21-29 provides evidence of the shortage of workers within the shipyard in 1915, and it is this lack of workers together with the lack of steel which are cited as the limiting factors in terms of Dreadnought production. Attempts to increase the provision of these resources are evidenced by official letters which add to the number of documents attributed to 'providing resources' within the analysis.

Categories E and F within Figure 7.3, 'sub-systems carrying out transformations' and 'performance monitoring sub-system', show a leaning towards the Contractor records retrieved from the Glasgow archive. This is

again would be expected since it was on the Clyde that HMS Barham was constructed and hence the ‘transformations’ and ‘monitoring’ aspects of the construction would have taken place here. The ‘decision making process’ is heavily loaded towards the Brass Foundry records which also reflects that as HMS Barham was the fourth of five ships within the class was controlled, at least to a large degree, by the Admiralty based on their requirements and experience gained in the construction of the three preceding vessels, built at other shipyards.

The split therefore between document sources is therefore not illogical given the roles which the Admiralty as customer and John Brown & Co. Ltd. as the constructor fulfilled, and between them represent all aspects of the Systems Model. The next Section looks in depth at the documents which provide the statistics in Figure 7.3 above, and investigates the specific elements of project management which they depict.

7.2.2 Initial findings relating to the Essence of Project Management

The analytical method used in examining the data collected, relating to both Systems Theory and the Essence of Project Management, was coded and displayed as described by the matrix in Section 5.6.3.

The data collected (see Appendices 6.8 and 6.11) was particularly rich in terms of the detail pertaining to the Essence of Project Management . Already in this chapter, matrix displays have been used to illustrate the presence of the Systems Theory within the collected data. Section 7.2.3 continues the use of matrix displays, this time in relation to the Essence of Project Management. Section 7.3 contains a network display focusing on the construction processes evidenced around a project lifecycle, showing how these processes were used, in which order over time, to deliver the output. The final part of the archival analysis, in Section 7.3.1, concentrates on a narrative presentation drawing together the free text comments from today’s naval PMs to support the emerging picture, using direct quotes from the focus groups.

7.2.3 Essence of Project Management Matrix Displays

A view is provided (Figure 7.4) of the overall, or total, strength of evidence, or alignment, for each element of the Essence of Project Management. This is based upon the bar chart presented at Figure 6.3, replicated below which shows the number of files coded to each element of the Essence of Project Management, (see section 6.2.2).

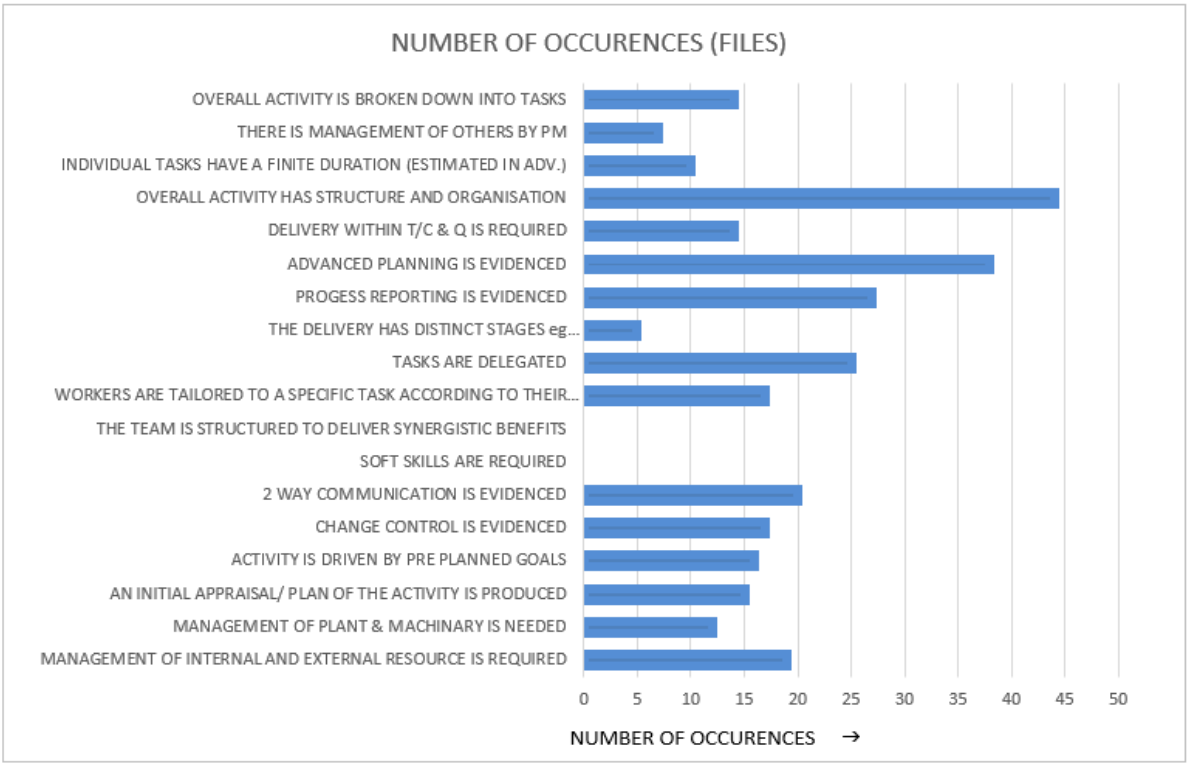


Figure 7.4 – The number of times the archival sample aligned to one of the elements of Essence of Project Management

The bars in Figure 7.5 show the overall strength of alignment which has been found for each element of the Essence of Project Management. The values for each of the elements, 1-18, has been calculated by adding together the strength ratings recorded for each individual rating. The comparative heights of the bars show the categories in which the most evidence for Project Management was found in the archives. This is measured in terms of the number of files exhibiting each characteristic of the Essence of Project Management and the strength of that evidence.

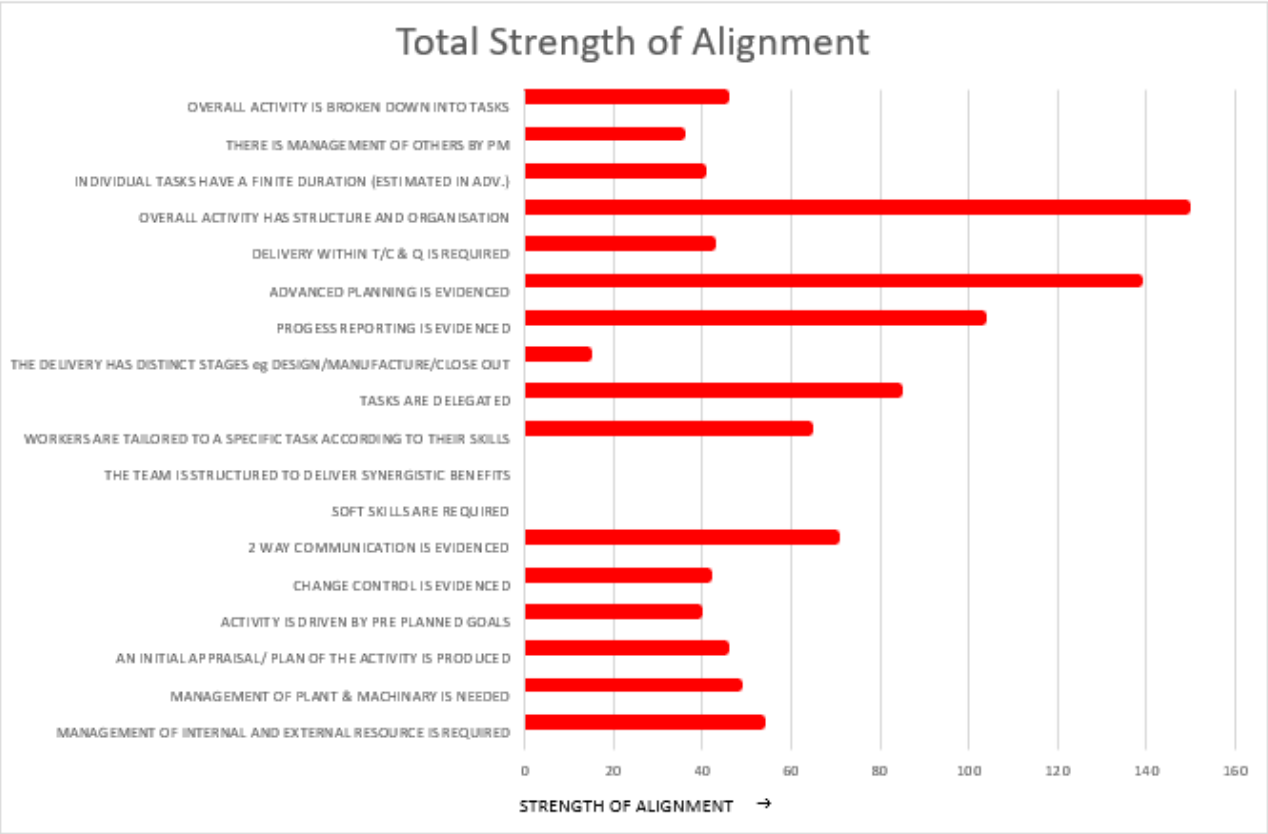


Figure 7.5 – Graph showing the overall strength of alignment of elements of the Essence of Project Management in the archival records

The fluctuation in the length of the bars in Figure 7.5 is predominantly a function of the number of files found for each element, rather than the strength of evidence found in each file. Table 7.1 showed minor variations in the average strength of alignment.

The data shows the average strength of alignment for both the elements related to the Systems Model (Figure 7.6) and for those relating to the Essence of Project Management (Figure 7.7) and reveals that the overall average strength of alignment for all elements of the Systems Model and for all elements of the Essence of Project Management is similar at a strength of approximately 3, (shown in the hatched bars of both Figure 7.6 and 7.7). The figure for Figure 7.6 is slightly higher than that for Figure 7.7 which is suppressed by the two less tangible elements were no data was found, as discussed above.

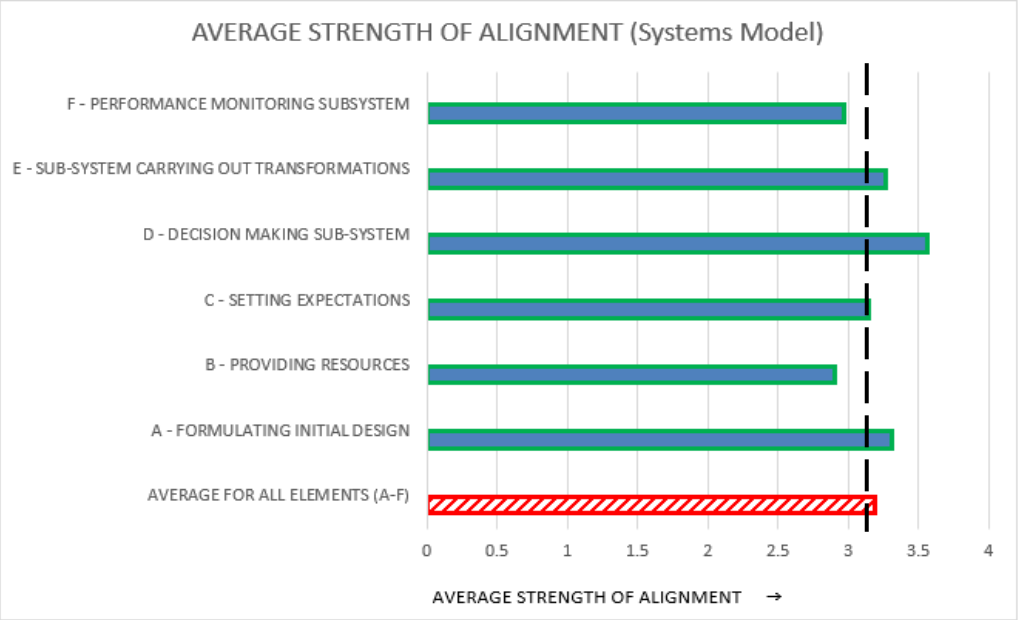


Figure 7.6 – Average strength of alignment of elements of the Systems Model in the archival records

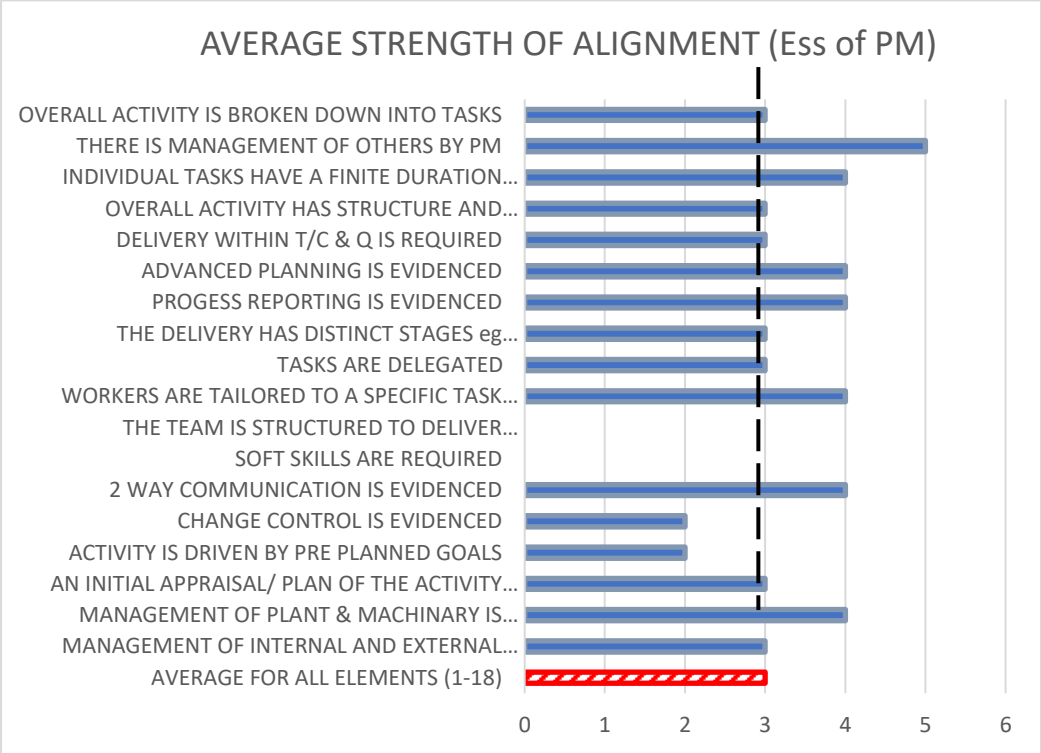


Figure 7.7 – Average strength of alignment of elements of the Essence of Project Management in the archival records

The vertical dotted lines in both Figure 7.6 and Figure 7.7 highlight areas of below and above average strength. Within Figure 7.6 there is not a significant

difference between the values. In Figure 7.7 however some of the variations in levels of strength are more pronounced.

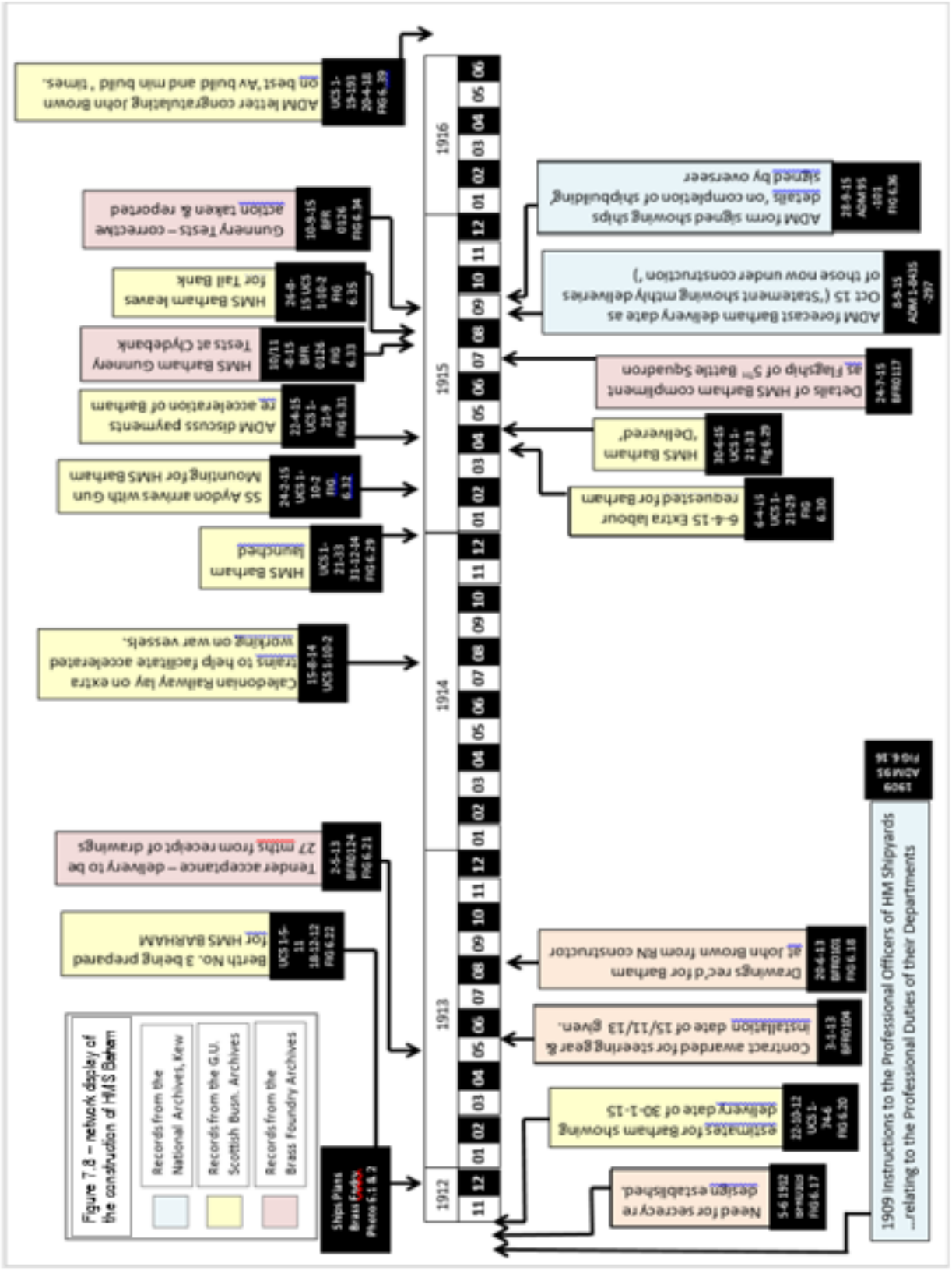
One interesting element is that connected with management of others by the PM. There is a high average strength of alignment here, which differs from that shown in Figure 6.9 as a direct result of Figure 7.7 being derived from the full set of data and not just those slides shared with the current day naval PMs. Whilst the term ‘Project Manager’ was not used at the time of the construction of HMS Barham (Section 6.2.2) the function of management of others was observed. Tasks linked with planning and progress monitoring also show an above average score in the diagram. Some of the documents showing the presence of change control and activities being driven by pre planned goals show low levels of strength, resulting in a below average score for these elements. This can be attributed partly to the fact that of the documents found reflecting these aspects some had a low level of strength of alignment which was none the less present. Other documents had a very high level of alignment and some of these are explored further in section 7.3.

7.3 Essence of Project Management network displays

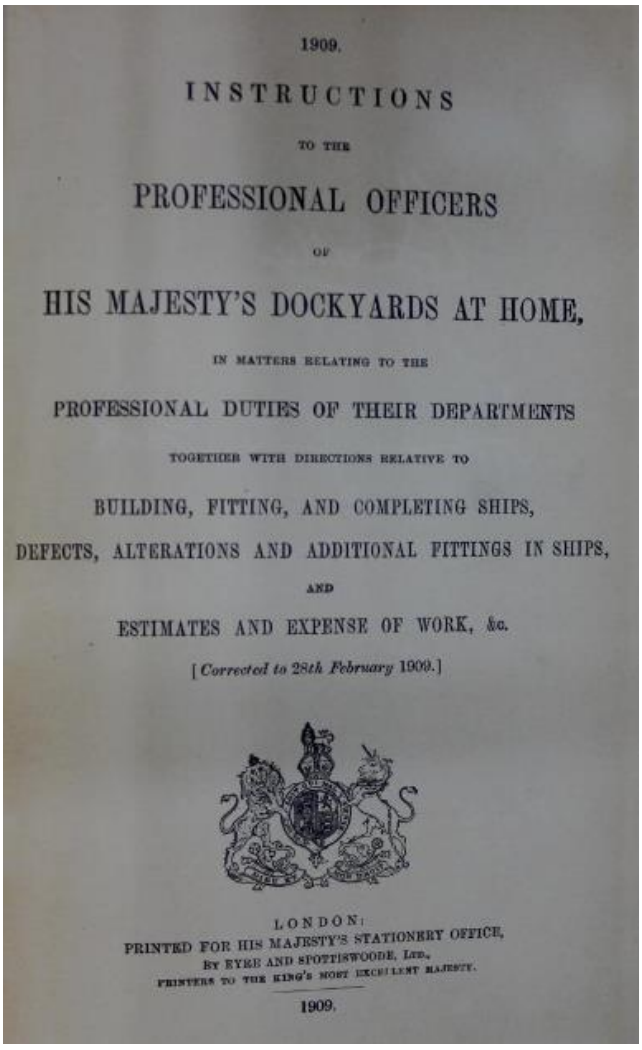
The aim of a Network Display is to show how a process or a ‘network’, constructed from the evidence found, transforms a situation over time. Within this study a timeline showing the analysed processes against a project timeline or lifecycle was constructed as a valuable demonstration of the activity at the shipyard through the lifecycle of HMS Barham.

The ship build timeline shown over-leaf, at Figure 7.8, predominantly shows the period between 1912 and 1916 and highlights some of the key documents found in the archives from a PM perspective in selected to show progression through the period of construction and demonstrate alignment to key elements of the Essence of Project Management. The ordering of the tasks can be seen to represent a modern-day project lifecycle for the

construction of HMS Barham:



The first item on the timeline shown in Figure 7.8 above is dated 1909, and does not relate directly to HMS Barham. The record it relates to is an Admiralty publication titled ‘1909 Instructions to the Professional Officers of His Majesty’s dockyard at Home in Matters Relating to the professional Duties of Their Departments Together with Directions Relative to Building, Fitting, and Completing Ships, Defects, Alterations and Additional Fittings in Ships and Estimates and Expense of Work etc.’ The title page is shown below at Figure 7.9.


1909.

INSTRUCTIONS

TO THE

PROFESSIONAL OFFICERS

OF

HIS MAJESTY'S DOCKYARDS AT HOME,

IN MATTERS RELATING TO THE

PROFESSIONAL DUTIES OF THEIR DEPARTMENTS

TOGETHER WITH DIRECTIONS RELATIVE TO

BUILDING, FITTING, AND COMPLETING SHIPS,

DEFECTS, ALTERATIONS AND ADDITIONAL FITTINGS IN SHIPS,

AND

ESTIMATES AND EXPENSE OF WORK, &c.

[*Corrected to 28th February* 1909.]

LONDON:

PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,

BY EYRE AND SPOTTISWOODE, LTD.,

PRINTERS TO THE KING'S MOST EXCELLENT MAJESTY.

1909.

Figure 7.9 – Title page from HMG publication dated 1909.

The book extends to 20 chapters and its 320 pages cover subjects ranging from the duties of key Dockyard officers and the individual dockyard departments - Engineering, Construction, Electrical Engineering and the Admiralty Chemist’s Department. Further chapters address ‘Building, fitting

and completing ships for commission', 'Progress of work', 'Estimates and expense of work' together with appendices detailing the 'Periodical accounts reports and returns' which each of the four departments listed above, together with the Captain of the Dockyard, were expected to file.

Given that the book is dated 1909, it was of importance to see that this particular copy, held at the National Archives, was inscribed inside the front cover 'W J Dally foreman of the yard 12/4/15.' The book of instructions was therefore being used in the period between 1909 and 1915 and hence at the time of HMS Barham's construction. The instructions however relate to HM Dockyards and Barham was built at John Brown & Co. Ltd.

Barham however was the fourth in class of five Queen Elizabeth Dreadnoughts. The first two, HMS Queen Elizabeth and HMS Warspite were built at HM Dockyards, Portsmouth and Devonport respectively, and would therefore have been built under these rules and regulations

HMS Valiant was the third in class (built by Fairfield Shipbuilding & Engineering Co) HMS Barham was the fourth, and HMS Malaya was the fifth, built by Armstrong Whitworth & Co.

The construction of all these ships started at some point between Oct 1912 and Oct 1913 with completion dates ranging between Dec 1914 and Jan 1916, they were produced simultaneously, in parallel, and if the first two were built under such an organised system, the others would surely have had some similar expectations placed upon them. This therefore suggests that there was considerable organisation and structure placed around these endeavours and that these organisation and expectations were in line with what the APM (2006, p.146) describe as 'Organisation Structure' – 'the organisational environment within which the project takes place. It defines the reporting and decision-making hierarchy of an organisation and how project management operates within it.'

One of the first tasks in constructing the Queen Elizabeth Class ships was to agree a design and produce the drawings from which the ships could be constructed. The range of surviving plans held at the Brass Foundry is shown below in Table 7.2:

Table 7.2 - HMS Barham Plans held at the Brass Foundry

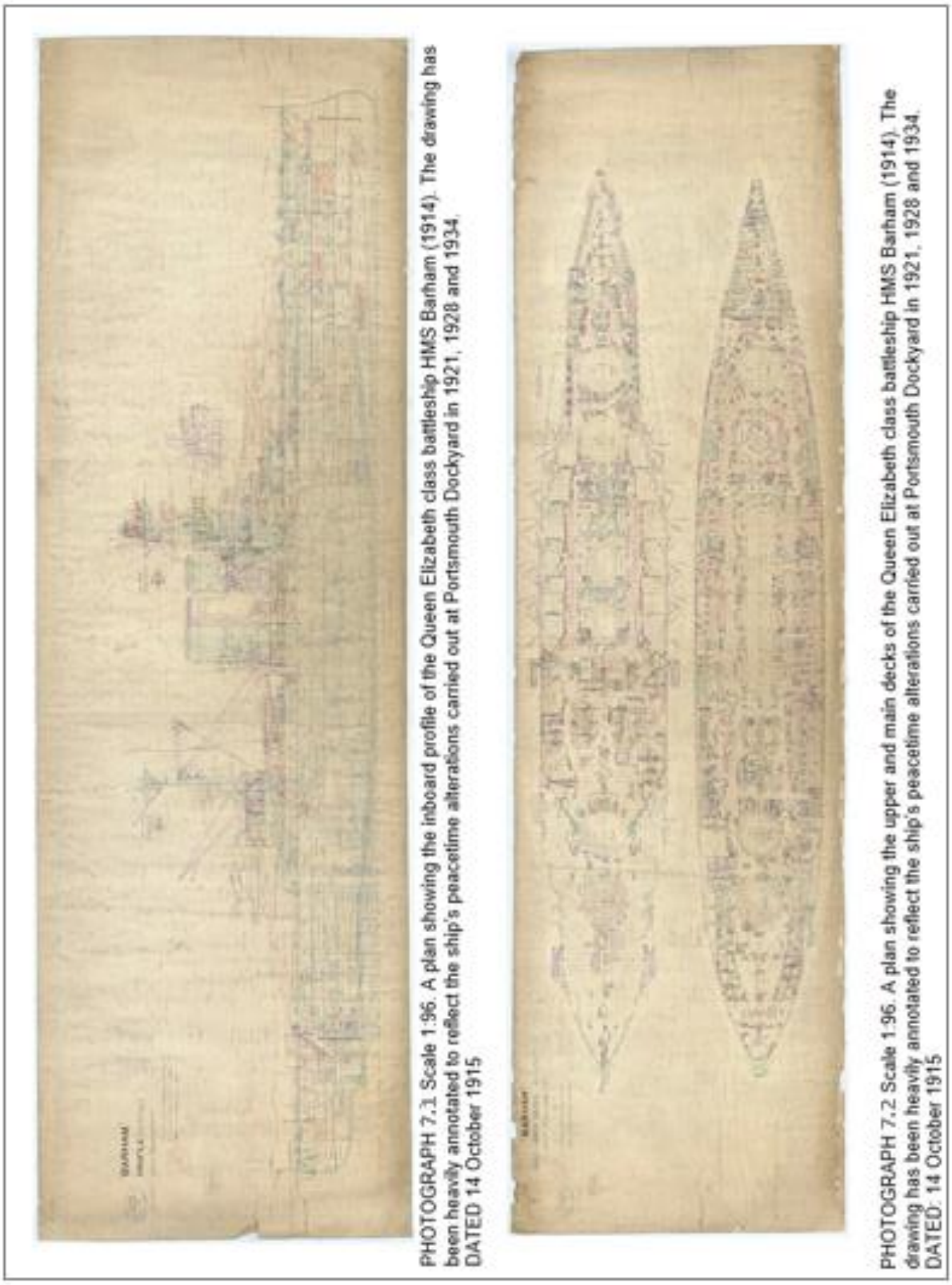
Barham (1914)		
Line	Plan	Scale
1	NPA6483 (J9455). Profile, as fitted +Mods	1:96
2	NPA6484 (J9456). Main & upper deck, as fitted + Mods	1:96
3	Middle & Lower Decks As Fitted + Mods NPA6485	1:96
4	Platforms & Hold As Fitted + Mods NPA6486	1:96
5	Sections As Fitted + Mods NPA6487	1:96
6	Forecastle & Shelter Decks As Fitted + Mods NPA6488	1:96
7	Body Plan NPA6489	1:24
8	Sketch of Rig As Fitted 1934 NPA6490	1:192
9	Profile 1912 NPA6491 ADR129	1:48
10	Upper Deck 1912 NPA6492 ADR129	1:48
11	Middle Deck 1912 NPA6493 ADR129	1:48
12	Lower Deck 1912 NPA6494 ADR129	1:48
13	Platform Deck 1912 NPA6495 ADR129	1:48
14	Hold Plan 1912 NPA6496 ADR130	1:48
15	Forecastle 1912 NPA6497 ADR130	1:48
16	Sections 1912 NPA6498 ADR130	1:48
17	Sections Forward 1912 NPA6499 ADR130	1:48
18	Sketch of Rig 1912 NPA6500 ADR131	1:192
19	NPA6501(M0215) Midship Sections 1912	1:24
20	Shelter Deck 1912 NPA6502 ADR131	1:48
21	Main Deck 1912 NPA6503 ADR131	1:48
22	Sheer Draught 1912 NPA6504 ADR131	1:48
23	NPA6505(M0216) G A Armour 1912	1:192

Post design drawings

Design drawings

It can be seen that various scales have been used, and that predominantly the larger scales are used for the 1912 pre-build plans. HMS Barham was approaching 650 ft in length, so the length of these plans is considerable, the largest, the Body Plan (No. 7) over twenty-seven feet long. This made it difficult to take photographs of these to illustrate this part of the process. However, two plans, both post 1914, have been digitalised by the National

Maritime Museum and are included below for illustrative purpose, noting that a further fifteen pre-build plans also survive, (see photographs 7.1 and 7.2.)



PHOTOGRAPH 7.1 Scale 1:96. A plan showing the inboard profile of the Queen Elizabeth class battleship HMS Barham (1914). The drawing has been heavily annotated to reflect the ship's peacetime alterations carried out at Portsmouth Dockyard in 1921, 1928 and 1934. DATED 14 October 1915

PHOTOGRAPH 7.2 Scale 1:96. A plan showing the upper and main decks of the Queen Elizabeth class battleship HMS Barham (1914). The drawing has been heavily annotated to reflect the ship's peacetime alterations carried out at Portsmouth Dockyard in 1921, 1928 and 1934. DATED: 14 October 1915

The next document in the timeline at Figure 7.8, dated May/ June 1912, reflects the need to closely guard the design of the Queen Elizabeth class. These ships were faster than their predecessors, more heavily armed with fifteen-inch guns rather than the thirteen and a half inch guns of the preceding Iron Duke Class, and the oil-powered engines gave a key advantage. Churchill, at the time the First Lord of the Admiralty, is recorded as saying 'the argument for the design of the Queen Elizabeths was fully explained to the Cabinet last year, and no doubt can be entertained of the decisive military advantages inherent in the creation of a fast division of vessels of the maximum fighting power. The fact that oil-burning ships can refuel at sea, and thus avoid the growing submarine menace which will await them near their coaling bases, is a newly realised advantage of first importance.' (Gilbert, 1969, p.1822.) The need for secrecy was reflected in the appointment of those working on the build as shown in Figure 7.10.

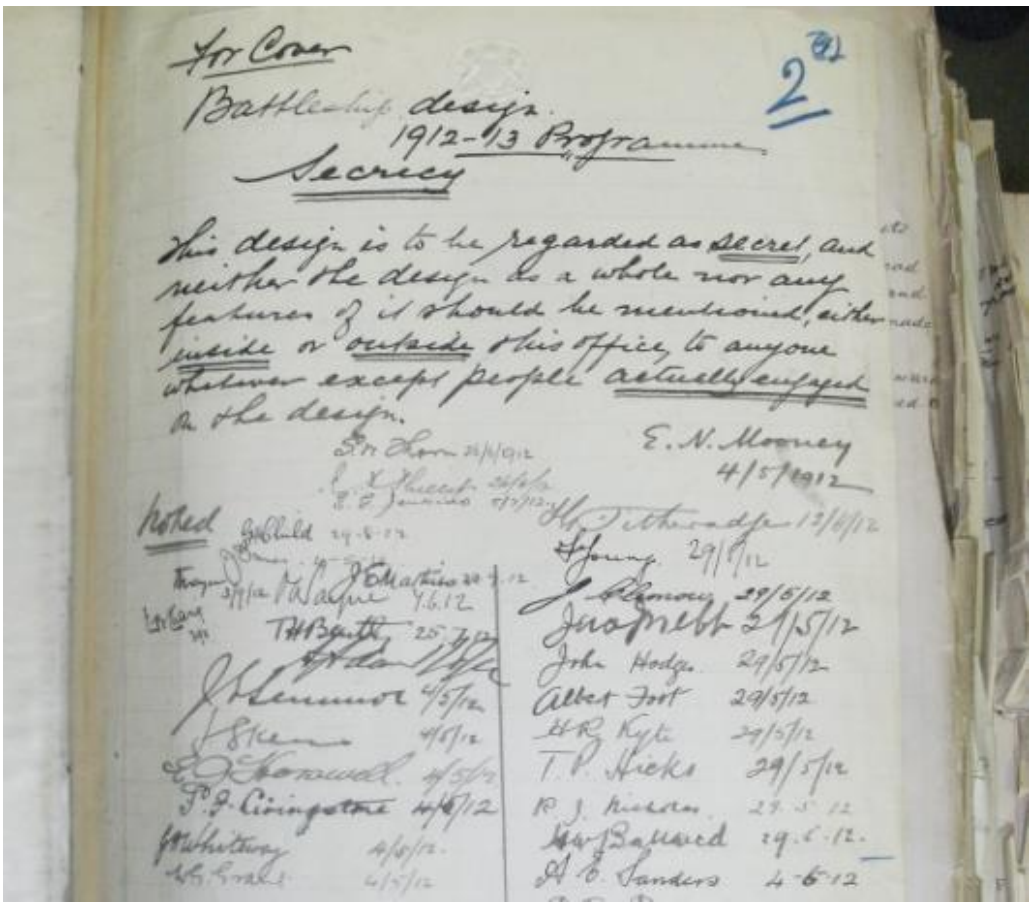
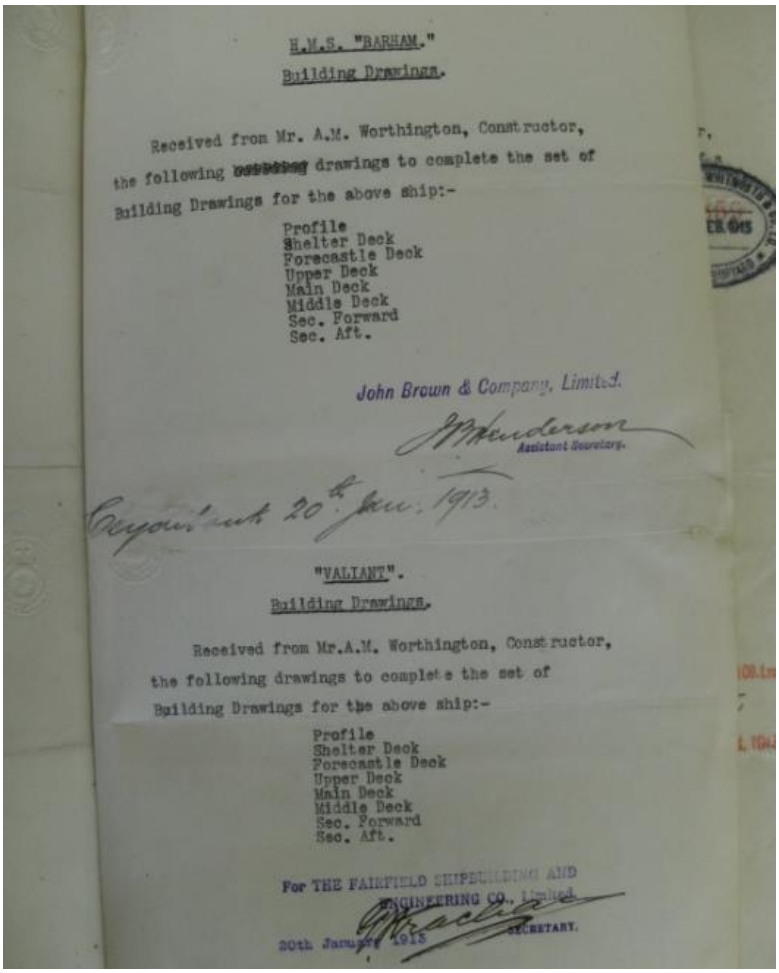


Figure 7.10 – extract showing some of the signatories to a document limiting the discussion of design details to those 'actually employed on the design'

The document at Figure 7.10 requiring secrecy, is headed ‘Battleship design 1912-13 Programme.’ This is a programme in today’s project management sense, which defines a programme as a ‘group of related projects, which may include related business-as-usual activities, that together achieve a beneficial change of a strategic nature for an organisation.’ (APM, 2006 p.149). Given the quote from Churchill above, the nature of the beneficial change is clear to see, and the related nature of the projects can be seen by the shared drawings (similar to those shown in Photographs 7.1 and 7.2) that arrived at John Brown & Co. a year later shown as recorded in Figure 7.11:



H.M.S. "BARHAM."
Building Drawings.

Received from Mr. A.M. Worthington, Constructor,
the following drawings to complete the set of
Building Drawings for the above ship:-

Profile
Shelter Deck
Forecastle Deck
Upper Deck
Main Deck
Middle Deck
Sec. Forward
Sec. Aft.

John Brown & Company, Limited.
Assistant Secretary.

Receipt dated 20th Jan. 1913.

"VALIANT".
Building Drawings.

Received from Mr.A.M. Worthington, Constructor,
the following drawings to complete the set of
Building Drawings for the above ship:-

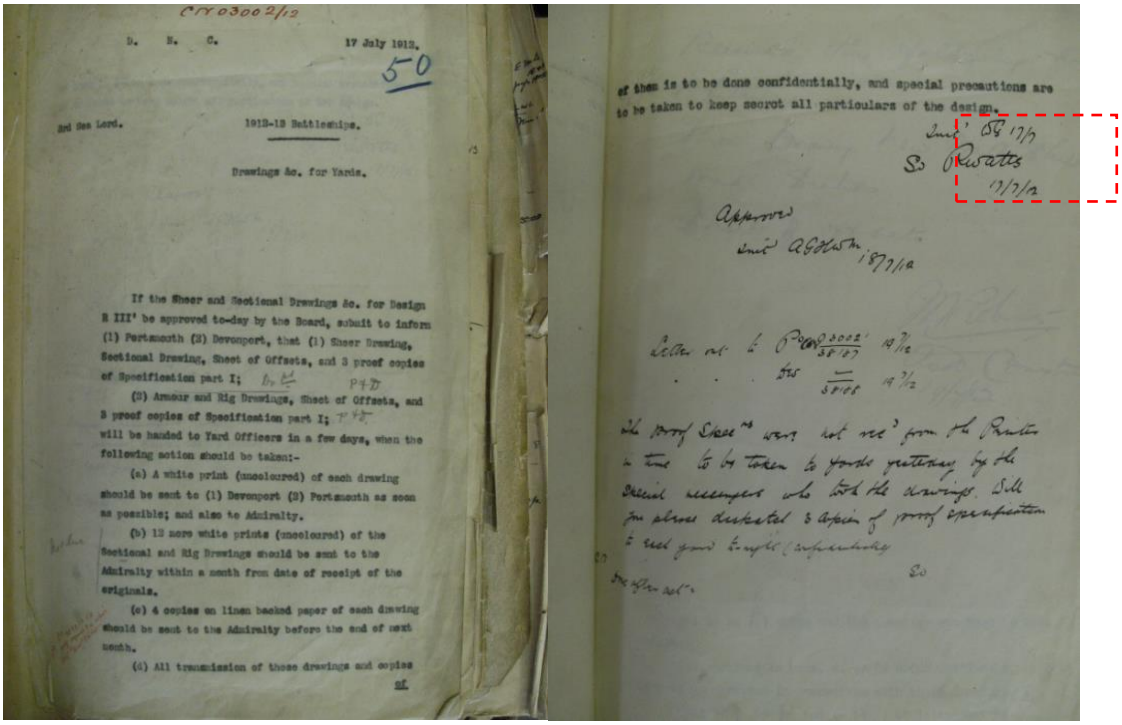
Profile
Shelter Deck
Forecastle Deck
Upper Deck
Main Deck
Middle Deck
Sec. Forward
Sec. Aft.

For THE FAIRFIELD SHIPBUILDING AND
ENGINEERING CO., Limited.
SECRETARY.
20th January 1913

Figure 7.11 – letter showing receipt of drawings shared for HMS Barham and HMS Valiant.

The process for distributing these drawings can be seen three months earlier where the renown naval architect Sir Philip Watts, architect of HMS Dreadnought and Director of Naval Construction at the Admiralty up until

1912, authorised the distribution of the drawings on 17-7-12, as shown in Figure 7.12.



D. N. C. 17 July 1912.

50

1913-13 Battleships.

Drawings &c. for Yards.

If the Sheer and Sectional Drawings &c. for Design R III' be approved to-day by the Board, submit to inform (1) Portsmouth (2) Devonport, that (1) Sheer Drawing, Sectional Drawing, Sheet of Offsets, and 3 proof copies of Specification part I;

(2) Armour and Rig Drawings, Sheet of Offsets, and 3 proof copies of Specification part I;

will be handed to Yard Officers in a few days, when the following action should be taken:-

(a) A white print (uncoloured) of each drawing should be sent to (1) Devonport (2) Portsmouth as soon as possible; and also to Admiralty.

(b) 12 more white prints (uncoloured) of the Sectional and Rig Drawings should be sent to the Admiralty within a month from date of receipt of the originals.

(c) 4 copies on linen backed paper of each drawing should be sent to the Admiralty before the end of next month.

(d) All transmission of these drawings and copies

of them is to be done confidentially, and special precautions are to be taken to keep secret all particulars of the design.

Approved

Figure 7.12 – letter showing approval of drawings by the ADM and details re distribution to HM Dockyards.

The distribution of these documents is followed by estimates of the cost for the Hull/ Engines and Boilers as per Figure 7.13 below. It can be seen that this is in respect of HMS Barham since the Clydebank yard ship number – 424 is written on the October 1912 document (Figure 6.20) in blue pencil.

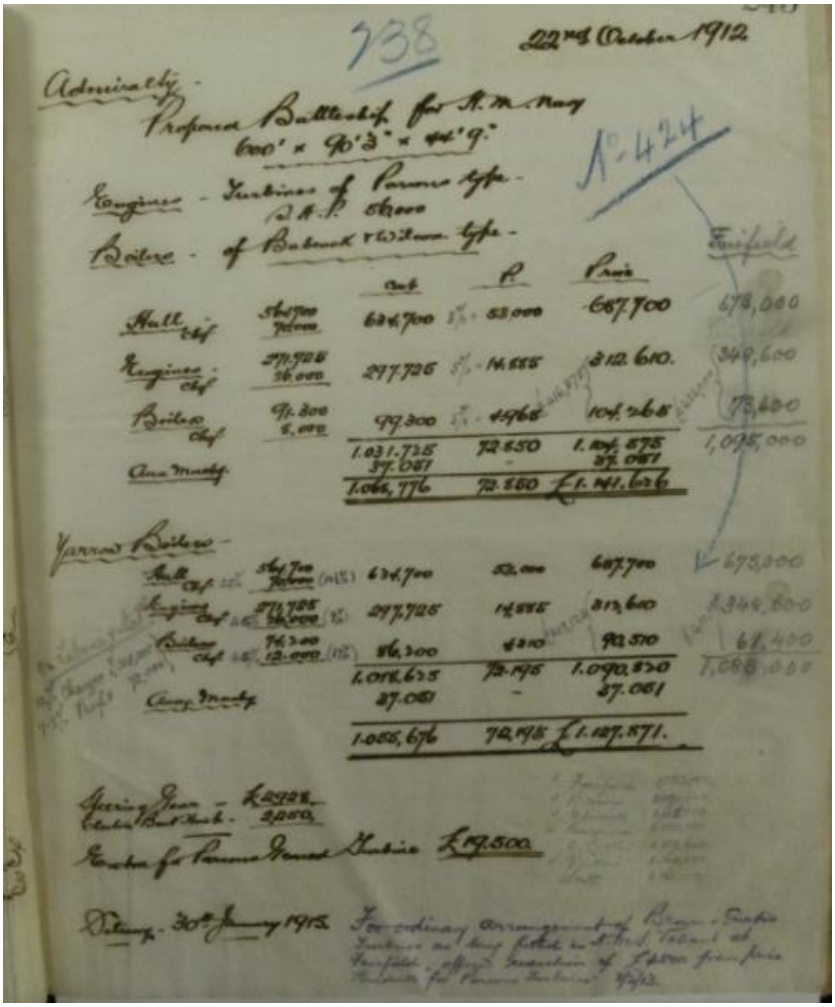
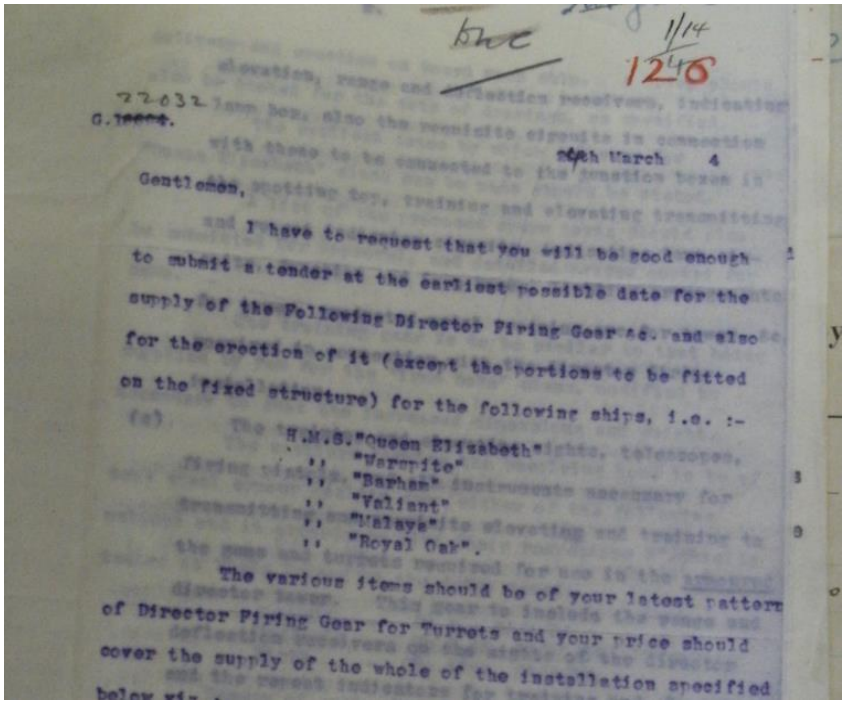


Figure 7.13 – calculations showing HMS Barham costs and delivery date estimates.

The estimates show total costs for the elements noted of £1,127,871 and a delivery date of January 30th 1915. Later in the year, in May 1913, a contract from Armstrongs for the building of HMS Malaya was authorised. Given that Malaya was the last in class and that the ships proceeded at roughly the same rate as evidenced by Figure 7.12 and Figure 7.14 below, it is not unreasonable to expect the contract for HMS Barham to have also been awarded by this point.



22032

Gentlemen,

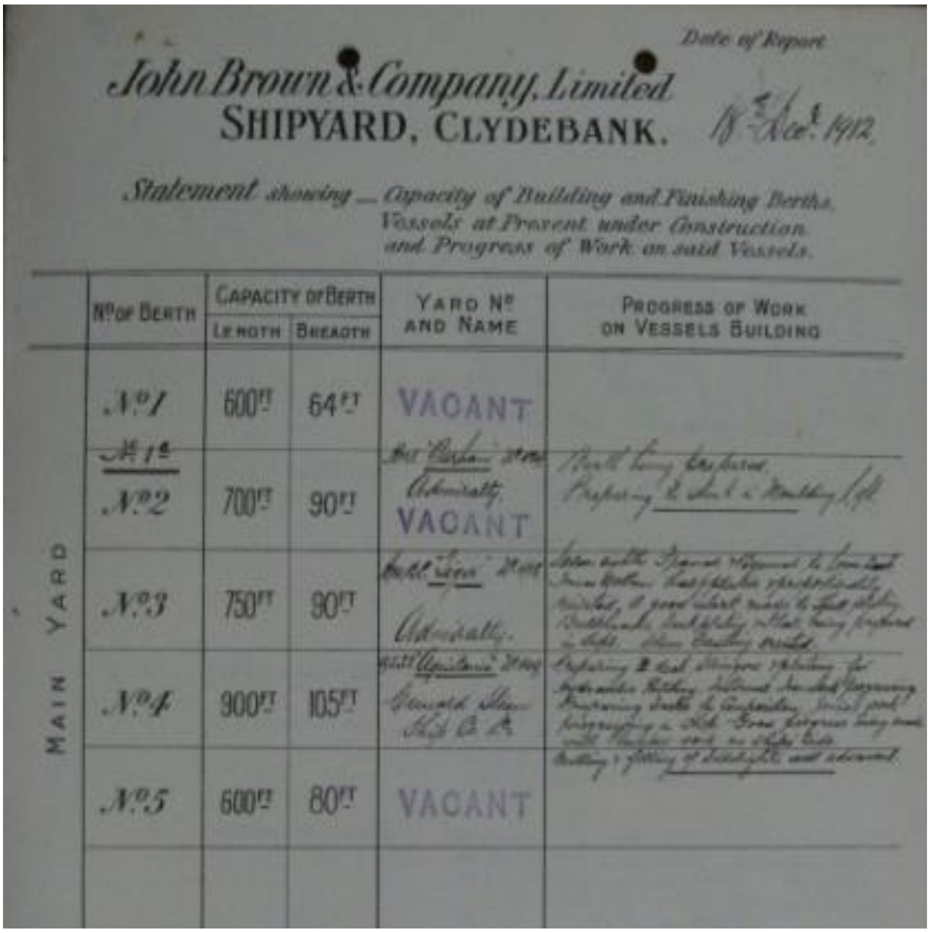
I have to request that you will be good enough to submit a tender at the earliest possible date for the supply of the following Director Firing Gear &c. and also for the erection of it (except the portions to be fitted on the fixed structure) for the following ships, i.e. :-

H.M.S."Queen Elizabeth"
" "Warrrite"
" "Barham"
" "Valiant"
" "Malaya"
" "Royal Oak".

The various items should be of your latest pattern of Director Firing Gear for Turrets and your price should cover the supply of the whole of the installation specified

Figure 7.14 – shows the firing gear for all Queen Elizabeth Class ships being ordered at the same time and being treated as part of the same order.

Clearly however, John Brown had had advance ‘notice’ of the contract award, or at the very least, considered it likely, given the size of the programme and the availability of large yards with sufficient capacity, to have started making preparations some six months earlier in December of 1912. Figure 7.15 shows the last copy of the Yard Reports which the Glasgow John Brown archives contain. It can be seen that it is a printed report that is completed to reflect the capacity of the yard, the vessels under construction at the time of the report and also the progress on those ships. The fact that it is a printed report is important as from this it can be inferred that it is a regular, formal report that even if some are missing from the archives, can be seen as part of a standard process (Gaddis, 2004). The last in the series of these reports does however tantalisingly read, in respect of HMS Barham, ‘Berth being prepared. Beginning to start in the moulding loft.’ The following two years of reports would have been invaluable in completing this study, yet unfortunately are not held in the collection and the fear is that they no longer survive.


Date of Report

John Brown & Company, Limited
SHIPYARD, CLYDEBANK.

18th Dec. 1912

Statement showing — Capacity of Building and Finishing Berths, Vessels at Present under Construction and Progress of Work on said Vessels.

	No. of Berth	Capacity of Berth		Yard No. and Name	Progress of Work on Vessels Building
		Length	Breadth		
MAIN YARD	No. 1	600ft	64ft	VACANT	
	No. 1a / No. 2	700ft	90ft	[illegible] Admiralty VACANT	[illegible]
	No. 3	750ft	90ft	[illegible] Admiralty.	[illegible]
	No. 4	900ft	105ft	[illegible]	[illegible]
	No. 5	600ft	80ft	VACANT	

Figure 7.15 John Brown & Co Ltd Report/ Statement 18 Dec 1912.

The report at Figure 7.15 suggests that perhaps both Berth No. 1 and Berth No. 2 were being prepared for HMS Barham (the left-hand column appears to have a hand-written annotation merging Berth No. 1 with Berth No.2.) The exact siting of these berths can be seen in another part of the same report, as shown in Figure 7.16. At the time of the 18 Dec 1912 report, both Berths 1 and 2 are shown vacant, and it is these that the report details as being prepared for work to start on HMS Barham.

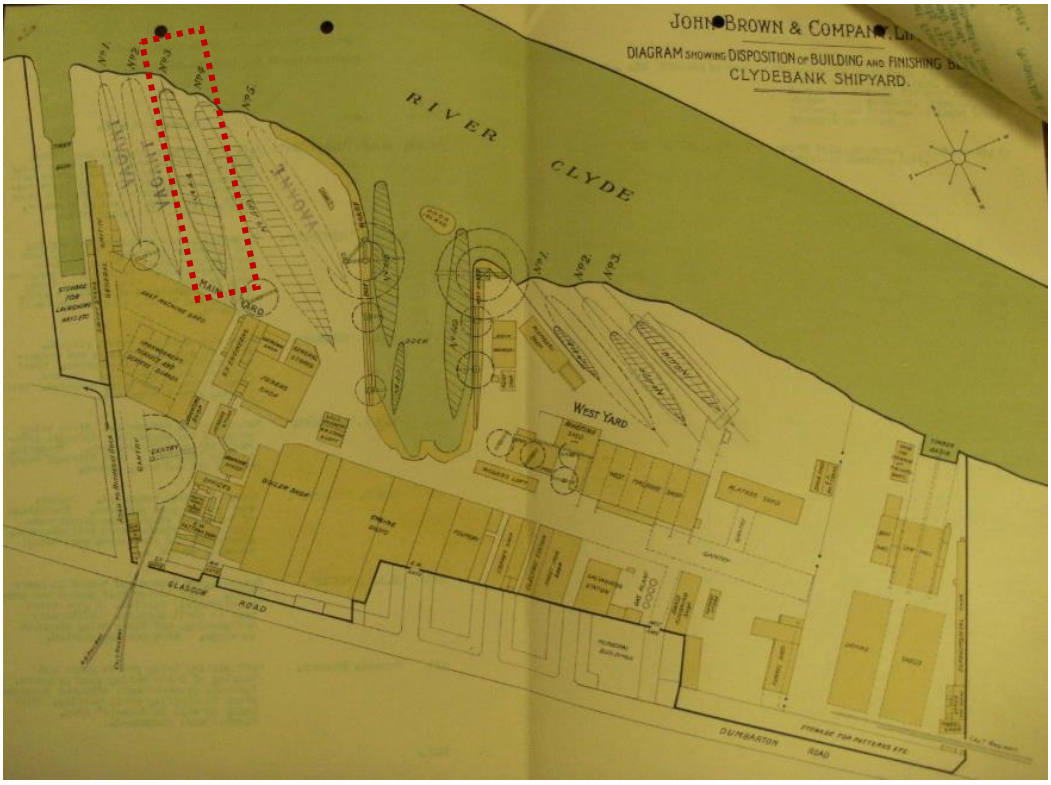
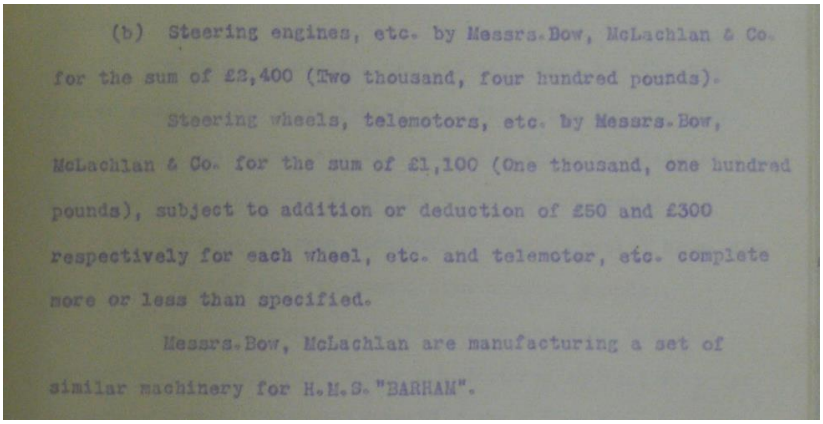


Figure 7.16 John Brown & Co Ltd Report - shipyard diagram 18 Dec 1912.

On the 31st of January 1913, the timeline in Figure 7.8 shows that the contract for the steering mechanism was awarded, and a delivery date for its installation of 15/11/13 was given. Certainly, it would have had to have been installed well before the launch at the end of 1914. Other evidence of orders for machinery exist. A copy of a letter dated 2nd May 1913 (following up on an Admiralty telegram of 7/2/13,) accepting the 30/12/12 tender for a Battleship from Armstrong Whitworth & Co. also shows that the new ship shared components and design with HMS Barham. The letter binds Armstrong Whitworth to certain terms and conditions, one of them re the design of shared, steering components, is evidenced below at Figure 7.17.



(b) Steering engines, etc. by Messrs. Bow, McLachlan & Co. for the sum of £2,400 (Two thousand, four hundred pounds).

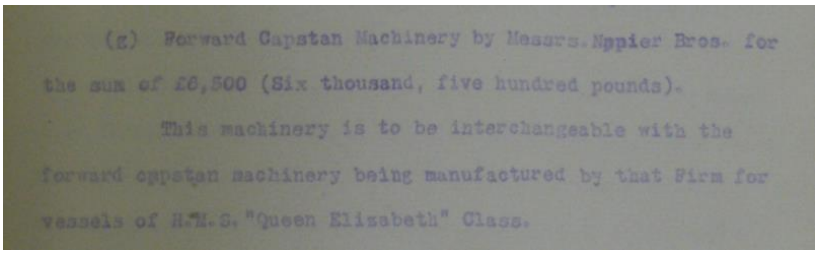
Steering wheels, telemotors, etc. by Messrs. Bow, McLachlan & Co. for the sum of £1,100 (One thousand, one hundred pounds), subject to addition or deduction of £50 and £300 respectively for each wheel, etc. and telemotor, etc. complete more or less than specified.

Messrs. Bow, McLachlan are manufacturing a set of similar machinery for H.M.S. "BARHAM".

Figure 7.17 extract from Admiralty letter 2/5/13 showing commonality of steering components, - text reproduced below:

> (b) Steering engines, etc. by Messrs. Bow, McLachlan & Co. for the sum of £2,400 (Two thousand, four hundred pounds).
>
> Steering wheels. Telemotors, etc. by Messrs. Bow, McLachlan & Co. for the sum of £1,100 (One thousand, one hundred pounds),subject to addition or deduction of £50 and £300 respectively for each wheel, etc. telemotor, etc. Complete more or less than specified.
> Messrs. Bow, McLachlan are manufacturing a set of similar machinery for H.M.S. "Barham".

Armstrong built the last of the Queen Elizabeth Dreadnoughts – HMS Malaya, and it is this vessel that the letter refers to. HMS Malaya was laid down eight months after HMS Barham in October 1913 and Barham and the other Queen Elizabeth Class Dreadnoughts are used again as a reference in the Admiralty letter again where the need for other areas of commonality is specified:



(g) Forward Capstan Machinery by Messrs. Napier Bros. for the sum of £6,500 (Six thousand, five hundred pounds).

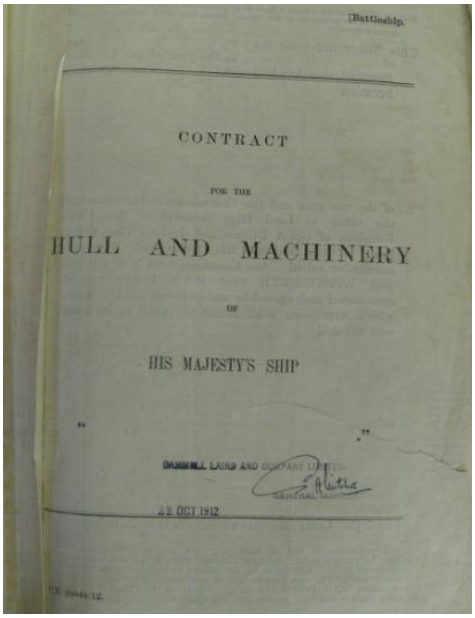
This machinery is to be interchangeable with the forward capstan machinery being manufactured by that Firm for vessels of H.M.S. "Queen Elisabeth" Class.

Figure 7.18 extract from Admiralty letter 2/5/13 showing commonality of capstan machinery - text reproduced below:

> (g) Forward Capstan Machinery by Messrs. Napier Bros. for the sum of £6,500 (Six thousand, five hundred pounds).
> This machinery is to be interchangeable with the forward capstan machinery being manufactured by that Firm for vessels of H.M.S. "Queen Elisabeth" Class.

The files therefore demonstrate similarities in the approach to the construction of the ships as a class and hence as a programme of five projects.

Unfortunately, a contract wasn't to be found for Barham's hull and machinery. Having demonstrated the similarity, a printed 'pro forma' contract for the Hull and Machinery of a Battleship was found in the Queen Elizabeth Class file which given its location and formal pre-printed nature is likely to have been similar if not the same as HMS Barham's. (Curiously though it is stamped Cammell Laird & Co. and dated 22/10/12 but none of the Queen Elizabeth Dreadnoughts were made by Cammell Laird – perhaps one had intended to be but the decision was changed?)


Battleship.

CONTRACT

FOR THE

HULL AND MACHINERY

OF

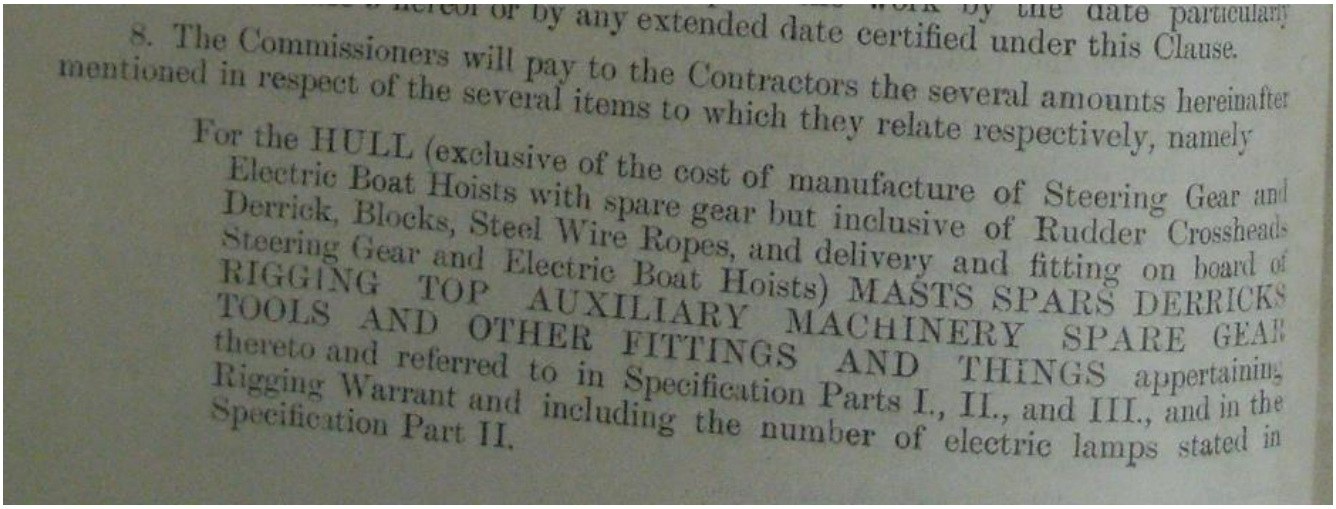
HIS MAJESTY'S SHIP

CAMMELL LAIRD AND COMPANY LIMITED.

22 OCT 1912

Figure 7.19 title page from 1912 Battleship Hull and Machinery contract

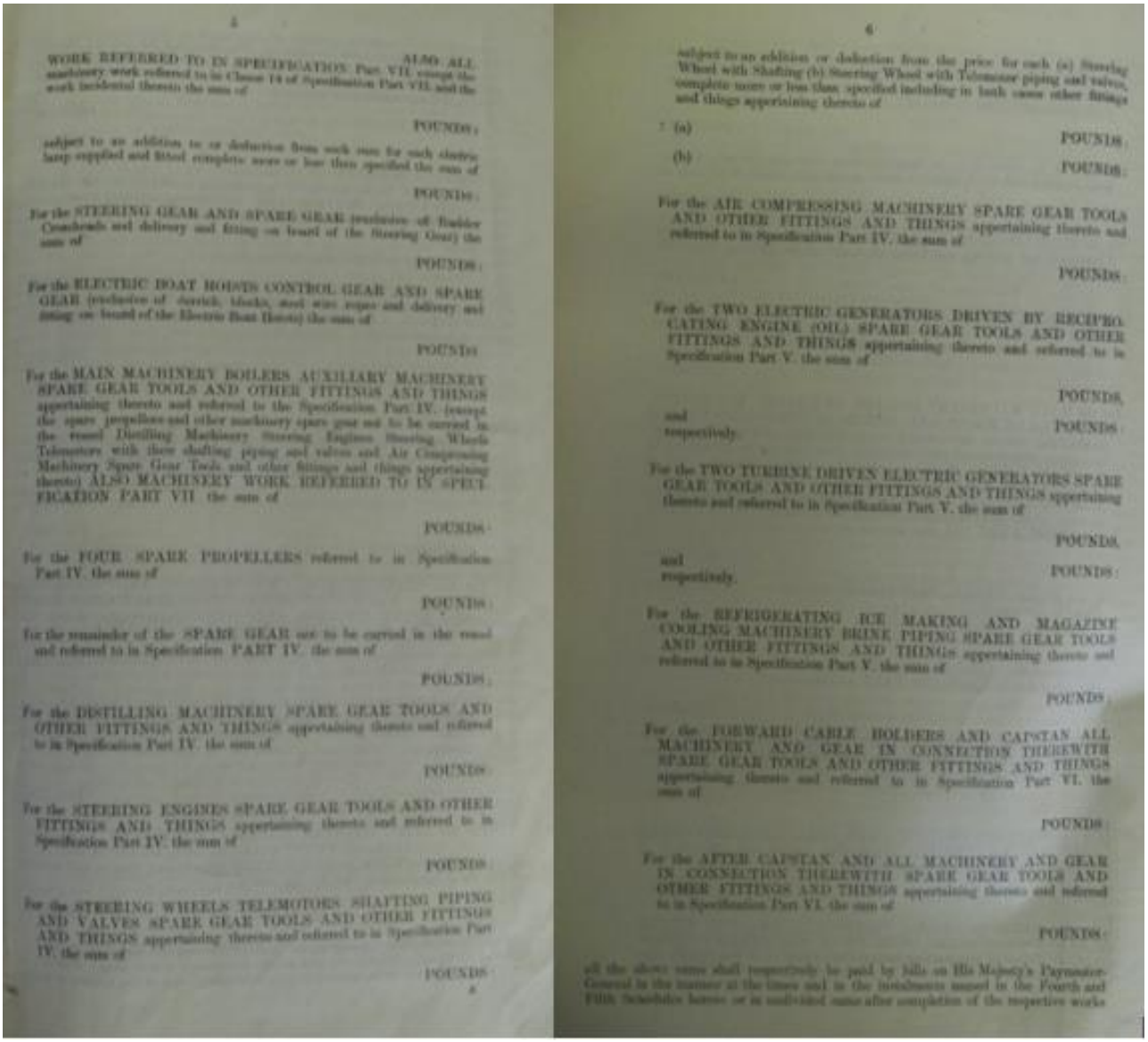
Figures 7.20 and 7.21 show the typical components of a 1912 Hull and Machinery contract.



8. The Commissioners will pay to the Contractors the several amounts hereinafter mentioned in respect of the several items to which they relate respectively, namely

For the HULL (exclusive of the cost of manufacture of Steering Gear and Electric Boat Hoists with spare gear but inclusive of Rudder Crossheads Derrick, Blocks, Steel Wire Ropes, and delivery and fitting on board of Steering Gear and Electric Boat Hoists) MASTS SPARS DERRICKS RIGGING TOP AUXILIARY MACHINERY SPARE GEAR TOOLS AND OTHER FITTINGS AND THINGS appertaining thereto and referred to in Specification Parts I., II., and III., and in the Rigging Warrant and including the number of electric lamps stated in Specification Part II.

Figure 7.20 components of the Hull and Machinery contract



WORK REFERRED TO IN SPECIFICATION Part VII. except the machinery work referred to in Clause 14 of Specification Part VII. and the work incidental thereto the sum of

POUNDS

subject to an addition to or deduction from such sum for each electric lamp supplied and fitted complete more or less than specified the sum of

POUNDS

For the STEERING GEAR AND SPARE GEAR (exclusive of Rudder Crossheads and delivery and fitting on board of the Steering Gear) the sum of

POUNDS

For the ELECTRIC BOAT HOISTS CONTROL GEAR AND SPARE GEAR (exclusive of derrick, blocks, steel wire ropes and delivery and fitting on board of the Electric Boat Hoists) the sum of

POUNDS

For the MAIN MACHINERY BOILERS AUXILIARY MACHINERY SPARE GEAR TOOLS AND OTHER FITTINGS AND THINGS appertaining thereto and referred to the Specification Part IV. (except the spare propellers and other machinery spare gear not to be carried in the vessel Distilling Machinery Steering Engines Steering Wheels Telemotors with their shafting piping and valves and Air Compressing Machinery Spare Gear Tools and other fittings and things appertaining thereto) ALSO MACHINERY WORK REFERRED TO IN SPECIFICATION PART VII the sum of

POUNDS

For the FOUR SPARE PROPELLERS referred to in Specification Part IV. the sum of

POUNDS

For the remainder of the SPARE GEAR not to be carried in the vessel and referred to in Specification PART IV. the sum of

POUNDS

For the DISTILLING MACHINERY SPARE GEAR TOOLS AND OTHER FITTINGS AND THINGS appertaining thereto and referred to in Specification Part IV. the sum of

POUNDS

For the STEERING ENGINES SPARE GEAR TOOLS AND OTHER FITTINGS AND THINGS appertaining thereto and referred to in Specification Part IV. the sum of

POUNDS

For the STEERING WHEELS TELEMOTORS SHAFTING PIPING AND VALVES SPARE GEAR TOOLS AND OTHER FITTINGS AND THINGS appertaining thereto and referred to in Specification Part IV. the sum of

POUNDS

subject to an addition or deduction from the price for each (a) Steering Wheel with Shafting (b) Steering Wheel with Telemotor piping and valves complete more or less than specified including in both cases other fittings and things appertaining thereto of

(a) POUNDS

(b) POUNDS

For the AIR COMPRESSING MACHINERY SPARE GEAR TOOLS AND OTHER FITTINGS AND THINGS appertaining thereto and referred to in Specification Part IV. the sum of

POUNDS

For the TWO ELECTRIC GENERATORS DRIVEN BY RECIPROCATING ENGINE (OIL) SPARE GEAR TOOLS AND OTHER FITTINGS AND THINGS appertaining thereto and referred to in Specification Part V. the sum of

POUNDS

and POUNDS

respectively

For the TWO TURBINE DRIVEN ELECTRIC GENERATORS SPARE GEAR TOOLS AND OTHER FITTINGS AND THINGS appertaining thereto and referred to in Specification Part V. the sum of

POUNDS

and POUNDS

respectively

For the REFRIGERATING ICE MAKING AND MAGAZINE COOLING MACHINERY BRINE PIPING SPARE GEAR TOOLS AND OTHER FITTINGS AND THINGS appertaining thereto and referred to in Specification Part V. the sum of

POUNDS

For the FORWARD CABLE HOLDERS AND CAPSTAN ALL MACHINERY AND GEAR IN CONNECTION THEREWITH SPARE GEAR TOOLS AND OTHER FITTINGS AND THINGS appertaining thereto and referred to in Specification Part VI. the sum of

POUNDS

For the AFTER CAPSTAN AND ALL MACHINERY AND GEAR IN CONNECTION THEREWITH SPARE GEAR TOOLS AND OTHER FITTINGS AND THINGS appertaining thereto and referred to in Specification Part VI. the sum of

POUNDS

all the above sums shall respectively be paid by bills on His Majesty's Paymaster-General in the manner at the times and in the instalments named in the Fourth and Fifth Schedules hereto or in undivided sums after completion of the respective works

Figure 7.21 components of the Hull and Machinery contract

In Figure 7.8, the timeline shows that drawings were received at John Brown & Co. Ltd. from the Admiralty, for HMS Barham on 20/6/13 (see also Figure 7.12). There is then a gap on the timeline (Figures 7.9 and 7.36) until HMS Barham is shown as being launched on 31/12/14. The only record shown between these times, is a note from the shipyard diaries detailing the special train services laid on by the Caledonian Railway Company for Saturdays and Sundays to meet the need to increase the speed with which work on Barham, and other ships, was completed.

During this period the yard was constructing the hull and installing the machinery as Figure 7.22, constructed from the yards 'Contracts in Progress' book (UCS 1-75-8) by the author, shows:

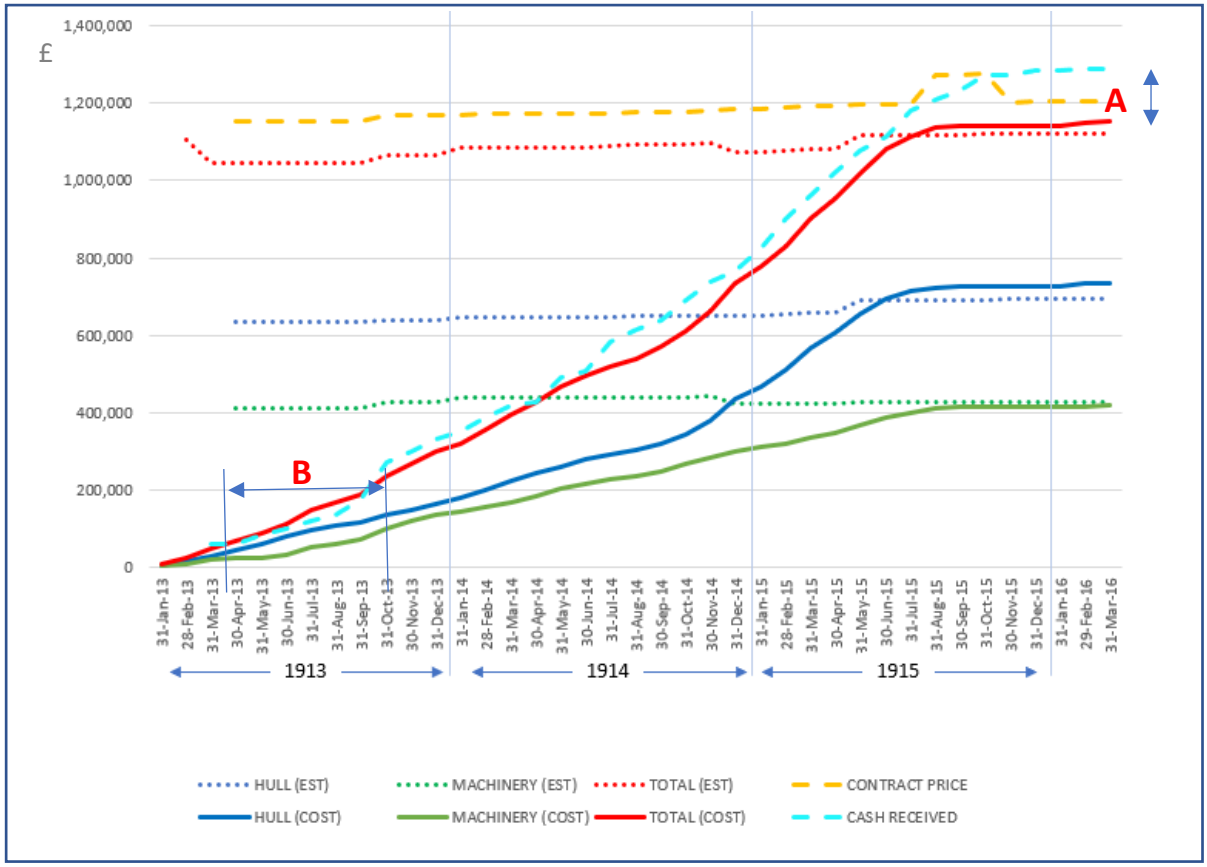


Figure 7.22 details of Hull and Machinery estimates, costs and actual £s rec'd constructed from the yards 'Contracts in Progress' book (UCS 1-75-8) by the author

The solid lines represent the cumulative costs (or 'actuals') spent on the hull (blue) the machinery (green) and the total (red). The dotted lines, similarly

colour coded, show the original total estimates for the components. The estimates are largely constant and fairly accurate over their lifespan, at the start of the process the Hull is estimated at £634,700 (31st January, 1913) and the estimate varies by 9.5% at the end of the chart (31st March, 1916). The Machinery is even closer in terms of its estimate at the start, £410,773 and its final 31st March estimate of £427,504, a difference of 4%. Overall the combined, or total variance, between the estimate from the beginning of the process to the end is 7.3%, which suggests that there must have been an accurate estimating process in place during the 1912-1916 build process.

The profit earned by John Brown & Co. Ltd. is shown by 'A' in Figure 7.22 – the gap between the total cost and the cash received - £135,419 representing an 11.75% profit margin.

Overall the amounts paid by the HM Government (the dotted blue line in Figure 7.22,) closely follow the Total Costs (solid red line.) There is only one period where the red line is above the dotted blue line, (shown as 'B' in Figure 7.22.) This represents the period where the constructor has a 'funding gap' and would have needed to borrow money from other parts of the business or from third party funders in order to finance the project. The period is short and the gap small, suggesting that the contract and payment terms are well thought out from the contractor's viewpoint and little is required in terms of funding capital, overdrafts or loans to cover the time when the contactor had paid out monies in advance of their receiving payment themselves.

The solid lines in Figure 7.22 above are cumulative figures. As such they show the characteristic pattern seen in modern-day projects. Typically, cumulative curves within Project Management, will exhibit what is known as an 'S Curve' shape, (Buttrick, 2009). This illustrates that the rate of increase, period on period, is greatest during the middle section of a venture and hence the gradient of the curve is steepest in the middle section. A flatter section at the start and end of the curve is caused by a comparative slow periodic rate of increase in costs incurred as the project is begun and a

similar period at the end of the lifecycle as the tasks are wound down. The shape produced by the Hull and Machinery curves for the construction of HMS Barham show the typical trait of a project S-curve.
Barham was launched on 31-12-14 as shown by Figure 7.23.

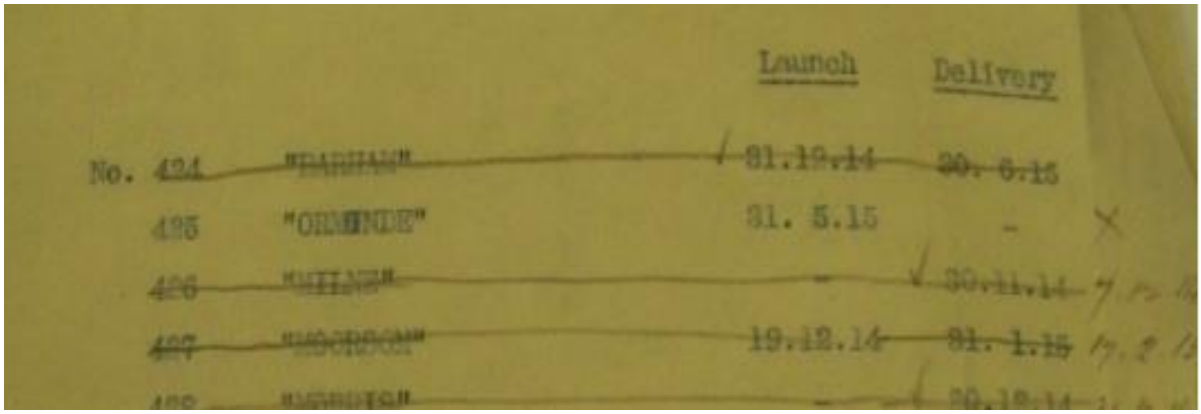
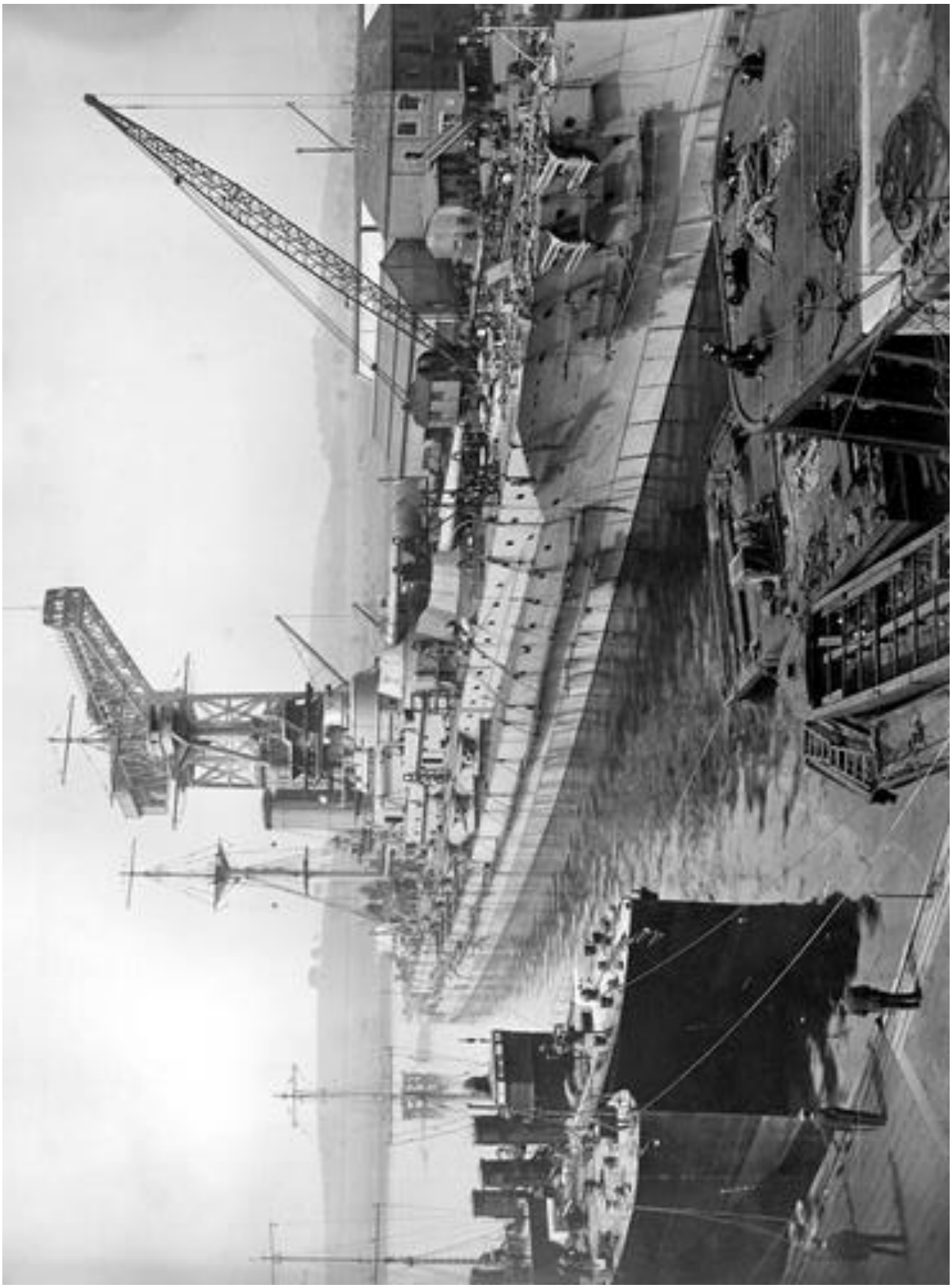


Figure 7.23 – extract from John Brown & Co Ltd records showing launch and delivery dates of current order

The launch date is followed by a later ‘Delivery’ date showing that the launch didn’t represent the completion of the ship but that additional work was required before the ship was handed over to the Admiralty on 30th June 1915. Indeed Photograph 7.3 on the following page shows HMS Barham still at John Brown’s yard being fitted out in July of 1915.



Photograph 7.3 HMS Barham being fitted out – July 1915

A letter from this period (6/4/14) (Figure 7.24) shows that additional labour was required by John Brown and could be assigned specifically to the construction of HMS Barham in respect of extra carpenters, riggers and stagers and general labourers (Shown by the orange dotted highlight).

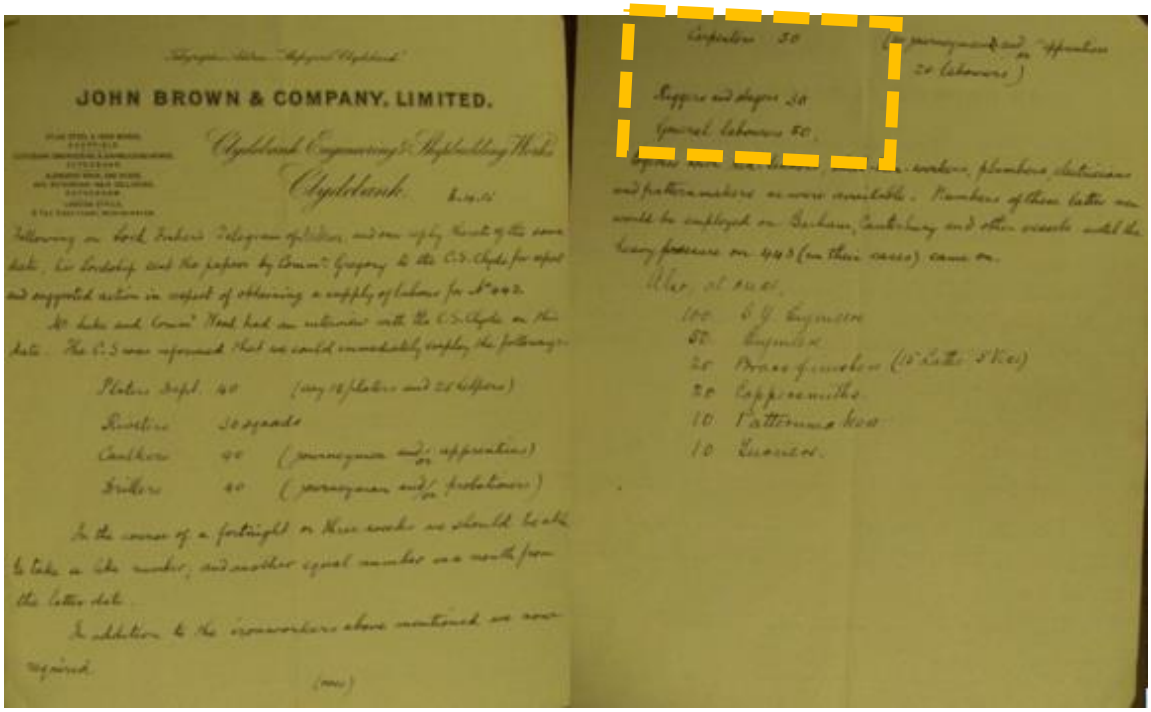
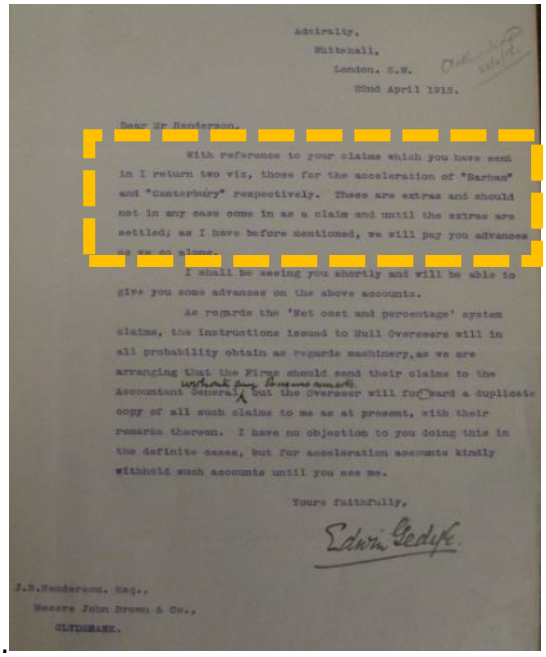


Figure 7.24 – extract from John Brown & Co Ltd records showing requirement for additional trades.

The Admiralty were content to pay for the costs in relation to the acceleration of work on HMS Barham, although as the letter at Figure 7.25 shows obtaining payment was not altogether straight forward.



Admiralty,
Whitehall,
London. S.W.
22nd April 1915.

Dear Mr Henderson,

With reference to your claims which you have sent in I return two viz, those for the acceleration of "Barham" and "Canterbury" respectively. These are extras and should not in any case come in as a claim and until the extras are settled; as I have before mentioned, we will pay you advances as we go along.

I shall be seeing you shortly and will be able to give you some advances on the above accounts.

As regards the 'Net cost and percentage' system claims, the instructions issued to Hull Overseers will in all probability obtain as regards machinery, as we are arranging that the Firms should send their claims to the Accountant General, but the Overseer will forward a duplicate copy of all such claims to me as at present, with their remarks thereon. I have no objection to you doing this in the definite cases, but for acceleration accounts kindly withhold such accounts until you see me.

Yours faithfully,

Edwin Gedye.

J.B.Henderson, Esq.,
Messrs John Brown & Co.,
CLYDEBANK.

Figure 7.25 – letter to John Brown & Co. from the Admiralty discussing payment for accelerating work on HMS Barham - text reproduced below:

> With reference to your claims which you have sent in I return two viz, those for the acceleration of "Barham" and "Canterbury" respectively. These are extras and should not in any case come in as a claim and until the extras are settled; as I have before mentioned, we will pay you advances as we go along.

The SS Aydon is mentioned in the yard diary on 24/2/15 (Figure 7.26) as delivering the gun mountings for HMS Barham, showing that reflecting the contract at Figures 7.20 and 7.21, the armament was not part of the Hull and Machinery build, and also illustrating one of the key 'project' interfaces that the yard would need to manage in order to deliver HMS Barham on time.

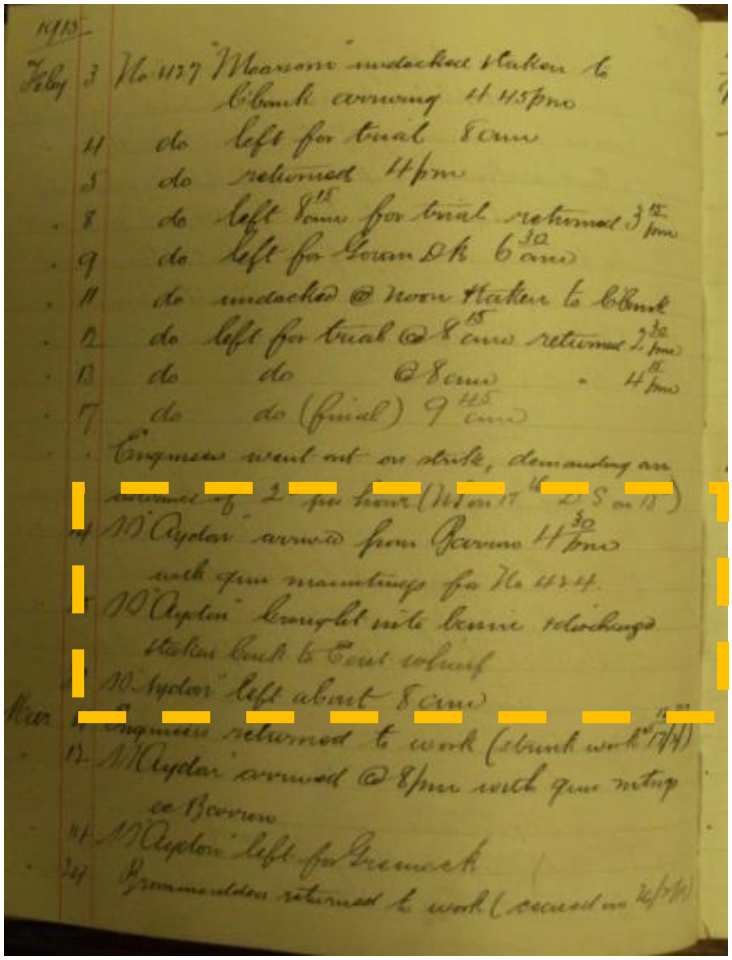
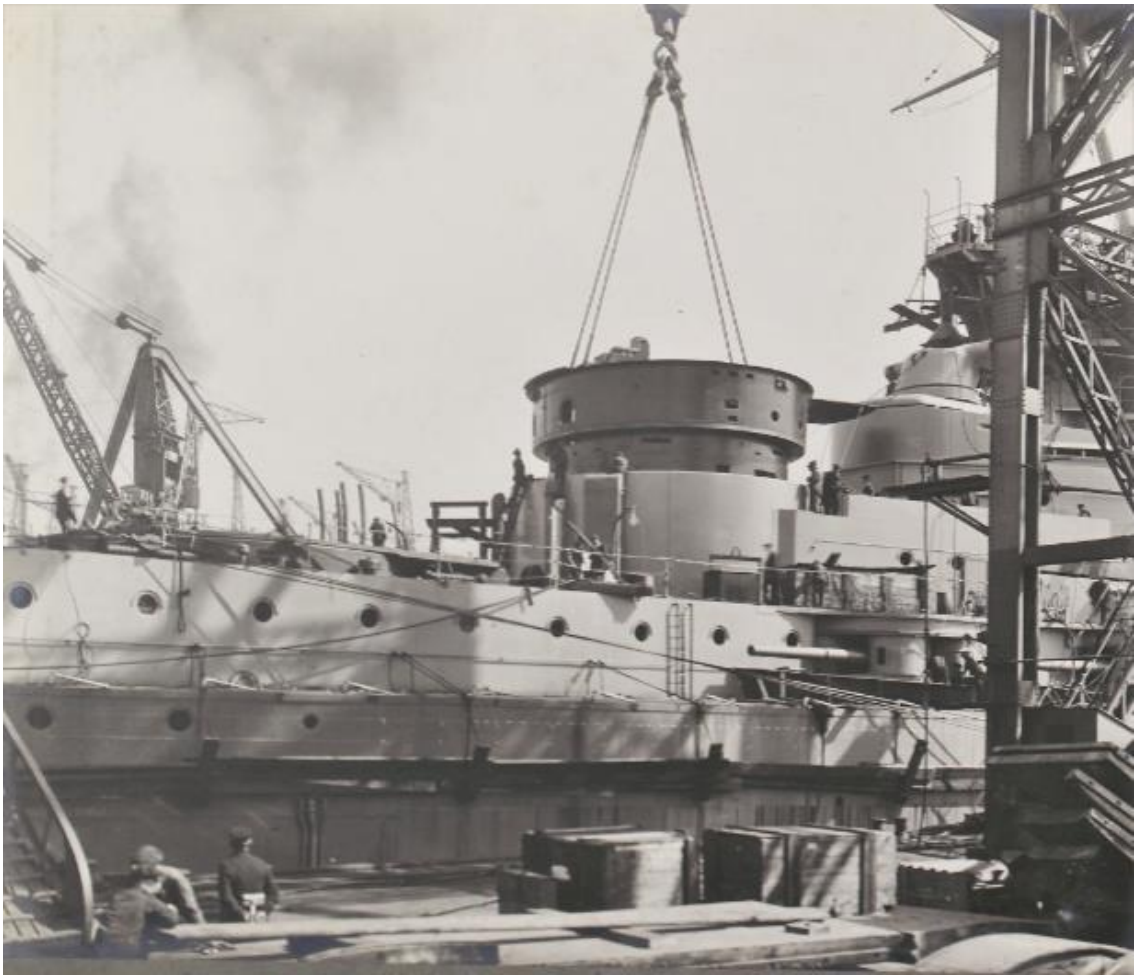


Figure 7.26 – July 24/28 1915, SS Aydon arrives with gun mountings for No. 424 (HMS Barham.) – text reproduced below:

24	SS "Aydon" arrived with gun mountings for No. 424.
28	SS "Aydon" left about 8am.

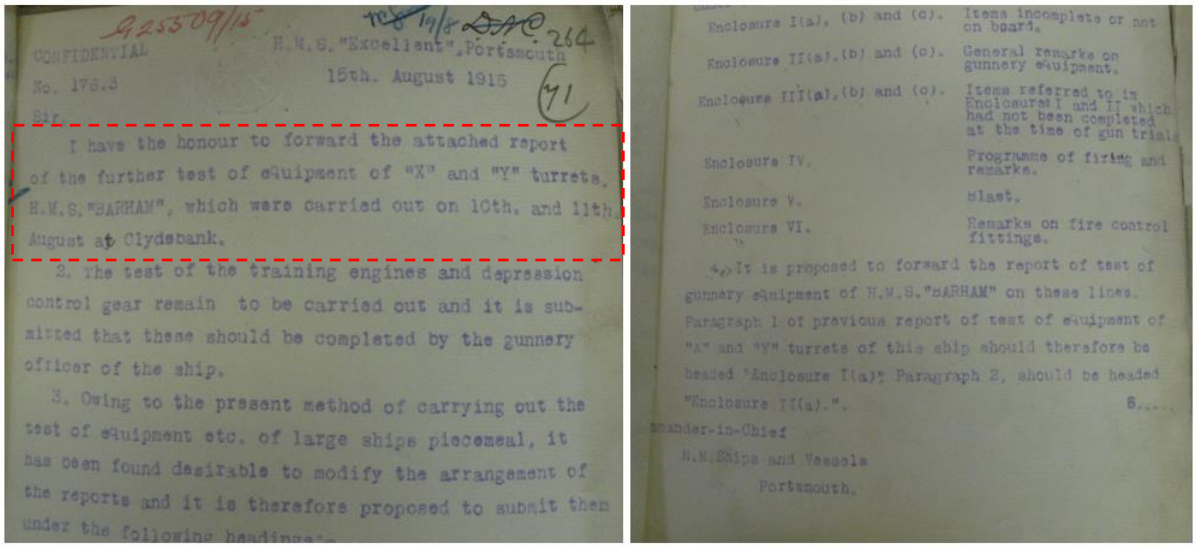
Photograph 7.4 below, shows the barbettes being fitted to HMS Barham. Mounted on these would have been the fifteen-inch guns in four twin gun turrets. B barbette would have been the second from the bow.



Photograph 7.4 - June 16th 1915 turntable for B Barbette being fitted to HMS Barham

Gunnery trials followed and show the only evidence of trials for HMS Barham that was found. These do however take the form that would be expected today, namely a pre-specified test, a report on that test and corrective action as necessary.

Figure 7.27 shows the test report covering letter for the main gun turrets on board HMS Barham.



CONFIDENTIAL
No. 176.3
H.M.S. "Excellent", Portsmouth
15th. August 1915

Sir,

I have the honour to forward the attached report of the further test of equipment of "X" and "Y" turrets, H.M.S. "BARHAM", which were carried out on 10th. and 11th. August at Clydebank.

2. The test of the training engines and depression control gear remain to be carried out and it is submitted that these should be completed by the gunnery officer of the ship.

3. Owing to the present method of carrying out the test of equipment etc. of large ships piecemeal, it has been found desirable to modify the arrangement of the reports and it is therefore proposed to submit them under the following headings:-

Enclosure I(a), (b) and (c).	Items incomplete or not on board.
Enclosure II(a), (b) and (c).	General remarks on gunnery equipment.
Enclosure III(a), (b) and (c).	Items referred to in Enclosures I and II which had not been completed at the time of gun trials
Enclosure IV.	Programme of firing and remarks.
Enclosure V.	Blast.
Enclosure VI.	Remarks on fire control fittings.

It is proposed to forward the report of test of gunnery equipment of H.M.S. "BARHAM" on these lines. Paragraph 1 of previous report of test of equipment of "X" and "Y" turrets of this ship should therefore be headed "Enclosure I(a)"; Paragraph 2, should be headed "Enclosure II(a).".

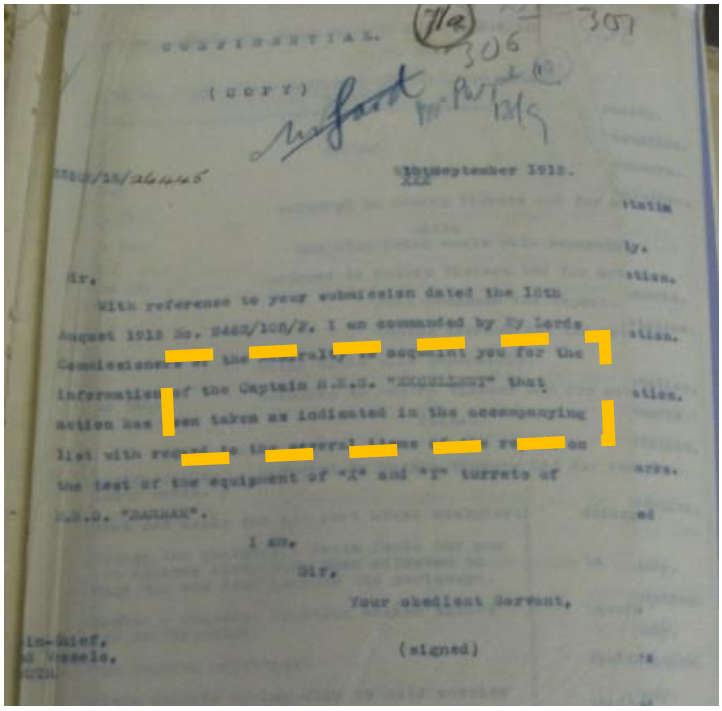
S.....

...mander-in-Chief
H.M. Ships and Vessels
Portsmouth.

Figure 7.27 – HMS Barham – Gunnery test report - text reproduced below:

I have the honour to forward the attached report of the further test of "X" and "Y" turrets, H.M.S. "Barham" which were carried out on 10th and 11th August at Clydebank.

By 10/9/15 corrective action had been taken as evidenced in the follow up to the Gunnery test shown below at Figure 7.28, which comes from a larger report. The full report addresses the issues found in the test and details what was done to correct the issues found.



CONFIDENTIAL.
(COPY)

...September 1915.

Sir,

With reference to your submission dated the 15th August 1915 No. 2463/106/7, I am commanded by My Lords Commissioners of the Admiralty to acquaint you for the information of the Captain H.M.S. "EXCELLENT" that action has been taken as indicated in the accompanying list with regard to the general items of report on the test of the equipment of "X" and "Y" turrets of H.M.S. "BARHAM".

I am,
Sir,
Your obedient Servant,

(signed)

Figure 7.28 – HMS Barham – Gunnery test correction report - text reproduced below:

I am commanded by My Lords Commissioners of the Admiralty to acquaint you for the information of the Captain of H.M.S. "Excellent" that action has been taken as indicated in the accompanying list with regard to the several items of the report on the test of the equipment of "X" and "Y" turrets of H.M.S. Barham.

It was shortly after the Gunnery tests that HMS Barham left for the 'Tail of the Bank.' The 'Tail of the Bank' was, and is still, an area of the Clyde which offered relatively deep water and was where ships would anchor as they waited to come into the yards for a refit or wait before going out to sea to undertake the sea-worthiness tests which new ships generally underwent. The Tail of the Bank refers to the last in a chain of sandbanks from Dumbarton to Greenock which offers particularly good anchorage, other parts of the river between Dumbarton and Glasgow having been heavily silted for many years. A view of the 'Tail' is shown in the postcard below from around the time of HMS Barham (Figure 7.29):

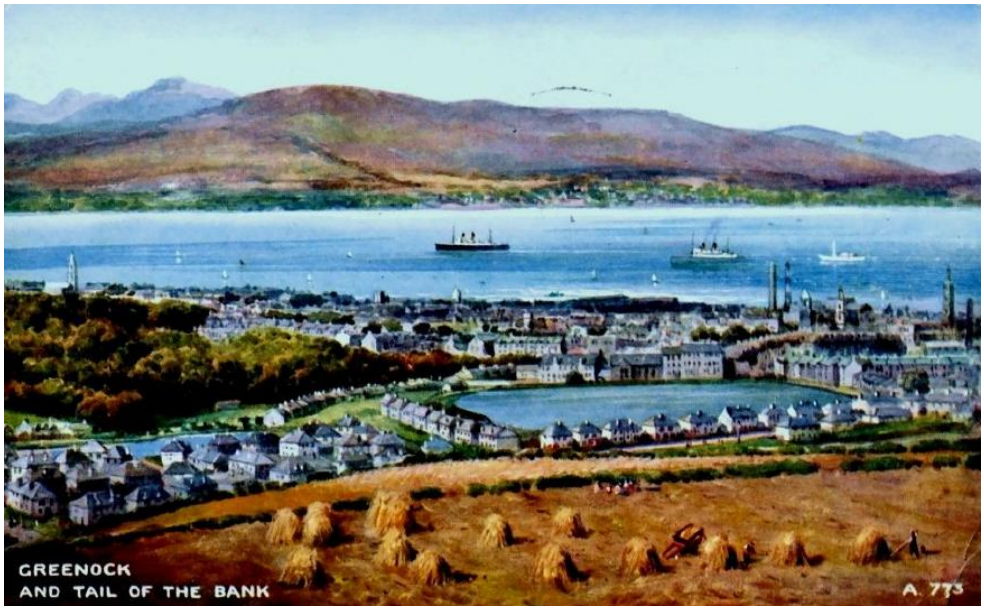


Figure 7.29 – A view of the Tail of the Bank

The Admiralty signed-off the form agreeing the particulars of the Barham 'as built' on the 28th September 1915. The document at Figure 7.30 shows that both sides signed to say that the particulars of the ship were as stated on, what is in effect, a sign-off / acceptance certificate for the project.

The document is headed 'this form is to be rendered on the completion of …. shipbuilding'. This completed sign-off comes just eighteen days after the

gunnery tests findings were resolved and in advance of the Oct 1915 delivery date that the Admiralty were expecting (see Figure 7.31.)

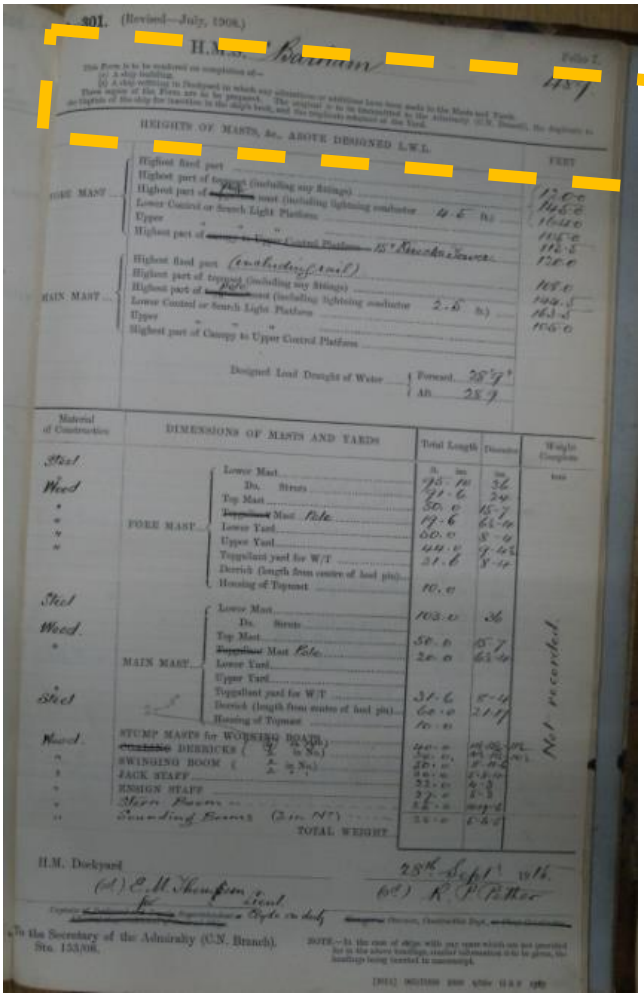


Figure 7.30 – HMS Barham's completion of build certificate – text reproduced below:

H.M.S. Barham

This form is to be rendered on completion of

(a) Ship building

(b) A Ship refitting in a dockyard in which any alteration or addition has been made.....

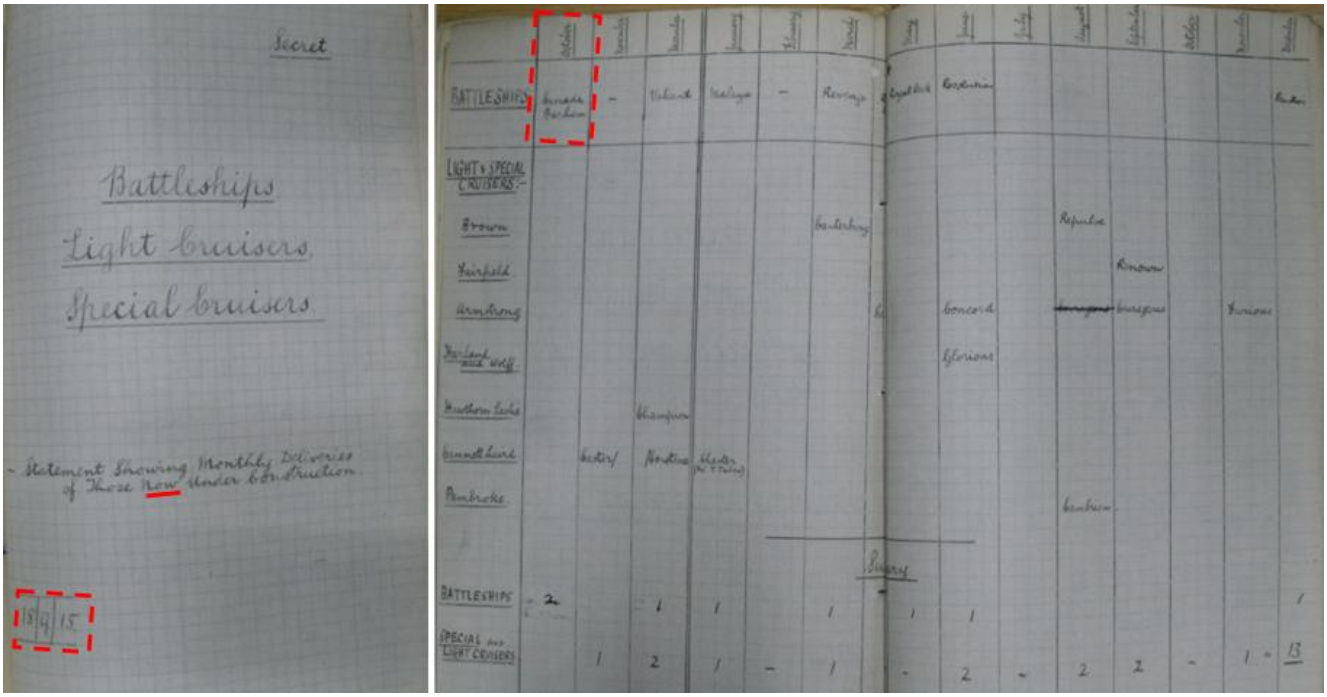
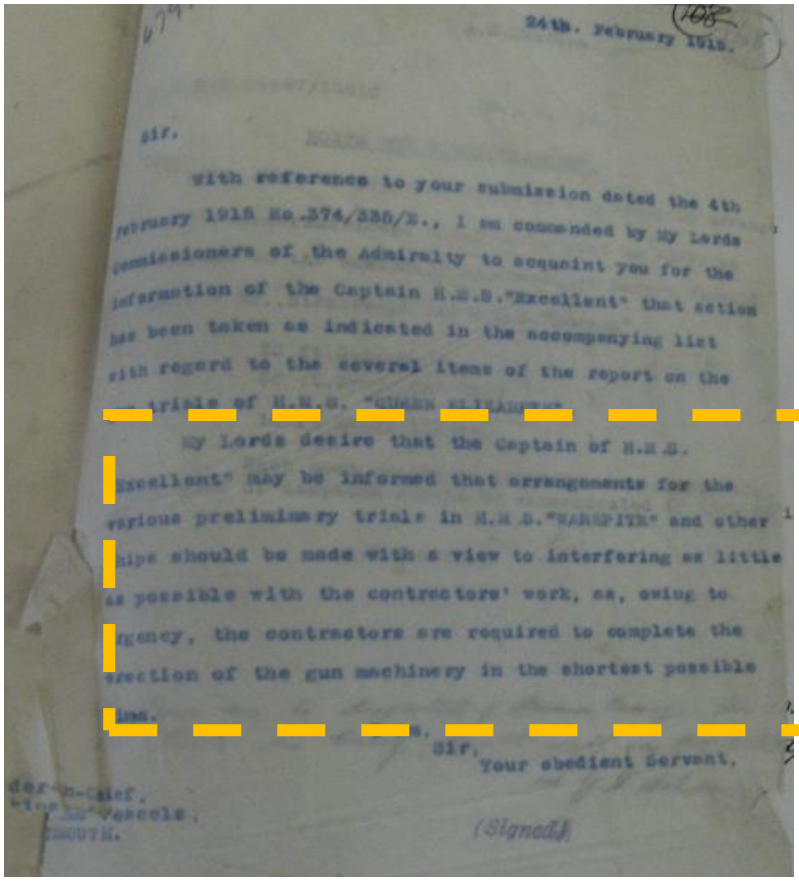


Figure 7.31 – Admiralty expectations of new ships – a ‘Delivery Milestone Chart? (HMS Barham highlighted)

The 18/9/15 date highlighted in the bottom left of Figure 7.31, is later than the date of 31st Jan 1915 shown in the bottom left hand corner of Figure 7.13, indicating that there were some time delays during the build and hence some time pressures were experienced. This is supported by the highlighted section of the letter dated 24/2/15 below at Figure 7.32:



24th. February 1915.

Sir,

With reference to your submission dated the 4th February 1915 No.374/330/E., I am commanded by My Lords Commissioners of the Admiralty to acquaint you for the information of the Captain H.M.S."Excellent" that action has been taken as indicated in the accompanying list with regard to the several items of the report on the [illegible] trials of H.M.S. "[illegible]".

My Lords desire that the Captain of H.M.S. "Excellent" may be informed that arrangements for the various preliminary trials in H.M.S."WARSPITE" and other ships should be made with a view to interfering as little as possible with the contractors' work, as, owing to urgency, the contractors are required to complete the erection of the gun machinery in the shortest possible time.

I am, Sir,
Your obedient Servant,

(Signed)

Figure 7.32 – Admiralty request to speed trials up as much as possible – text reproduced below:.

> My Lords desire that the Captain of H.M.S. "Excellent" may be informed that arrangements for the various preliminary trials of H.M.S. "Warspite" and other ships should be made with a view to interfering as little as possible with the contractors' work , as, owing to urgency, the contractors are required to complete the erection of the gun machinery in the shortest possible time.

If it were inferred, in Figure 7.32, where ship's captains are asked not to 'interfere' with ship's trials owing to the urgency the contractors are required to complete the gun machinery in the shortest possible time, that quicker trials would be less thorough and hence potentially result in a slightly inferior product, then this is clear evidence of the 'iron triangle' of project trade-offs between two elements of the time, cost and quality triangle which Barnes developed in 1969, (Vahidi and Greenwood, 2009). The extent to which the Admiralty were willing to trade off trials for a quicker delivery date is perhaps behind the difficulty found in identifying records of Barham's sea trials in any of the archives. Whilst they are there for other ships within the covers at the Brass Foundry none were found for Barham. This may simply be because they were produced in a 'lite' format, or entirely by-passed, or simply just not

preserved. There is anecdotal evidence from the Spectator (1967) that there was indeed not a full set of trials carried out on Barham. Relating a story told to him by his late brother, the account tells that the brother who worked at John Browns, ‘thought that HMS `Barham' was likely to prove superior to HMS 'Queen Elizabeth.' But there was no trial trip for the 'Barham,' as it had to be got ready to join the Grand Fleet in a hurry’. Even as in today’s projects, the trials or acceptance testing part of the project can become squeezed if time is short. It was an effort however, not unappreciated by the Admiralty, as the example of a congratulatory Admiralty letter at Figure 7.33 below shows:

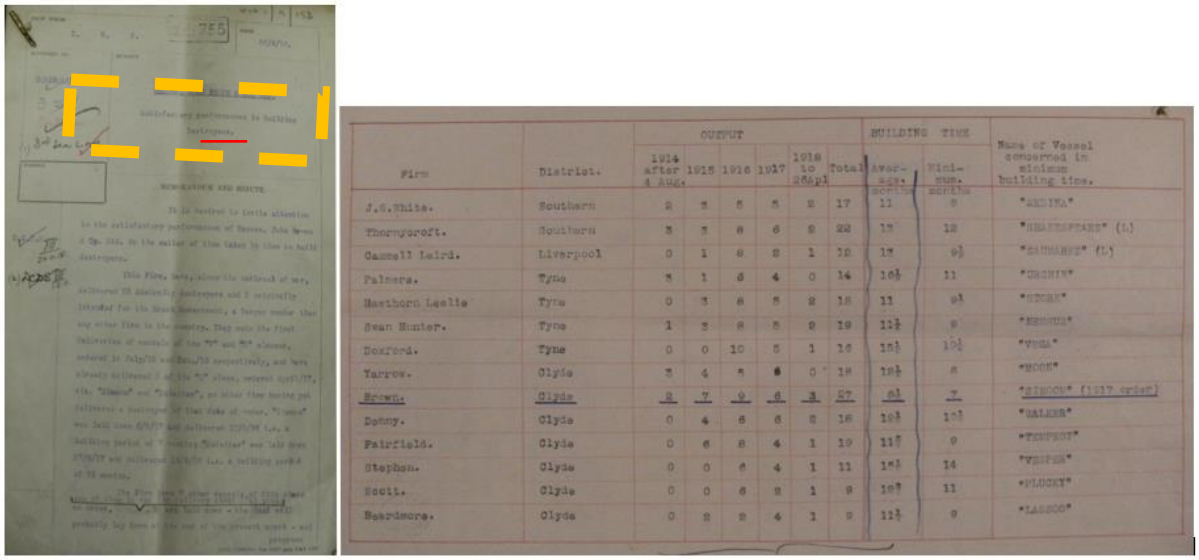


Figure 7.33 – Letter from the Admiralty to John Brown & Co. congratulating them on their war efforts – highlighted text reproduced below.

> It is desired to invite attention to the satisfactory performance of Messrs. John Brown & Co. Ltd. in the matter of time taken by them to build destroyers.

The Figures above demonstrate a number of key project management behaviours. Management of quality (Figures 7.27 and 7.28), human resources (Figures 7.9 and 7.25), leadership (Figure 7.10 and 7.12), organisational structure (Figures 7.9 and 7.10) and information systems (Figure 7.22) are all present in the records found for HMS Barham. Potentially Figure 7.25, a letter discussing Admiralty payments for accelerating the rate of work, could claim to be risk management since it identifies a risk, that of late delivery, and proposes a costed solution. It is not

however a Risk Log as we would recognise it today but it is addressing a similar issue, that of possible non-achievement of objectives.

The timeline at Figure 7.8 follows the order of events that a modern-day project would. It has an orderly progression from design – manufacture – test – delivery which is very much equivalent to the four phases of the APM's project lifecycle - concept / definition / deployment / transition, (see Figure 7.51). The timeline also shows clear evidence of sign-off or agreement of the outcome/ output of each phase. Items such as Figure 7.23 'Barham Delivered', Figure 7.30 'Barham signed-off on completion' are also accompanied by discussions on design, and the testing completed. All of these 'agreements' represent the formal end of one of the four lifecycle phases above and would have authorised the transition into the next phase of construction.

The results detailed above are, of course, only part of the activity involved in constructing HMS Barham, there was much additional work that needed to be completed. Some of this, where the records themselves are missing, is recorded in the Director's minute books, and the Shipyard Diaries. This is shown in Figure 7.34 where it applies directly to the construction of HMS Barham. The diagram suggests evidence for a busy period once the Hull and Machinery were complete and evidences the fact that the guns and mountings were brought in from a third-party manufacturer.

1909
1909 Instructions to the Professional Officers of HM Shipyards ...relating to the Professional Duties of their Departments
Need for secrecy re design established
5-6 1912
estimates for Barham showing delivery date of 30-1-15
22-10-13
Contract awarded for steering gear & installation date of 15/11/13 given
3-1-13
Drawings rec'd for Barham at John Brown from RN constructor
20-6-13
Berth No. 3 being prepared for HMS BARHAM
18-12-12
Tender acceptance – delivery to be 27 mths from receipt of drawings
2-5-13
Figure 7.34 – network display of construction of HMS Barham overlaid with Shipyard info.
Records from the National Archives, Kew
Records from the G.U. Scottish Busn. Archives
Records from the Brass Foundry Archives
1912
1913
1914
1915
1916
11 12 01 02 03 04 05 06 07 08 09 10 11 12 01 02 03 04 05 06 07 08 09 10 11 12 01 02 03 04 05 06
Men borrowed for on Tiger gone back to Barham SEPT 28 1914
Barham launched at noon to enable men to watch. DEC 31 1914
Barham to be accelerated to complete summer 1915 OCT 27 1914
HMS Barham launched
31-12-14
Barham moved along dock wall to ship foremast. JAN 17 1915
Barham moved along dock wall to ship turbines. JAN 21 1915
Barham given precedence for 15" guns & mountings. JAN 26 1915
SS Aydon arrives with A & B gun mounting for Barham. JUNE 4 & 14 1915
Gunnery Tests – corrective action taken & reported
10-9-15
ADM letter congratulating John Brown on best 'Av build and min build ' times.
20-4-16
SS Aydon arrives with Y & X gun mounting for Barham. FEB 24 MAR 12 1915
HMS Barham commissioned in the dock AUG 18 1915
28-9-15

7.4 Essence of Project Management narrative presentations

Two narratives were written. The first narrative was written drawing from the free text comments from the naval PMs who participated in the Main Study. This narrative is discussed in this section. The second narrative focused on the question of whether or not it was possible to undertake historical project research and the challenges that the researcher might face in doing this. This was compiled using the experience gained researching this study, and is discussed in Section 7.5.

7.4.2 Narrative from the Naval PMs

The free text comments from the PMs were collected from the focus groups using the list of questions shown at Appendix 6.5 The comments from these groups were collated in Appendix 6.11 and are discussed here in light of what they reveal about each of the slides viewed by the PMs and hence the nature of the management process of constructing HMS Barham. The slides shown to the group of naval PMs form the back bone of this narrative and draws on the comments made and recorded on Appendix 6.11.

The first slide (Figure 7.35) reviewed was:

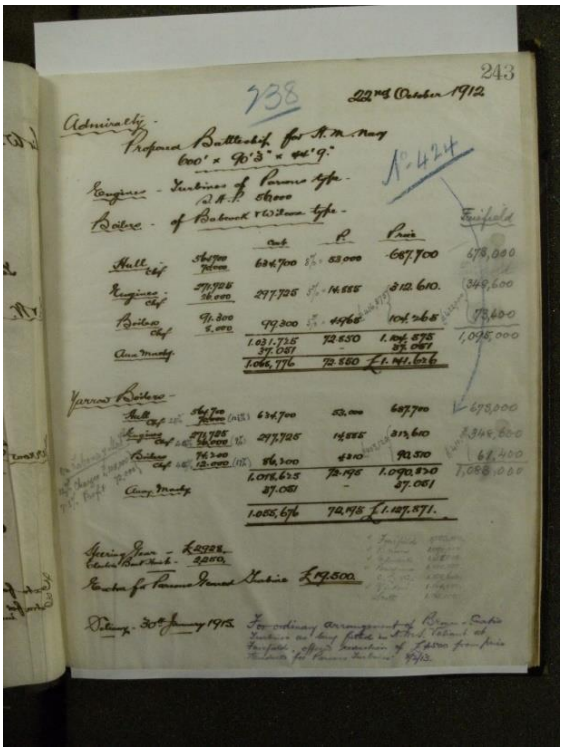


Figure 7.35 Slide from File UCS 1-74--6

(When viewing the documents shown at Figures 7.35 to 7.50 the source file is given, see Appendix 6.2, which details where the document was found, The UCS files came from the John Brown archive while the Brass Foundry files show detail found in the Ships Covers.)

In the following Figures 7.35 – 7.50, the bullet points detail the comments received, from the respondents, in relation to the Project Management function served by each slide. The salient points have been highlighted in red italics and underlined in each set of bullet points. The red highlights have then been summarised in the review sentence that immediately follows the bullet points. The comments from the PMs were as follows:

- This is an early, high level *estimate* that pulls in past performance information, known *costs* and potentially historic (norms) for hull, engineering etc.
- Appears to be an initial breakdown of *costs* but difficult to determine any true linkage to a project concept except for initial *cost estimate* linked to previous build of another ship therefore an element of learning from experience.

- This is base *estimates*- setting expected *budget* and expectations. Decisions would be based on that accordingly and monitored against.
- The slide shows evidence of *costing* for the build of building a ship *using previous figures* from historic builds.

The comments show a strong level of commonality highlighted above, and would support the slide as evidence of costs, costings and estimates based on prior experience.

The second slide (Figure 7.36) reviewed was:

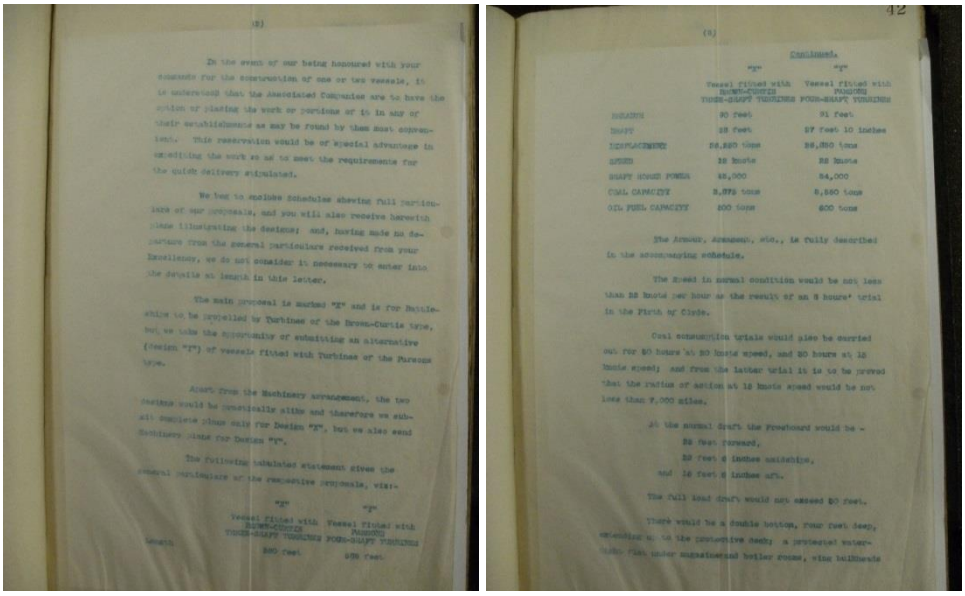


Figure 7.36 Slide from File UCS 1-13-1

- Assuming that the letter is responding to a 'specification' / Tender request then this response is *informing a requirement* that was set by the 'Wider System' in this case the Admiralty.
- The document provides an initial overview of performance in terms of what the output will achieve. An *element of design* is covered and appreciation of *what the solution will provide.*
- This is a *response to Tender*. They're offering a *potential solution* which is as Industry do today. Limited detail but enough to *set expectations*. Costings would then feed their forecasts.
- The tender response sets out the *expectations of its deliverable* to the project team, and the wider system, it defines exactly the *performance output* of the deliverables and provides 2 options. These

options can then be used by the system to decide the option the project will select.

The responses to the slide talk about the setting of expectations or requirements and setting out possible solutions and outputs.

The third slide (Figure 7.37) reviewed was:

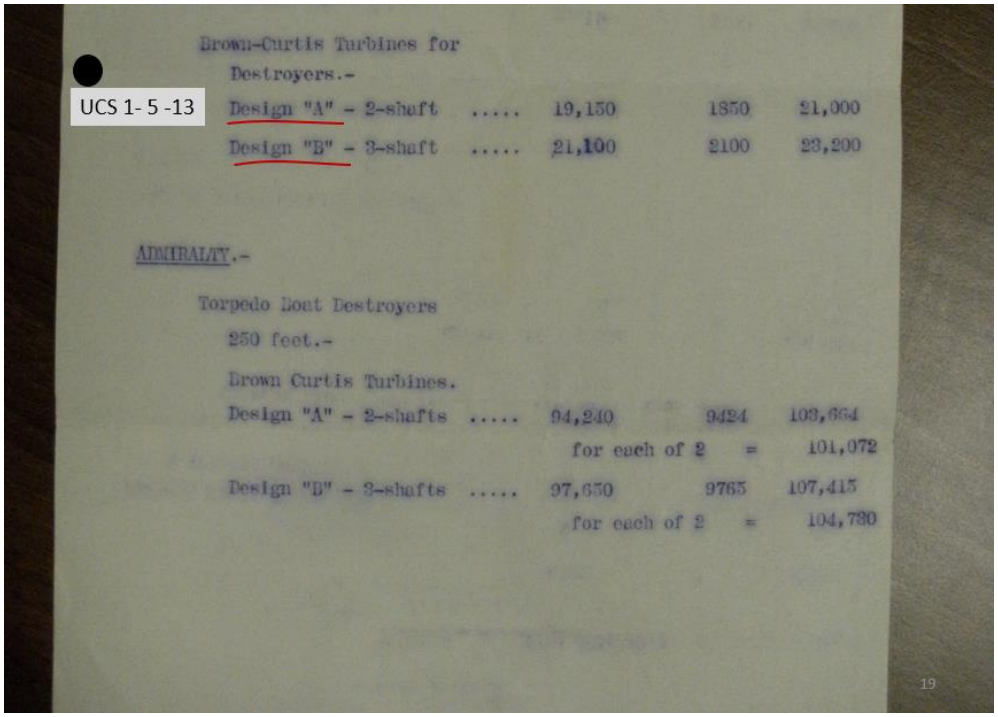
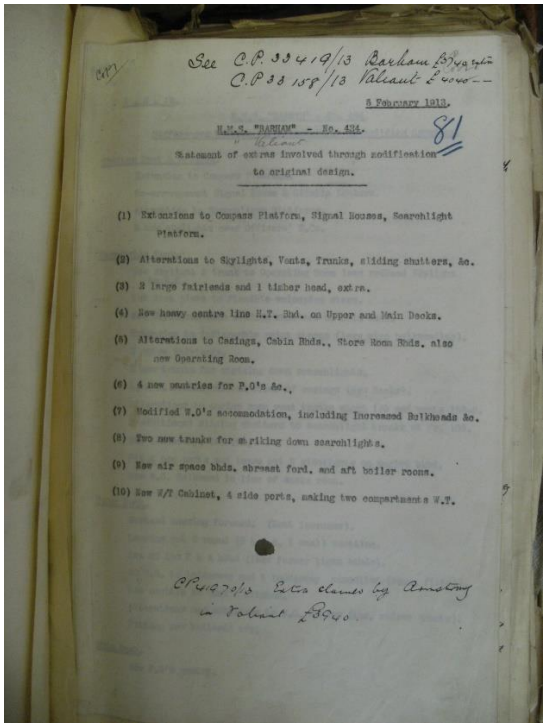


Figure 7.37 Slide from File UCS 1-5-13

- There is an element of formulating an *initial design* in that there appears to be two options to down select from.
- This is capturing *requirement options* – providing detail/ options on the design in order for the Admiralty to make a decision. A quotation received which would feed the costings, included expected profit.
- The slide provides quotes for *2 options* against the build, design A and B offering 2 or 3 shafts. Although there are prices which influence decisions there are no performance metrics to justify the extra costs.

The comments highlight the emerging design and the option analysis between different possibilities. As one respondent points out, it is similar in purpose to the slide at Figure 7.35.

The fourth slide (Figure 7.38) reviewed was:


See C.P. 33419/13 Barham
C.P. 33158/13 Valiant

8 February 1913.

H.M.S. "BARHAM" - No. 434.
Valiant

81

Statement of extras involved through modification to original design.

(1) Extensions to Compass Platform, Signal Houses, Searchlight Platform.

(2) Alterations to Skylights, Vents, Trunks, sliding shutters, &c.

(3) 2 large fairleads and 1 timber head, extra.

(4) New heavy centre line H.T. Bhd. on Upper and Main Decks.

(5) Alterations to Casings, Cabin Bhds., Store Room Bhds. also new Operating Room.

(6) 4 new scuttles for P.O's &c.,

(7) Modified W.O's accomodation, including Increased Bulkheads &c.

(8) Two new trunks for striking down searchlights.

(9) New air space bhds. abreast fore. and aft boiler rooms.

(10) New W/T Cabinet, 4 side ports, making two compartments W.T.

CP 4979/13 Extra claims by Armstrong in Valiant £8940

Figure 7.38 Slide from File Br/Fndry DSCF 3510

- *Valiant is the baseline.* This is a list of '*extras*' now managed through Customer Led Change. This assumes a Standardised Class of Ship which can *be tailored* by the Admiralty (Control) against an initial design.
- Evidence of breakdown of components and uses *Learning from Experience (LFE) from previous Valiant* build in terms of cost and requirements.
- *Changes to design.* Reporting changes to initial Performance/ Quality.
- The document seems to be capturing the *design changes* on HMS Barham. The information is then *compared to a previous build HMS Valiant in a base-lining activity* to set expectations of costs against the project.

Here the document is adjudged to be part of the Learning from Experience (LFE) process, or through the comparison to baseline, the formulating of alterations required by the customer. It is noted that HMS Valiant was the baseline. Valiant was Barham's sister ship, built by Fairfields, the third in class whilst Barham was the fourth in class as discussed in Section 7.2.2. Valiant was only a few months ahead of Barham in terms of construction so any LFE would need to be incorporated quickly! The use of a baseline is an important feature of modern-day projects. Without the establishment of a baseline, variances cannot be tracked and so budgets, timelines, quality of output and change control cannot be managed effectively.

The fifth slide (Figure 7.39) reviewed was:

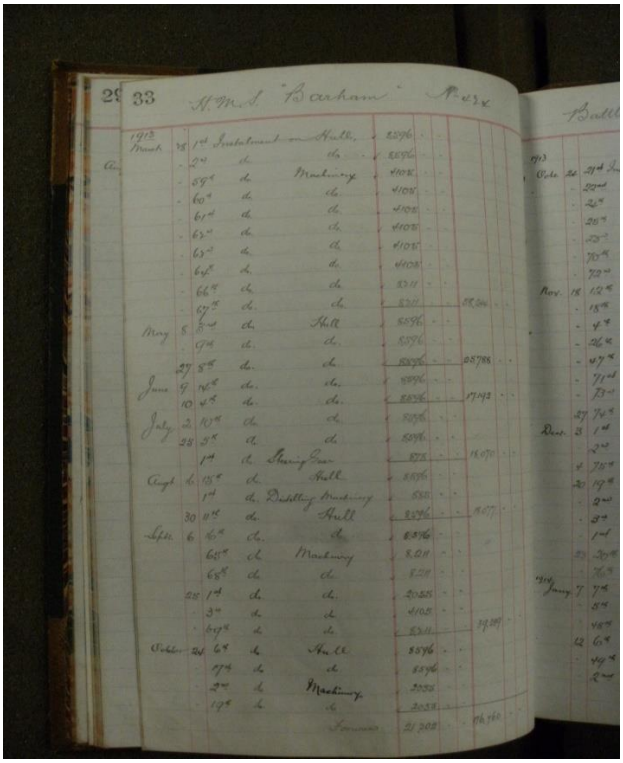


Figure 7.39 Slide from File UCS 1-61-2

- This appears to be a costed breakdown by category that has been developed as part of a *pricing schedule* to determine *cash-flow*.
- Appears to be some form of *cash flow ledger* but difficult to ascertain how this relates to an overall budget. There is some form of crude breakdown between hull and machinery.
- Reporting *payments against activities*, in a given timeframe/ period.

- Slide 1-61-2 appears to be a *cashflow / milestone payment plan*. This would be used to set expectations of cash flow within the project.

The over-riding opinion is that this document details cash-flow. If it is viewed as recognising cash-flow once it is received, then it becomes ‘payments against activities’. What it does show is a number of regular instalments to be made or made at certain times through the construction process. The regularity of the payments, in terms of the sums involved, would suggest that these amounts are contractual, and if agreed at the start could indeed be both ‘instalments to be made and instalments made’.

The sixth slide (Figure 7.40) reviewed was:

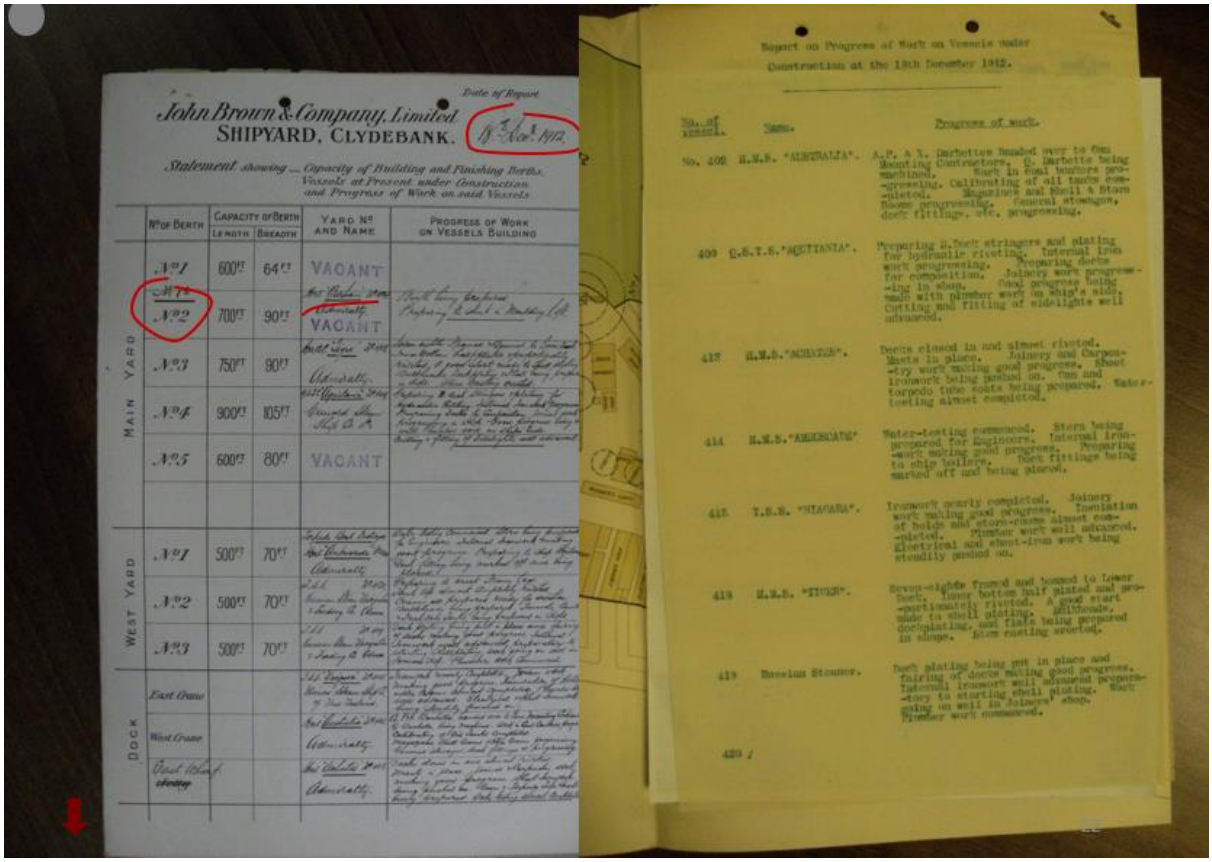


Figure 7.40 Slide from File UCS 1-5-11

- Identified movements, *progress* and *capacity* to undertake the work.
- *Planning* by John Brown evidenced in the documents and *scheduling.*

The comments received highlight progress reporting, capacity planning, planning in general and scheduling. The last of the comments above with

regard to planning is perhaps a little harder to see, but given the comments in respect of HMS Barham, ‘Berth being prepared. Preparing to start in the moulding loft’, there is clear indication about the sequencing of tasks and hence an indication of scheduling and planning.

The seventh slide (Figure 7.41) reviewed was:

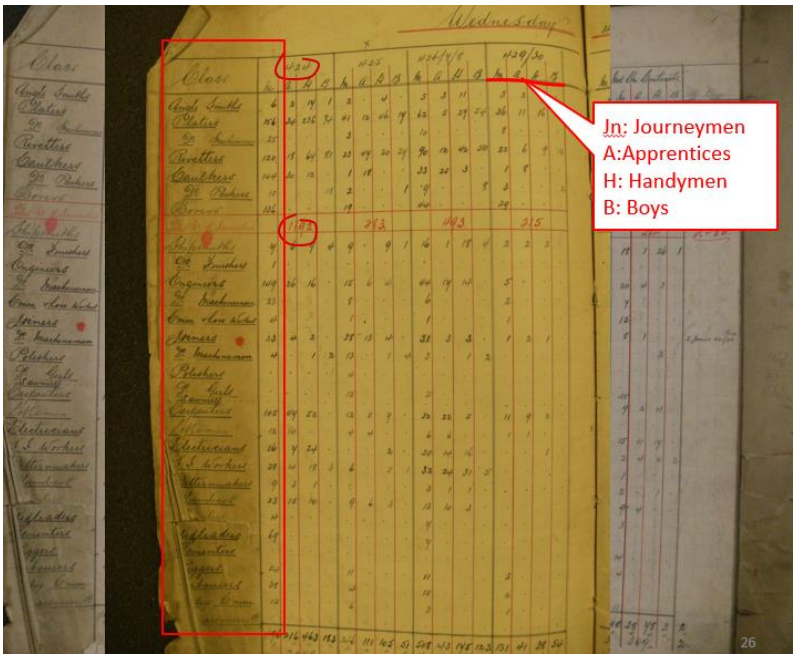


Figure 7.41 Slide from File UCS 1-59-1

- This ledger is effectively the ‘*actuals*’ Table of the cost model. This is *consistent with current practices* within shipyards which go on to inform their productivity metrics and actual reporting.
- Breakdown of time spent by each element of labour and therefore *resource consumed*. Assume an estimate would have developed that this was compared to.
- *Monitoring* hours – *Reporting* of.
- The document records the *cost of resources* used to build HMS Barham, captured on a weekly basis.

The consensus is that the document at Figure 7.41 shows the costs of the resources used in the construction of HMS Barham. Interestingly it is noted as still being a method used in today’s ship construction and the view is given that it could be used to produce performance metrics.

The eighth slide (Figure 7.42) reviewed was:

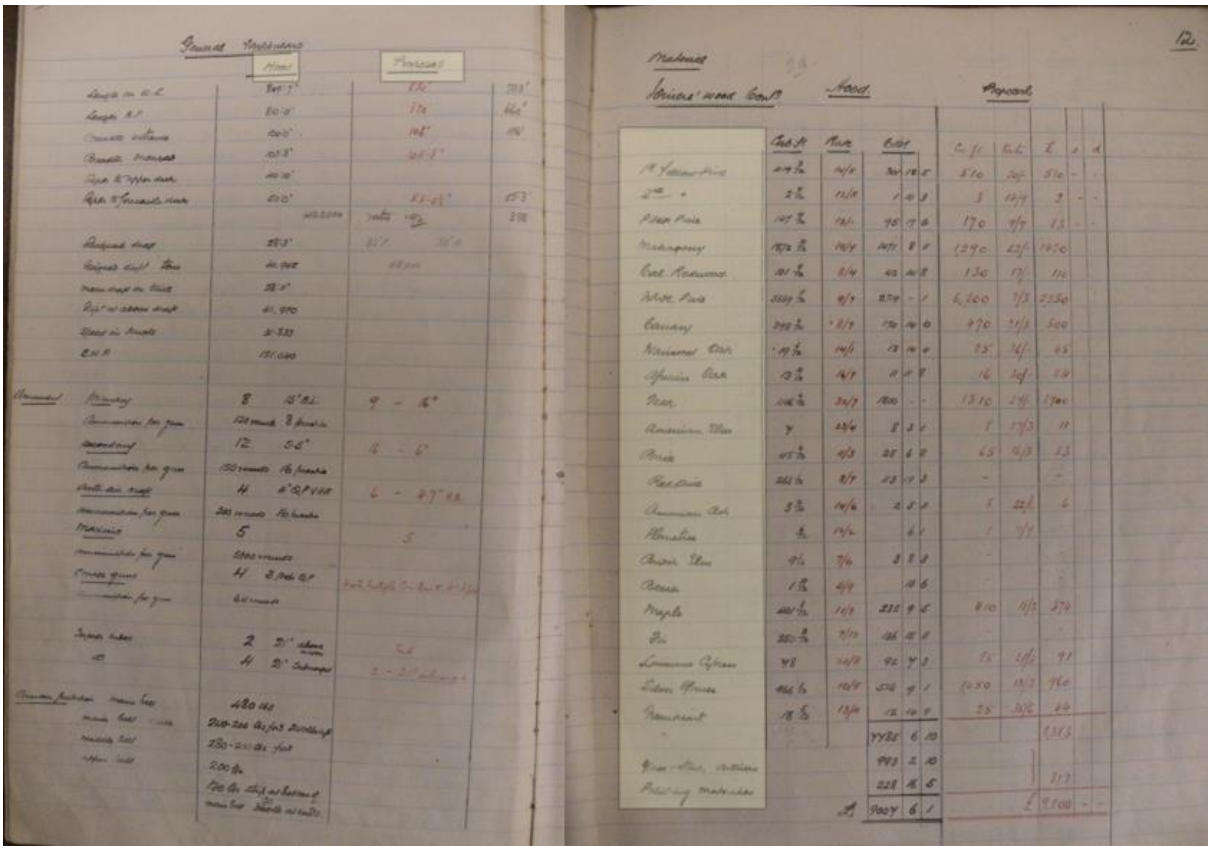


Figure 7.42 Slide from File UCS 1-85-3

- This is a cost model. It is *consistent with current approaches* – materials/ labour.
- Fascinating breakdown of *cost comparison* between HMS Hood and the proposed to provide an *analytical comparison*.
- The slide is showing they have used historic data to build on estimates of the current design, this would help to *understand costs* of the whole build and support on decision making/ cost cutting.

This slide again is highlighted as being 'consistent with current approaches'. Although there is no direct link to Barham, it does show that the John Brown ship yard had a process in place, around the time of the completion of Barham which used comparative, analytical estimating processes in order to cost new 'proposed' builds. (Comparative estimating is an estimating technique used today in Project Management where similar projects, one past and one proposed are compared in

order to provide cost estimates for the new project. To do this the differences between the projects must be understood and factored into the estimates. Analytical estimating is another estimating process used today and is considered to be the most accurate and most time intensive. It involves the bottom up calculation of costs, breaking the project down into its constituent elements and costing these parts individually before summing them, (APM, 2006).

The ninth slide (Figure 7.43) reviewed was:

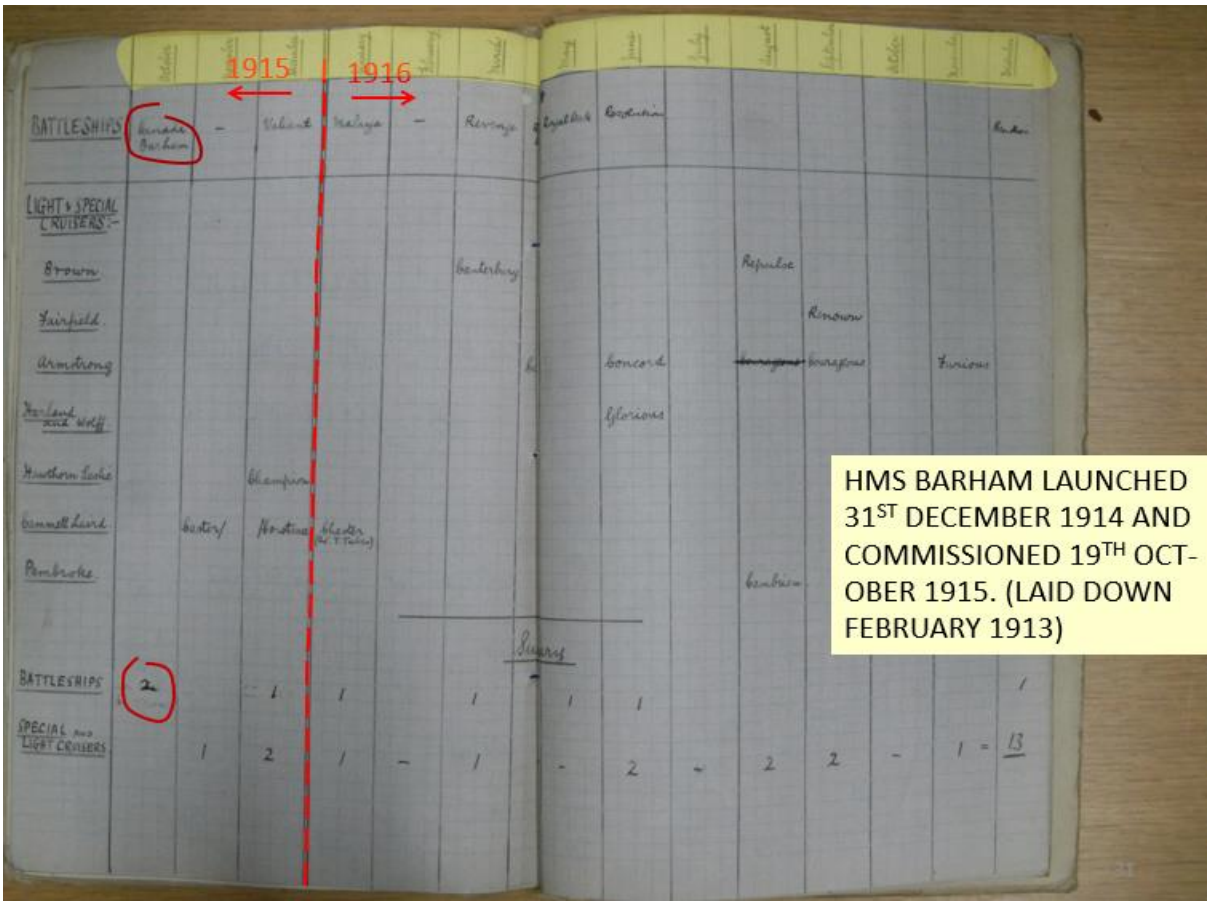


Figure 7.43 Slide from File ADM 1-8435-297

- *Forecasted ship delivery schedule*. Based on Admiralty requirement. Enables the Admiralty to plan their workforce / crew etc.
- *Planned dates* in a form of *crude schedule*.
- The document looks to be a *schedule of delivery* of warships, this would help to support training requirements and planning other areas of resource planning/ spend.

This slide gives an advance view of predicted ship delivery dates – crucial at a time when the Admiralty were calculating losses and gauging future fleet superiority. The respondents identify the document as a schedule, or crude schedule, and it does indeed bear similarities to a Gantt chart showing delivery milestones, with a time line across the top and details of individual delivery milestones on the vertical axis.

The tenth slide (Figure 7.44) reviewed was:

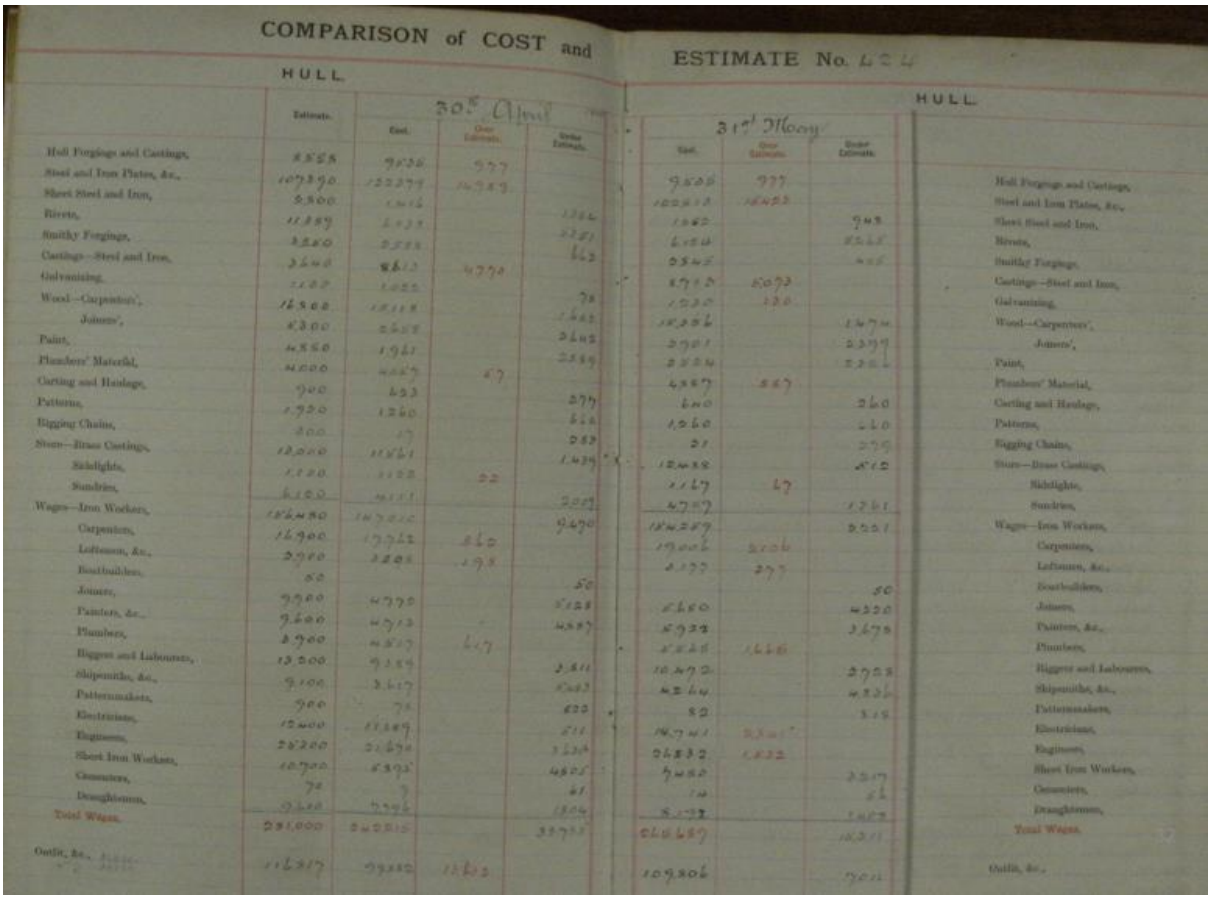


Figure 7.44 Slide from File UCS 1-86-9

- *Planned v. actual* view. Conducted on a monthly basis. Extremely consistent with current processes within ship-building.
- Fascinating depiction of *cost v. estimate* and description of any variance which would have been helpful.

The comments reveal a consistent view of the purpose of the document – the monitoring of spend against the estimated amounts or budgets. The variance would have enabled the yard to predict any over or under

spend, and perhaps to have justified or facilitated any transfer of monies between different parts of the build. Perhaps the most interesting observation though is that the process continues in a very similar manner through to this day.

The eleventh slide (Figure 7.45) reviewed was:

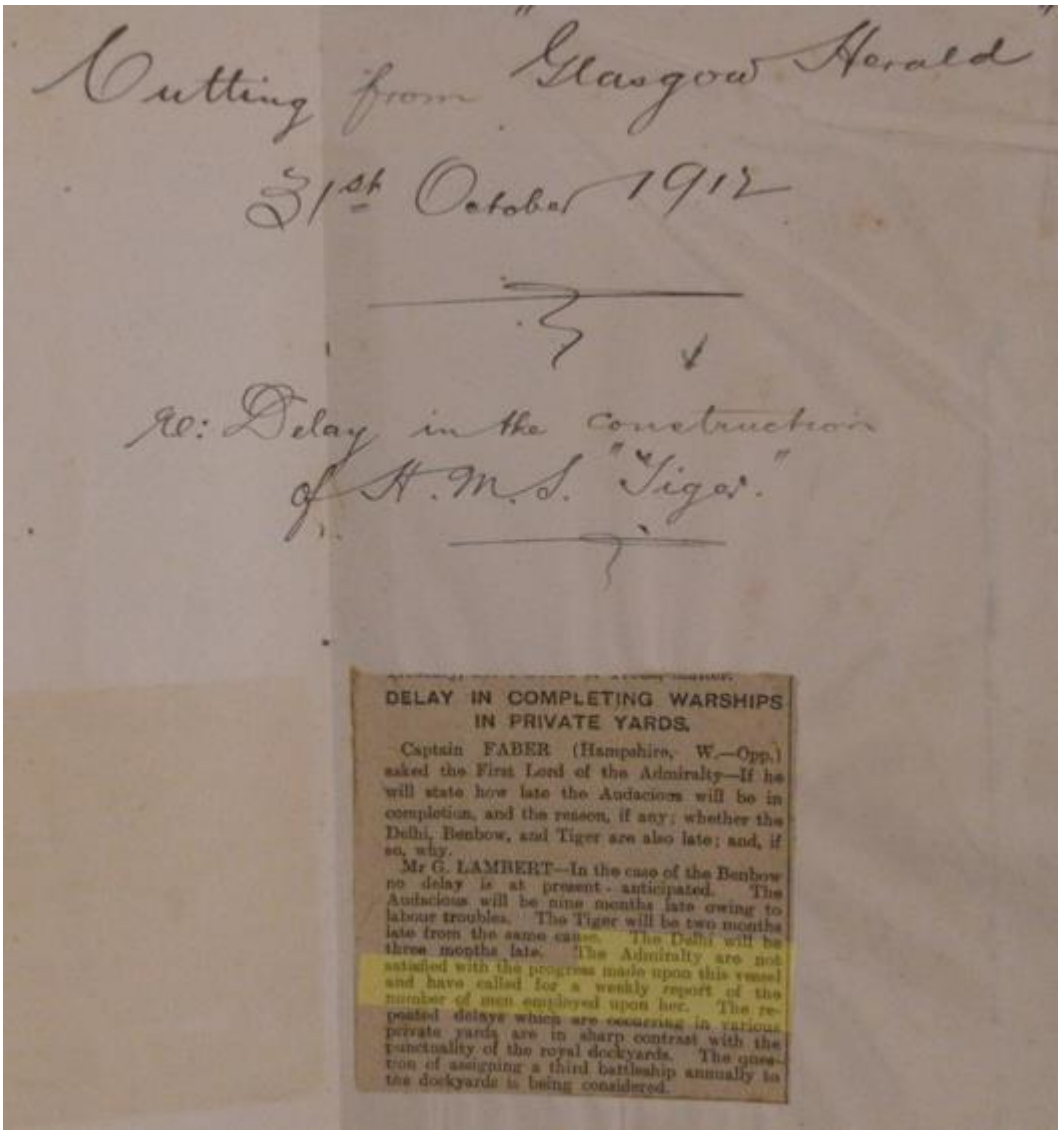


Figure 7.45 Slide from File UCS 1-64-1a

This slide attracted no comments from the respondents except for ‘n/a’. This was an interesting response as the newspaper cutting relayed news of delays to the completion of ships. It states that the Admiralty were not happy with the progress being made and had requested a weekly report on ‘the number of men employed upon her.’ Clearly this suggests the

establishment of a new form of progress reporting, but it is not direct evidence of the process, merely reporting of the issue. A nil response from the PMs is evidence that the PMs understood what they were being asked to look for and that it was the process itself that was at the core of the study rather than the story around the construction. The purpose of including the slide amongst the presentation pack was to test whether or not the process of analysis had been adequately explained and so the 'nil response' was reassuring.

The twelfth slide (Figure 7.46) reviewed was:

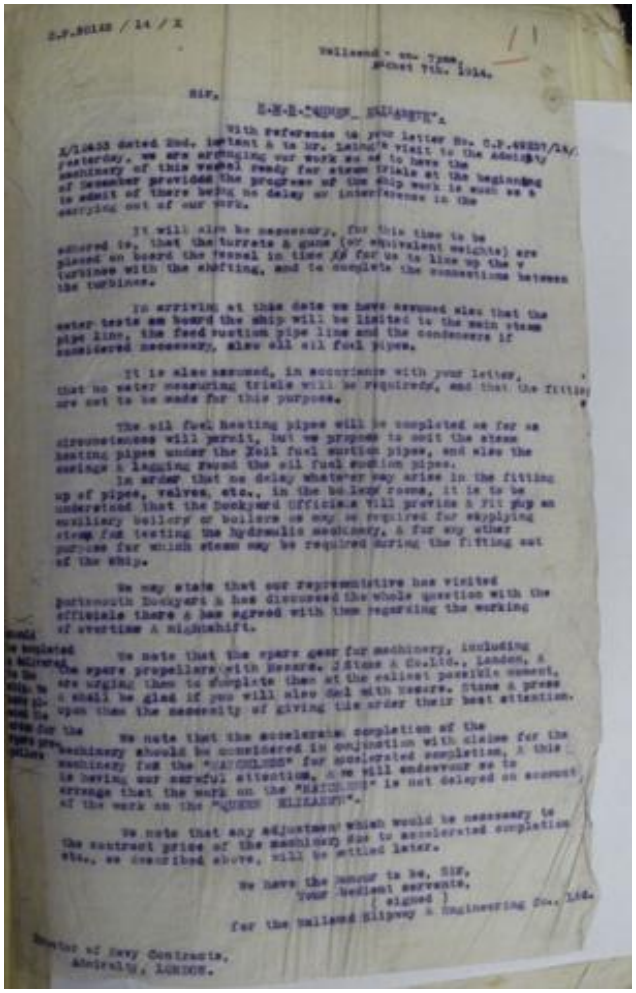


Figure 7.46 Slide from Br/ Fndry File DSCF 3626

- Letter essentially changes acceptance and contract terms as an instruction, *compromising on quality*
- *Decision making* is linked to the *need to get into service* to meet deployment needs.

- The *decision* has been made that the completion of the build *must be completed at whatever cost* (crashing with resource) due to the start of WWI which was driving the decision behind this.

All the comments above highlight the need for the Admiralty and contractors to use the trade-off between quality and time to make decisions about how the production of the ship is completed and which of the Time, Cost, Quality parameters is the most important.

The thirteenth slide (Figure 7.47) reviewed was:

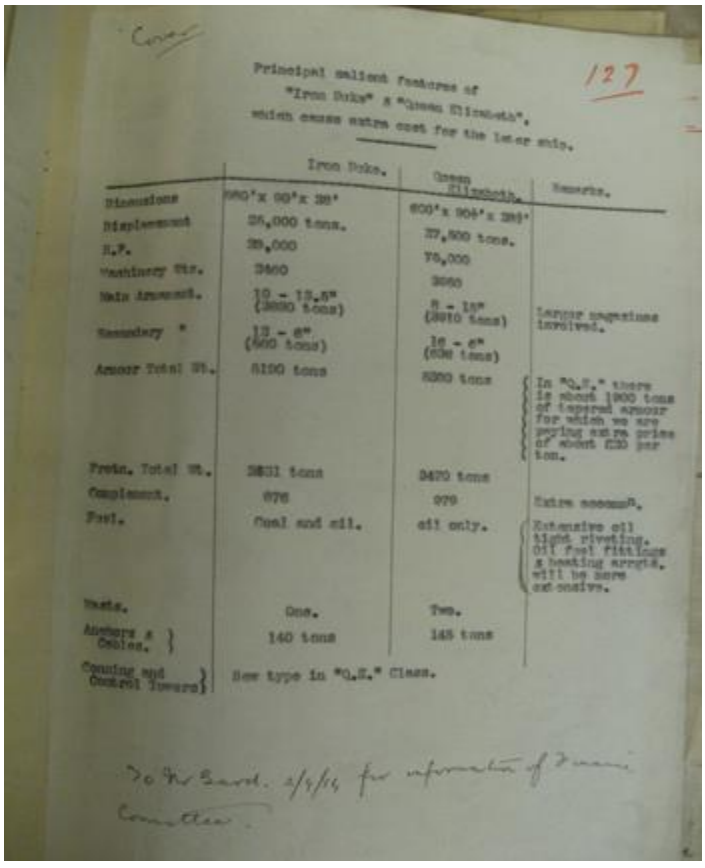


Figure 7.47 Slide from Br/Fndry File DSCF 3595

- See DSCF 3510 Comparison of differences. Could be extrapolated to view risk areas.
- Same as DSCF 3510.

The respondents considered this slide to be evidence of change control and its link to cost increases. DSCF 3510 (Figure 7.38) was considered to be similar in terms of the information it both considered and provided

in that it listed the design changes that HMS Barham underwent and related them to the costs incurred.

The fourteenth slide (Figure 7.48) reviewed was:

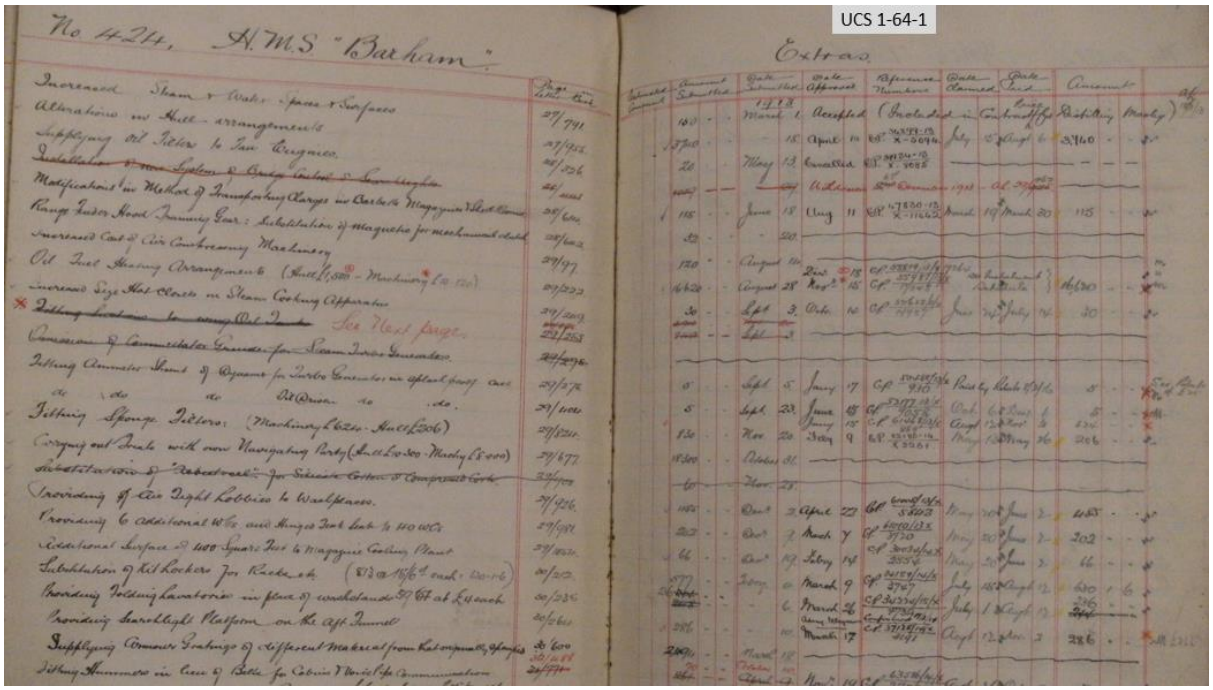


Figure 7.48 Slide from File UCS 1-64-1b

- *Change Control* Log
- *Change Control* documentation
- The document appears to be a *change log*, recording any additional cost incurred when building the ship.

This document was clearly thought to be evidence of a Change Control Log. It describes the nature of the change and details the estimated costs of making the change, dates when the change was approved and when the change was invoiced for and paid. In terms of a modern Change Control document, it lists the nature and cost of the change but does not evaluate the benefit of the change and whether or not, or by how much it exceeded the costs. What it does evidence though is the costing and invoicing element of change control.

The fifteenth slide (Figure 7.49) reviewed was:

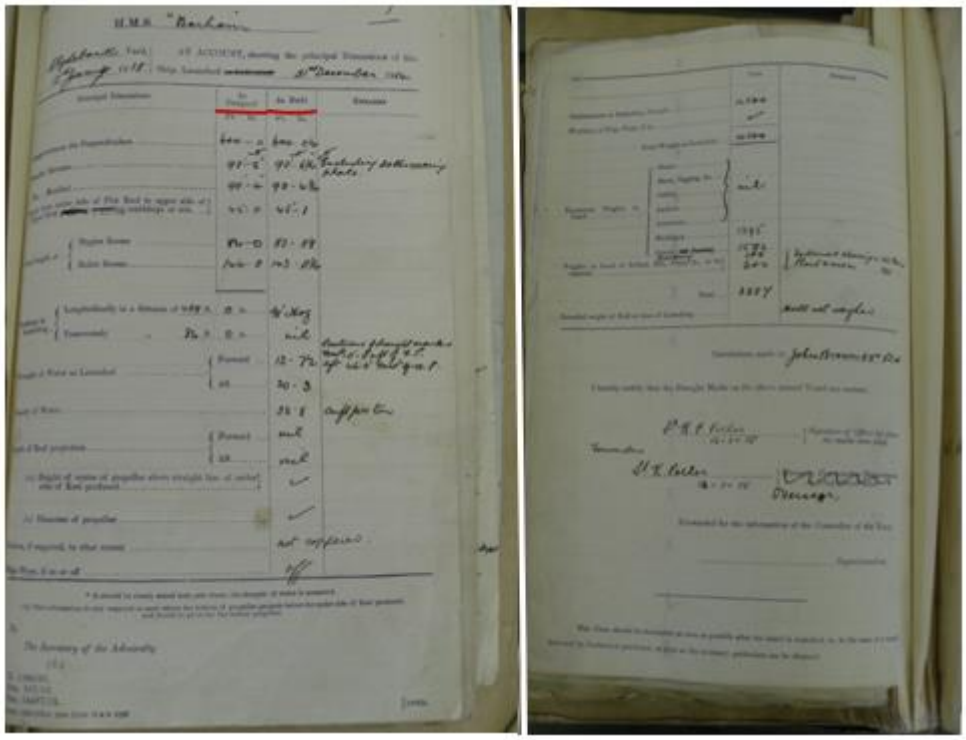


Figure 7.49 Slide from File DSCF 3575

- *Acceptance* of product is a product of the Wider System.
- Appears to be an *acceptance* document *from the customer*.
- The form appears to be an *acceptance document to support hand over* of the ship, forming part of the Handover Close out procedure.

The document shows the sign-off of the ship at launch. It is a quality check that formalises the acceptance of the Hull and Machinery as built. It is not a final acceptance document as the build continued after this date as shown in Figure 7.9. The document is evidence of an ongoing quality checking and approval process.

The sixteenth slide (Figure 7.50) reviewed was:

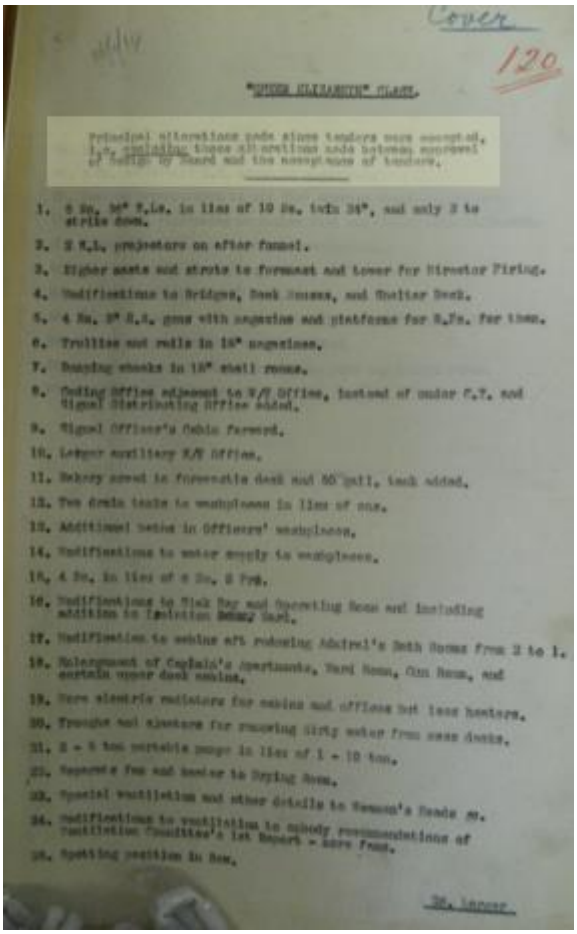


Figure 7.50 Slide from Br/Fndry File DSCF 3575

- *Change log and acceptance across the Class*, this is a change log as a snapshot.
- *Acceptance of Contract change* to the original requirements.
- The document appears to be a Change log that tracks change from the original design that was signed off from the *tender stage*.

This record documents the changes made across the Queen Elizabeth class. It is also evidence of stages within the construction process, tendering and acceptance of design, which would be present in the lifecycle of a project today.

Appendix 6.11 shows a table summarising the findings from the respondents' comments relating to Figures 7.35 – 7.50. The overriding view was that there was
substantive agreement that the following elements of the Essence of Project Management were found in the construction records of HMS Barham:

(i) Costs, costings and estimates
(ii) Setting of expectations or requirements
(iii) Emerging design and the option analysis
(iv) Use of a baseline
(v) Progress reporting, capacity planning, planning in general and scheduling
(vi) Estimating
(vii) Delivery milestones planning.
(viii) Monitoring of spend against the estimated amounts or budgets.
(ix) Trade-offs between quality and time.
(x) Quality testing
(xi) Tendering

The following picture (Figure 7.51) is produced when:

- elements (i) – (xi) above are placed in relation to each other, and
- positioned to reflect the Association for Project Management's (APM, 2019) project lifecycle:

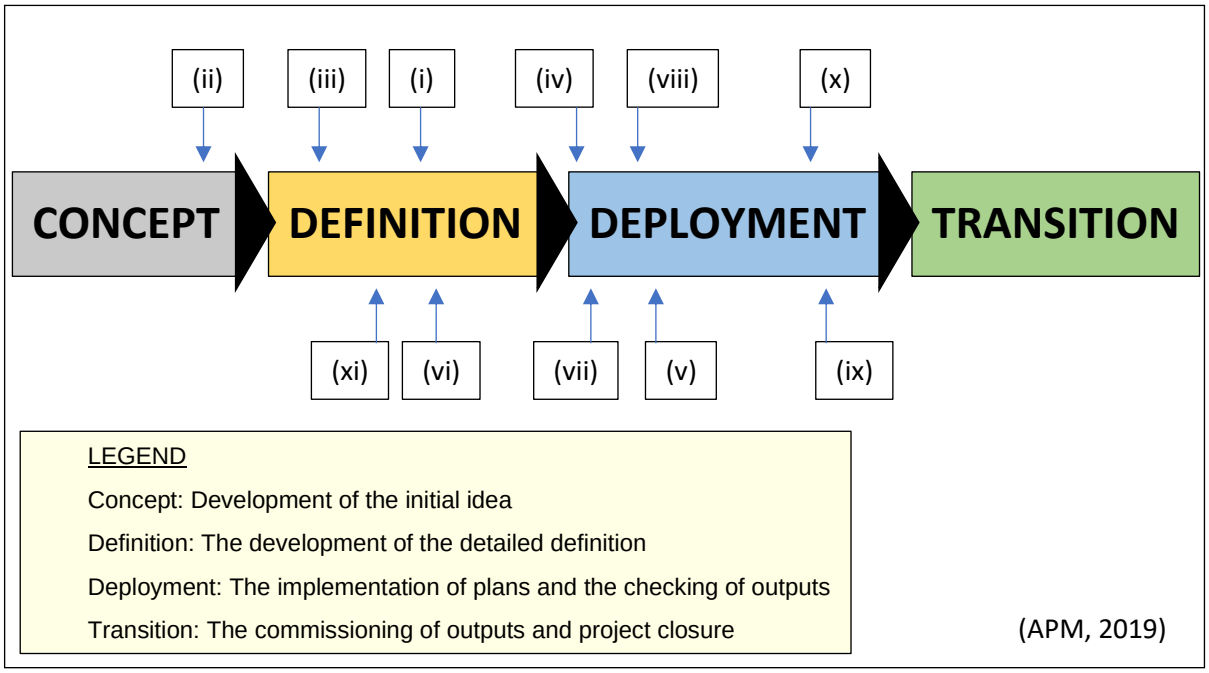


Figure 7.51 – Elements of PM identified in the list of questions plotted against the APM's Project Lifecycle.

The diagram at Figure 7.51 shows a wide spread of documents through the lifecycle of HMS Barham's construction. The documents are recognised, as Appendix 6.8 shows, by practicing project managers as having strong connections with today's practices and methodologies, some even being noted as 'consistent with current practices' within shipyards. It might be observed though, that no documents are aligned with the 'Transition' phase. This part of the lifecycle, the APM tells us focuses on the commissioning of outputs and project closure. No documents were found that illustrated project closure, but Figure 7.30 does show final acceptance of HMS Barham by the customer. This is not however, reflected in Figure 7.51 as these documents were not amongst those shown to the modern-day naval PMs. Perhaps a further reason for the lack of documents found relating to the 'Transition' phase is that the phase is a relatively short compared to 'Deployment' or 'Construction'. The decisions around HMS Barham's manning or compliment were made on 24/7/15 (BFR0117). This early decision, prior to the ship being signed off on 28/9/15 (ADM 95-101) perhaps add further testament to the short amount of time allowed for Barham's Transition phase.

7.5 Results from the study relating to future historical PM research

One of the key questions that this study seeks to investigate is assess ‘how easy is it to conduct historical project research?’ Through addressing the preceding questions in relation to HMS Barham, the study is well placed to answer this question.

One initial difficulty was in finding where the archives were physically located and whether or not there existed enough in the way of records in these archives to enable a study to be made. Historical accounts of companies are to be found without too much difficulty, but they rarely focus on the everyday minutiae of production management methodologies. The study first went to the Brass Foundry as a contact at the National Museum of the Royal Navy had said that all ship records were here and contained in the ‘Ships Covers’. This proved to be partially true. What these archives largely contained were the surviving records for the ships, but from only one perspective – that of the Admiralty or Customer. Some records were there from HM Dockyards who constructed the first in class, but these were not detailed enough, or complete enough, to be able to construct a study solely around them. The Ships Covers might contain an acceptance certificate, but there were none of the everyday constructor’s records present. The next stage was to look in the archives of one of the constructor’s – that of Vickers (Armstrong) held at Cambridge University. This as previously stated, proved to be disappointing and also did not yield the type, quality or quantity of information required. The next archive visited was the National Archive at Kew, where again most records retained were, when relevant, from the customer point of view. At this stage the study was at risk due to insufficient relevant data being found. Discussions at the National Archive however lead to the discovery of the Upper Clyde Shipbuilding records held at Glasgow University. The records of John Brown & Co. Ltd. turned out to be very useful to the research. They form a large portion of the documents referenced in the study, and in doing so provide the contractor’s side

counterpart to the Admiralty's customer viewpoint contained in the archives at the Brass Foundry and National Archives.

How the John Brown records came to be at the Glasgow Archive and what they cover is however a matter of chance. In 2002 Michael Moss recounted in the Dunaskin News (February, 2002) how he had managed to save elements of the John Brown archive:

> *'I can well remember coming out of Central Station in Glasgow on the evening of 14th June 1971 and seeing the headlines in the evening newspapers announcing the liquidation of Upper Clyde Shipbuilders. I had only been Registrar of the National Register of Archives (Scotland) Western Survey for just nine months. Nevertheless, during that difficult year, I had already been involved in the rescue of records from several bankrupt businesses. Reading the headlines, I knew instinctively that this was the big one. Apart from Alexander Stephen & Sons, the firms which constituted UCS, had always been secretive about their records. In the case of John Browns at Clydebank it was believed that they had all been destroyed during the Blitz in 1941, even though the yard had sustained relatively little damage.'*

However, despite the archives having always been 'elusive',

> *'a chance phone call to the manager's private secretary…revealed that there was a 'safe' full of records. My first visit was perhaps the most exciting of any in my career. The 'safe' turned out to be a huge strong room, which contained all the records of the yard back to the foundation of J & G Thomson in 1847, along with wartime utility underwear and quantities of pickled fish ordered for some long-forgotten launch party. By now it was late in the year and there was no heating in the strong room. Regular sorties were made by Tony Slaven, John Hume, the staff of the National Archives of Scotland and myself to list this formidable accumulation. We all succumbed to chills and 'flu. As we laboured away it became clear that there was much more stored away in various parts of the yard. The photographic department had an unrivalled collection of negatives dating back to the 1880s and, although most the early*

drawings had gone, there was an almost complete set from about 1900. Far down the yard was an enormous shed full of computer printouts, which no one could interpret because they had lost the code. These we prudently left behind.'

It is reported (Glasgow University, 2019) by Michael Moss who collected the records, that the companies within UCS were very secretive about their records, indeed as the quote above (Dunaskin News, 2002) relates it was thought that the John Brown records had been destroyed in the Blitz of 1941. The collection of records discovered by Moss, a regular archive hunter, were described by him as 'perhaps the most exciting of any in my career', due to the range of records which he was able to recover. The decision to selectively save records, although perhaps a necessity at the time, has not pleased all researchers, Peebles (1987) suggests that more of the financial records should have been kept – even though these were described by Moss as being 'the most difficult to appraise'. Some financial records however, were kept and the surviving records proved comparatively wide and covered the period during which vessels such as HMS Tiger, HMS Hood and of course HMS Barham were constructed. Some records were found to be missing, for instance Shipyard Reports were present both before and after the WW1 period, but those between 1914 and 1918 were not found. This may have been due to security concerns resulting in these records being stored elsewhere and hence not preserved. The records though overall provided an excellent support for the choice of HMS Barham as the subject of this case study.

The extracts above demonstrate the vagaries that surround the survival of archives, and also the potential difficulty of locating relevant archives. Put together, these observations demonstrate a key difficulty of historical research in this area – it isn't known what survives until it is found and equally it will also be unknown which records the study fails to find!

The archives that are found however can be quite extensive and this can present another problem. With a fair wind the records will have been

catalogued and won't present the researcher with a large pile of un-ordered papers. It may not however, be that the archives are catalogued in a manner which will support a particular research aim. The National Archives at Kew for example, are often filed according to the source of the content rather than the purpose of the content, trawling through these files in search of a document that relates to the purpose of a specific study can be time consuming and often fruitless.

Once a relevant document is found, such as those in the Glasgow University Archives, it leaves the researcher with a challenge. The document will show the information recorded but not necessarily how it was used. An excellent, if not frustrating example of this is the diagram shown at Figure 7.22 and reproduced below (Figure 7.52):

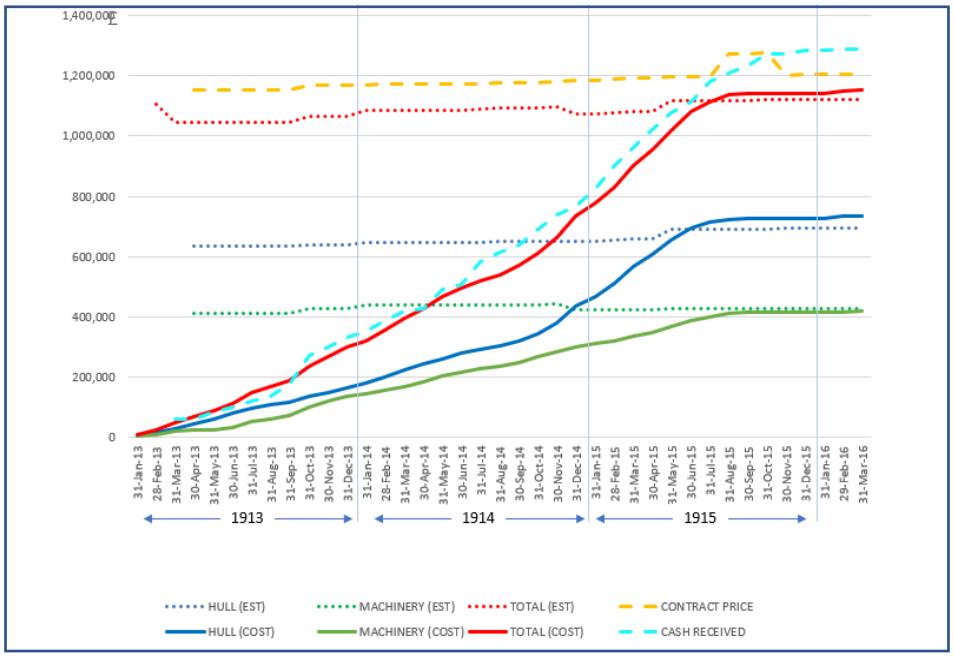


Figure 7.52 (reproduction of Figure 7.22) - details of Hull and Machinery estimates, costs and actual spend

The diagram bears a close resemblance to those used by many organisations today – for instance the example from NASA, shown below, detailing a project's Earned Value Management statistics (Figure 7.53).

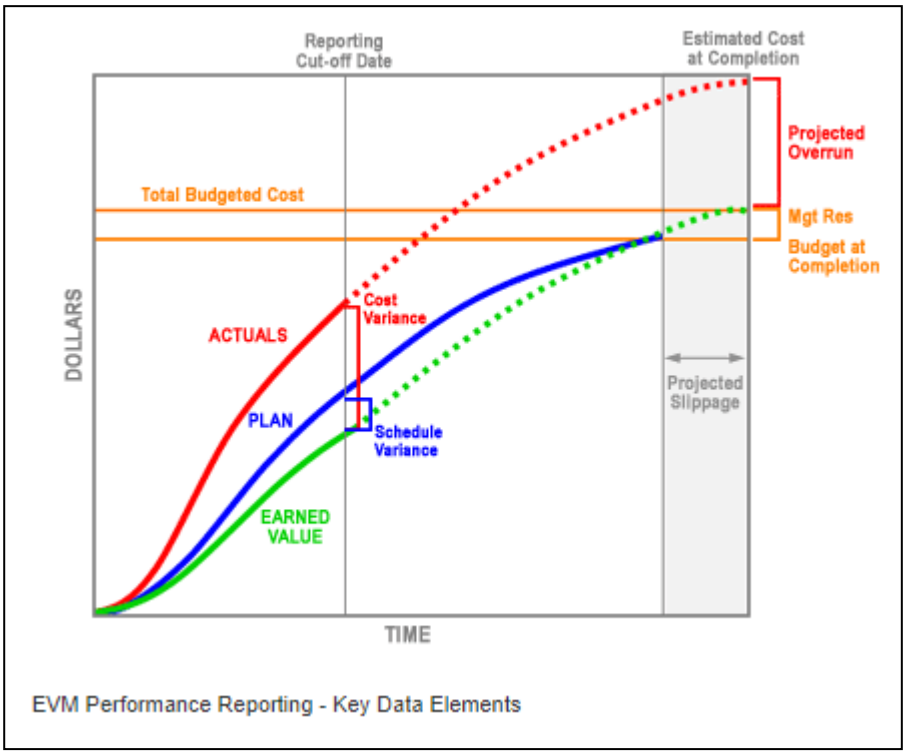


Figure 7.53 Nasa EVM graph

All the information needed to calculate Earned Value Management (EVM) statistics is contained in Figure 7.52, Actuals = Total Costs, Plan = Total Estimates (if scheduled over time,) and Earned Value = Cash received.

This information was all taken from the same page of a 1913-15 record (UCS 1-175-8) but what can't be told is whether or not the information in Figure 7.52 was used to monitor and control projects in the way that the information in Figure 7.53 was. EVM wasn't formalised until the writings of, amongst others, Lipke (1999) and wasn't widely used within UK MoD projects until 2006 when Major Gen Figgures, the then Technical Director of the Defence Procurement Agency mandated its use. Yet all the information needed to calculate EVM is there, on one sheet, 100 years prior in 1913 - 15.

It may be that there is evidence somewhere of how the information was used that this study didn't find, or of course it may be that the information was merely left as numbers in the ledger. It would however be surprising if some sort of trend analysis was not done. This however remains for the

moment a matter solely of conjecture and provides a degree of frustration and difficulty within a study such as this.
A further issue that the study faced, was missing data due to gaps in the timeline. Data could on occasions be found dating from before the date in question and also from after the date, but not for the actual date itself. Whilst it is valid to interpolate between the two, its existence or non-existence among the archives may be due entirely to what an historian or archivist deemed relevant and hence collected. As Carr (1990, p.11) put it 'it is the historian who has decided for his own reasons that Caesar's crossing of that pretty stream, the Rubicon, is a fact of history, whereas the crossing of the Rubicon by millions of other people before or since interests nobody at all. The fact that you arrived in this building half an hour ago on foot, or on a bicycle, or in a car, is just as much a fact about the past as the fact that Caesar crossed the Rubicon. But it will probably be ignored by historians.'

In the course of this study it is difficult to calculate the parts of archives or business records which existed but at some time have been deemed irrelevant or of insufficient interest. This is seen in company histories such as Scott's (1962) history of Vickers or Hume and Moss's (1979) Beardmore history and indeed Johnston's (2000) history of John Brown & Company, which do not consider everyday management methods to be of sufficient importance for inclusion.

The existence of printed forms such as those at Figures 7.10/ 16/ 20/ 30/ 40 and 49 are valuable not only for the data they contain but for the evidence of formal, established and repeated process that they provide. If the company has gone to the trouble of printing a form then the process that is recorded on that form must be a repeated one.

Kristeller (1961) in his paper 'Some Problems of Historical Knowledge', talks about the two main steps within historical research – firstly finding the data and then choosing how to analyse it. One of the key complications with the search for the study's historical data was identified by Kristeller who describes how the finding of data can consist of the collection of fragments

of the original data, but once found the data must be made available for study. In looking at modern rather than ancient history, this study has had the benefit of viewing archival collections rather than looking for ‘new’ evidence. Kristeller comments that once found, the records must be ‘available for study’ (p.92) a process that can be achieved by photographing them as this study chose to do. The difficulties found during the study with the actual identification of data sources and collecting the data have been discussed above. Modern history, Kristeller says, must be looked at through a prism of economics and statistics, which this study has tried to do. It is the view of the author of the study that the driver behind the key principles of project management are indeed economic, since any trade-off between Time Cost and Quality which the project puts into effect is merely an adjustment designed to increase the surplus of project benefits over project costs. Having looked at the challenges in finding the data, some of the difficulties found relating to the analysis of the data itself are discussed below.

It has been said that ‘no document can tell us more than what the author of the document thought’ Kristeller (1961, p.91) this would appear to be a limiting factor. But for a study such as this it can be considered very much a positive. If the author of the documents analysed above was thinking anything, then surely the company processes would have been foremost in their minds and hence reflected in the types of records that this study has found. They were being paid to construct a ship and to provide the supporting management records, the records found should be a reliable reflection of the methods used by John Brown to deliver each ship. The research did however struggle with the frustration and impossibility of fully understanding the past as discussed by Festle (2019). Festle asserts that it can sometimes seem that in order to completely understand the full complexity of history, the researcher must delve deeper than is possible! Amongst the reasons given for this are the limitations of sources and the passage of time. The first of these has perhaps been covered in the first part of this section, but the second reason given – the passage of time - comes back to the difficulties we face trying to analyse what was done a

hundred years ago, and why, through the binoculars of today. This study has attempted to do this through the analysis of exactly what the Essence of Project Management is, but it is impossible to say exactly what was in the minds of the modern-day PMs when they analysed the data. Comments, relating to the processes described through the archival documents, such as 'extremely consistent with current processes within ship-building', offer great encouragement to the researcher, but do not detail how the respondent was forming that view, nor in which direction - were the understandings of today imposed on the past, or was the past brought forward and found to mirror the present?

Overall however, the comments provided by the Project Managers of today's naval ships offer a good deal of assurance that similar processes were being used to manage the production of HMS Barham and that, in a number of cases, these processes bore a close similarity to the practices of today.

7.6 Summary

This chapter focused on analysing the data collected and presenting evidence in support of the research questions set out at the start of the study.

The analysis previously in Chapters 6 and 7 show sufficient strength of evidence to conclude that the archival documents supported both the presence of key elements of the Systems Model and of the Essence of Project Management within the documents. The network displays in Section 7.2.2.2 demonstrated the wide breadth of coverage which the documents found were able to show when compared to the 'lifecycle' of the project. Section 7.2.2.4 dealt with the comments from the respondents to the Main Study. A review of the comments made by the naval PMs lead to the summarisation of the comments and provided evidence supporting the existence of production management techniques from the construction of

HMS Barham that support, in the affirmative, the main research question relating to whether or not it was possible to detect signs of the Essence of Project Management within Barham's construction.

Section 7.5 reviewed the difficulties encountered in conducting this type of research. The study has proved that the study of project management within projects of a hundred plus years in age is possible, but not without facing the difficulties raised in Section 7.5. The surmounting of some of these issues is a matter of hard work and endeavour, others can be put down to the benefits of previous 'collectors' work and the ease with which these documents can be found.

The following chapter considers the unique contributions to knowledge that the research has provided as distinct from the implications of the research.

CHAPTER 8

- CONTRIBUTION TO KNOWLEDGE

8.1 Introduction

This chapter considers the contribution to knowledge that the study offers. This is distinct from the previous chapter in that Chapter 8 looked at how the research had met its research aims and the practical implications of the study, exploring both the limitations of the study and the areas for further research.

8.2 Contributions to knowledge

The study has provided four distinct contributions to knowledge. The contributions are however linked and as Figure 8.1 shows, each is dependent on the development of the previous in order to be established.

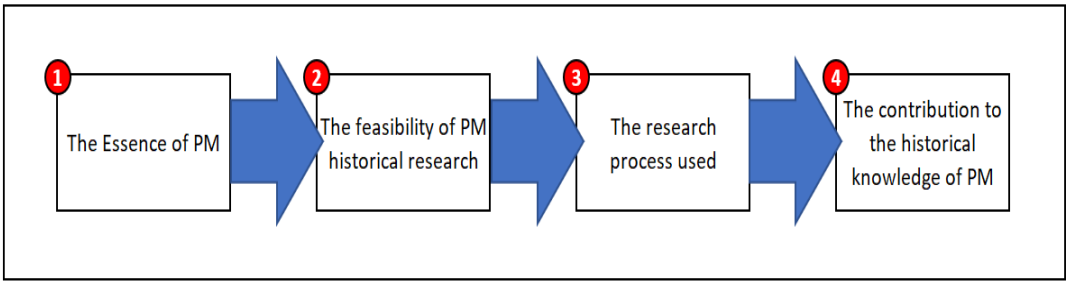


Figure 8.1 – the sequence of contributions to knowledge

Each of the four areas are new contributions as, the first, the essence of PM has not been described before and the remaining three derive from this. It has not been necessary to define the essence of PM before, as the existence of project management techniques have not been searched for within projects prior to the Manhattan or Polaris projects. The identification of the Essence of Project Management therefore has enabled the successive contributions (nos. 2-4) to be developed.

Each of the four contributions are described below.

8.2.1 – The Essence of Project Management

In order to begin the archival search, a prerequisite was that the research needed to provide a definition of what constituted the material that was being searched for and what were the characteristics of this material.

This was necessary if the researcher was to know if an artefact found during the archival search was something which represented a PM function or not.

Although the professional bodies have developed their Bodies of Knowledge, these consider the tools and techniques that a PM is required to practice. They do not claim to describe the functions or Essence of Project Management. Particularly relevant within this study, the Bodies of Knowledge have no requirement to look back at PM in previous periods to assess the approach(es) that might have been used at that time.

The Bodies of Knowledge are very much documents which describe the present needs and project these into the future. Consequently, what makes up the Essence of Project Management, defined in Chapter 3 as describing the ‘quintessential core, or heart, of what project management means and those components that contribute to the meaning of project management’ has been to date, undefined. The approach described in Chapter 3 takes input from key documents and seminal sources over a period of over 50 years.

From these sources, the Essence of Project Management is defined in Section 3.3.4 of Chapter 3 as consisting of the following characteristics:

Table 8.1 – the characteristics of the Essence of Project Management

- Projects are usually structured and organised by task
- The PM manages other workers
- The PM's task is finite in duration
- The project has a clear structure – a clear definition of authority and ownership
- Delivery within Time Cost and Specification is required
- Advance planning – avoid crises
- Progress Reporting is required
- The project has distinct stages – e.g. design, manufacturing and check-out
- Delegation is a factor within the project
- The project has a team tailored specifically to the project
- The team organisation planning is structured to deliver synergistic benefits – 'shaping a team that can 'play over its head''
- Soft Skills – understanding of the team personalities and attitudes is required
- Good two-way communication within the team is required
- Change Control is necessary
- The project is goal driven
- An initial project appraisal is required
- Management of plant and machinery is necessary
- Management of both internal and external resources is required

Without the definition of the Essence of Project Management being clearly established, the search for traces of Project Management in earlier years would have risked the dangers of presentism, as defined in section 4.4, where the researcher falls victim to looking for traces of the present in the past.

Having established the Essence of Project Management, the study was then able to move to its second area of contribution to knowledge.

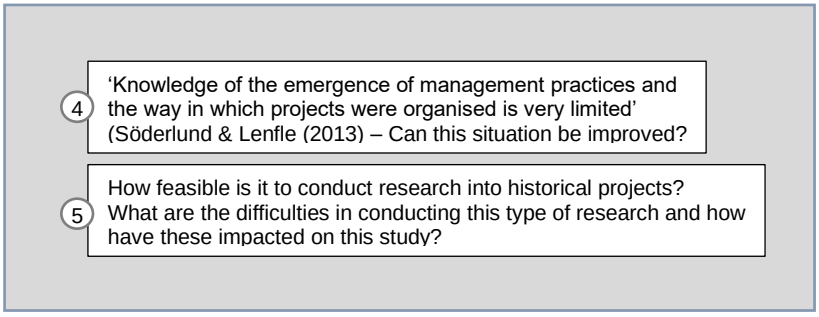
8.2.2 – The feasibility of PM historical research

The definition of the Essence of Project Management gave a focus around which the question of the feasibility of PM research could crystallise.

The need for more historical PM research was expressed by Söderlund and Lenfle as detailed in the fourth research question, reproduced in Table 8.2 below. The question was also raised as to how possible it was to complete research in this area. Research of this type and age has not to the author's knowledge been undertaken before, so much was unknown in terms of our

ability to go back 100 years and find traces of the now defined Essence of Project Management.

Table 8.2 – Secondary questions relating to the study of project management (reproduction of Table 1.3)



It is now clear that it is possible to undertake this type of research, although there are difficulties in doing so. These have been outlined, from different perspectives both in section 4.4 and 7.5. One of the main questions was 'would it be possible to find sufficient and relevant records after 100 years?' This proved possible and having shown it to be possible, the next contribution to knowledge is a description of the method by which the study was able to achieve this.

8.2.3 – The research process used in carrying out the study

Having established that research in this field was indeed possible, the study faced another issue.

Due to the novelty of this type of historical research, the method and approach used to conduct the study had to be designed without reference to the experiences of previous researchers.

The research method used was devised, in the early stages through some experimentation. The initial trialling was used to establish exactly how the records could be found and where they were located. It was found that the records were not all conveniently co-located, but rather located in two key areas, dependant on whether they were from the customer's side (the Brass Foundry) or the manufacturer's side (Glasgow Business Archive.) Having

established the location of the records the research continued to be delivered according to step 3 of the method described in section 5.5.2 and reproduced below:

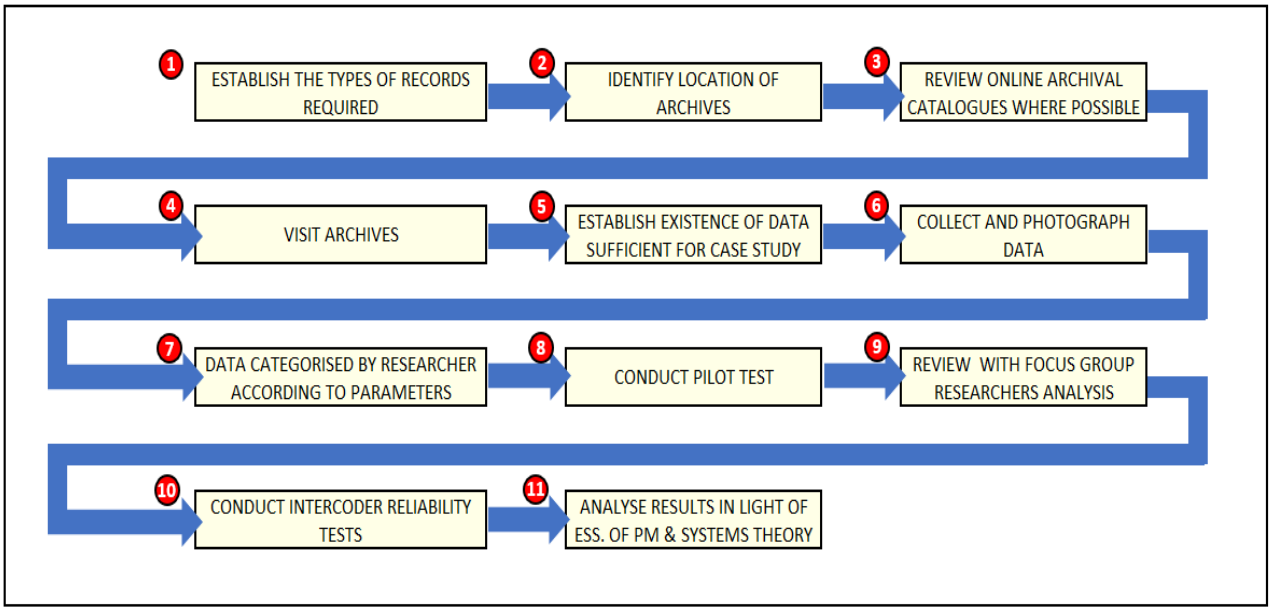


Figure 8.2 – the research process

Some of the key steps in the process shown at Figure 8.2 are discussed below.

Step 1 in the process is the output from the work done in defining the Essence of Project Management. The description of the core purposes of PM enabled the study to search for records which reflected these aspects in previous times. It was not impossible, for example, that in the early part of the twentieth century, the need for 'advance planning to avoid crises' (see Table 8.1) would not be evidenced by a Risk Log as we would expect to see today, but by letters requesting that work be accelerated to reduce the possibility of late delivery, (see Figure 7.25). In the case of HMS Barham's construction, these letters evidenced the treatment of risk just as well as the discovery of a Risk Log would have done, and in a way which the (unsuccessful) search for a Risk Log would not have been able to.

Step 5 of the process outlined in Figure 8.2, reflects the most fluctuations in, and the most threat to, the potential success of the study. Initially the Vickers Archive, held at Cambridge University, was visited but the archive proved not to hold the type of records required by the study, the records instead focused more on the history of the company rather than providing production management records. Step 5 therefore became a step that had to be repeated until a satisfactory set of archival records were found. Fortunately, these records were found at the Scottish Business Archives held at Glasgow University.

Step 6, the photographing of the archival data proved to be a useful approach. It sped up the collection process – the records were collected often by photographing a complete folder rather than analysing the records there and then which would have been time consuming. Instead, this approach enabled the records to be reviewed and analysed at leisure. It also, at times, enabled analysis to be done in a different way. For instance, during the analysis stage, the records used in producing the diagram shown at Figure 7.22 showing details of Hull and Machinery estimates etc., were only available from the yards 'Contracts in Progress' book because a full photographic record of the book was taken, even though one sheet showed the same purpose/ information as the next. It was only later, during the analysis process, that it was realised that the time series plotted showed similarities with today's Earned Value Management processes and contrast could be made with these, adding value to the analysis.

Step 7, the categorisation of the data found, once again drew on the work establishing the Essence of Project Management, which again shows the importance of this piece of work within the study.

Step 8 was a key step in terms in validating the researcher's coding - the review with the focus group. It was essential to corroborate the researcher's view of the purpose of each document found in order to ensure that the dangers of both presentism and finalism were avoided. Both these potential problems are discussed in section 4.4, presentism is defined above in section 8.2.1. Finalism can be described as looking for the foundations of

the present in the past, and hence analysing history as a finalised process that necessarily leads from that past point to the present point. The ability to check the validity of the researcher's coding therefore became vital to help eliminate these potential sources of error. The help of the focus group in doing this was vital and hinged upon the selection of the focus group members, who although small in number were, arguably, the most expert within the UK.

Having noted the input from the focus group, step 10 using Cohen's Kappa, was a useful way of establishing the link between both sets of coding. The documents being studied could be argued to have had an element of subjectivity about them, as discussed in earlier chapters. The degree of subjectivity however was not large, but could perhaps be a problem in further studies where the impact of subjectivity of interpretations could potentially be greater.

8.2.4 – The contribution to the historical knowledge of PM

The contribution to the historical knowledge of PM was the primary focus of the study and this has been fully discussed in Chapter 8, supported by the study's results discussed in Chapter 7 of the study.

Through the method described above in section 8.2.3, the study has been able to add significantly to the canon of historical PM project knowledge and in doing so, establish a far broader base for discussions around the power of examples as put forward by Flyvbjerg, and detailed in section 4.2. Table 4.2 revealed that Söderlund had found no UK based project histories and none written from the project manager's perspective. The study has also been able to address the concern, (raised by Söderlund and Lenfle (2011) and discussed in section 4.3.2), that with the exception of Morris (1997) and Hughes (1998) we know nothing of the history of the delivery of projects and the tools used. This study however does more than just recount the story of a project. For the first time, it specifically reviews the tools and techniques of the PM and illustrates how a significant project of national importance was

managed prior to the establishment and recognition of MPM, and in so doing provides a fourth contribution to knowledge within the field.

8.3 Summary of contribution to knowledge

The contribution to knowledge that the study has provided has been fourfold.

The four steps as shown in Figure 8.3 can be seen to build on each other and are mutually inter-dependent in delivering the study results outlined above.

It is hoped that these steps will prove of value to future researchers who choose to research project histories, and who may be able to push back the nascent beginnings of MPM even further than this study has achieved.

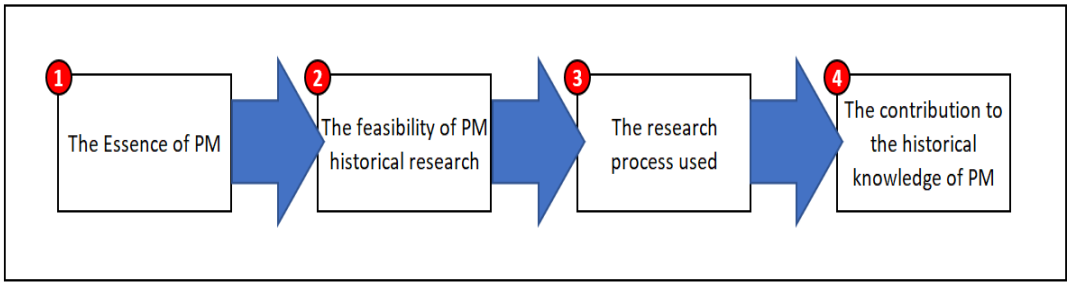


Figure 8.3 – the sequence of contributions to knowledge (a reproduction of Figure 8.1)

CHAPTER 9

- CONCLUSION

9.1 Introduction – achievement of study aims and objectives

Section 1.1 of the introduction to the study, set out a clear primary research aim, shown in Table 9.1 below:

Table 9.1 – Primary research aim

To provide a better understanding of the practices and techniques of managing early projects, with associated benefits for those developing project management theory.

Section 1.4 contained a list of the objectives for the study, which were:

1. To increase understanding of the history of MPM and to establish core conceptual frameworks and elements of MPM.
2. To establish what the Essence of Project Management is and to investigate its potential alignment to a systems approach.
3. To design a suitable archival approach to identify the Essence of Project Management in historic projects.
4. To identify and research relevant archives to establish the existence of any of these elements within a chosen case study and to analyse each record found, both in terms of alignment to the Essence of Project Management and to Systems Theory.
5. To validate the findings with independent third parties currently employed in the construction of modern-day naval vessels.
6. To investigate the possible presence of historical PM documents and the ease of researching historical projects with a view to determining how much more could potentially be learnt by the profession through this kind of study.

The study has been able to address these objectives, as shown below:
i) In defining and investigating the study's objective, one of the dangers was that of 'presenteeism'. This highlights the danger of looking into the past for something which is not defined until a later date. A natural tendency is to

look into history for the artefacts that are used today. The study has sought to overcome this by developing ‘core conceptual frameworks’ - the ‘Essence of Project Management’, that has enabled the researcher to recognise what to look for as indicators of Project Management in projects prior to the establishment of MPM.

ii) The study identified 16 elements of the Essence of Project Management and created a framework for evaluating the elements of systems theory. This was achieved through a review of key texts, namely Gaddis (1959) together with the UK’s earliest PM Body of Knowledge and Turner’s articles (2006) concerning the definition of the constituent parts of PM, a compilation of the constituent components of project management was formed

iii) The framework at ii) above, directed the search for historic artefacts which could be identified as serving a Project Management or Systems Theory Model purpose. The Essence of Project Management and its relation to Systems Theory, was established in Chapter 3 and detailed in Section 3.3.4. An alternative framework based on systems theory was developed in Section 3.4. The data gathered was analysed from both perspectives. Having categorised the elements of the Essence of Project Management, source archives were identified through discussion with subject experts (see Section 5.6.1) which proved fruitful in terms of uncovering relevant data.

iv) The fourth objective of the study led to the research needing to find relevant archives and then to examine the archives for relevant records. The research project successfully identified a case study on which to base this search. The analysis of these records, presented in Chapter 7 was able to show alignment to both the Essence of Project Management and the elements of Systems Theory and thereby demonstrate linkages between the two. In so doing, it has established the management practices used to deliver a ‘project’ some fifty years before project management was formally recognised.

v) The conclusions of the author’s findings, or data codings, were successfully validated by a panel of industry experts and through use of Cohen’s Kappa (see section 6.3).

vi) The archival search identified and recorded approx. 1,847 slides from over ninety different archive files drawn from three main archives spread throughout the United Kingdom requiring extensive travel and analysis to bring together a full picture of the project management of HMS Barham. The information was then analysed, codified and verified by practicing project managers. The analysis of the data included conducting both pilot tests and inter-coder reliability tests involving current military PPM Masters students and current naval project managers. The third-party analysis was invaluable and the access to their combined expertise added considerably to the richness of the study. The study itself is the first, as far as the author is aware, to bring together records from both the customer and constructor sides in such a focused way. It can be said that the presence of documents fulfilling a PM function was indeed found. This establishes earlier evidence of PM documentation and artefacts than previously recorded and so will help others in delivering the benefits of studying historical projects, as described in Chapter 4.

The research has therefore met the objectives of the study by presenting a fuller and better understanding of the practices and techniques of managing an early, pre MPM project, thereby providing both greater knowledge of early PM and in doing so provided potential assistance for those seeking to develop PM theory.

9.2 Summary of findings and limitations

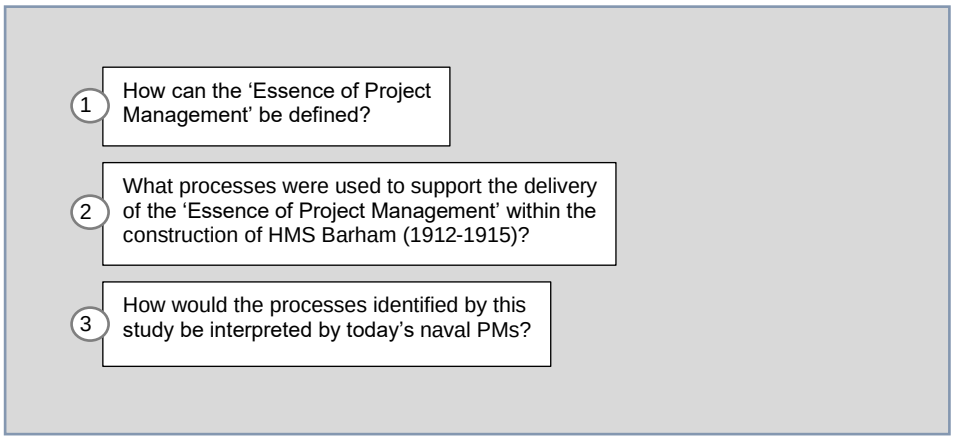
9.2.1 - Findings relating to the Research Questions

The study's aim and overarching question led to five secondary research questions which were addressed in order to meet the primary aim. These were split into two main groups.

The first of these groups related to establishing specific evidence of what today we would call 'project management practices' within the construction

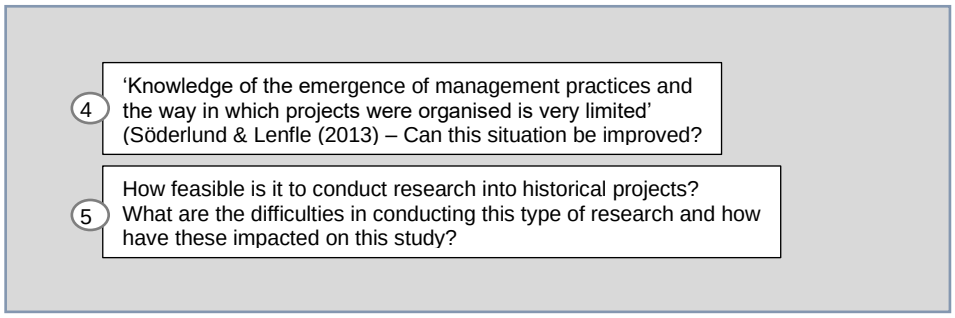
of a Dreadnought era warship built in the early part of the twentieth century as part of the United Kingdom's Grand Fleet. These questions, shown in Table 9.2, were:

Table 9.2 – Secondary questions relating to the search for project management artefacts within the construction of HMS Barham



The second group of questions (Table 9.3) focused on the recent discussions in academic papers around the scarcity and difficulty of historical project management research. These were:

Table 9.3 – Secondary questions relating to the study of project management history.



The answers to the first of these groupings of questions provided a greater understanding of the use of Project Management prior to the formalisation of MPM in the 1940s/ 1950s.

The first question raised (Table 9.2) is fully detailed in Chapter 3, and the effectiveness of the derived definition is shown throughout Chapters 6 and 7.

The second question in Table 9.2, is answered by the application of the findings from Chapter 3, to the archival search. The method used in conducting the search is detailed in Chapter 5 and the outcome, the evidence for the presence of the Essence of Project Management within the construction of HMS Barham, is laid out in Chapters 6 and 7, showing exactly which processes were found to have contributed to the successful delivery of HMS Barham.

The third question which the study raised (Table 9.2) was how well would a sample of these processes be recognised and identified as components of Project Management by a panel of today's naval PMs?
This was facilitated by a review and analysis of a sample of the documentation with practicing Project Managers involved in today's naval ship building projects. The study showed that within the archival documents, the panel recognised a high number of project management processes and in addition to all the elements of a System Theory Model. (See Figure 6.1 and 6.3). Some panel members were able to go as far as recording that some of the documents found were 'consistent with current practices' (Figure 7.41) and 'consistent with current approaches' (Figure 7.42).

Question 4 (Table 9.3) directly addresses the observations, outlined in Chapter 4, that the study of the history of Project Management exhibits very limited knowledge of the historical context and examples. This means that there is a need to fill this void through the study of the historical project delivery process in detail, noting that this can help to build relevant management theories, indeed Cicmil *et al.* (2006) argue directly for research on the 'actuality' of project management in order to support a bottom-up approach that will aid the development of PM theory. This study helps directly to meet this gap in PM knowledge.

In adding to the knowledge of emergent management practices, the study has delivered a detailed analysis of project management at a comparatively early date, and hence contributed to closing the gaps in the academic literature identified by a number of authors. Amongst these are Kozak-

Holland (2011) who regards examples from the past as being able to increase the understanding of present-day projects, and Söderlund and Lenfle (2013) who agree with Kozak-Holland's view, adding that this type of historical project management research adds to the empirical wealth of the subject, enriching our understanding of projects by appraising the steps which led to them.

The fifth research question posed by the study, (Table 9.3), is the issue of how achievable it is to undertake historical project research focused on project management methods, tools and techniques. Söderlund and Lenfle (2013 p.654) state that studies involving 'the emergence of management practises in projects and the nature of project organizing' are very limited. In saying this, they support the views of Morris, recorded above, and also express the hope that the levels of interest in historical project management research can be raised in order to improve the definition of project management as an area of academic inquiry.

This thesis directly answers the questions raised by Morris and Söderlund and Llenfle as to whether or not this type of research is possible within the UK and serves to highlight some of the potential difficulties and considerations in undertaking it.

The questions raised meant that the study chose to investigate the evidence of Project Management processes provided by the Construction of HMS Barham (1912-1915), and in so doing directly filled the literature gap identified by Morris (2013) (see Chapter 4) and helps to provide the comprehensive history of the profession, including examples of projects before the 1940s that can help to illustrate the emergence of Project Management as a discipline. The line of research within the study is further supported by Geraldi and Söderlund (2018) who highlight the importance of connecting with the day to day realities of projects if the theoretical under pinning of Project Management is to be explored and understood. Kant in his 1793 essay, quoted by Murphy (1998 p.7) said 'practice without theory is blind, theory without practice is empty' which clearly illustrates the need for

research in both the areas of theory and practice. It suggests that the exploration of early practice undertaken by this study, has a direct application to the current search for a theoretical underpinning for Project Management.

Photograph 9.1 - HMS Barham sailing back from her gunnery trials Aug 1915

9.2.2 Overview of the study's findings

The research has shown that it is possible to investigate the ways in which projects were managed in periods prior to the establishment of what has become known as MPM. The investigation and analysis was not however without difficulty. There was occasionally a small degree of subjectivity when deciding the purpose of a document. This was influenced by the specific role that a project professional might be assigned to, or indeed which aspects of PM that might currently be at the forefront of their mind. If

the PM's project was currently going through a costing stage, this could influence whether a document was identified as, for example, a costing document or a staffing document. Both are of course part of the Essence of Project Management and represent a second level of analysis.

Issues were also addressed with regard to selecting a historical project as the basis of research, for which the records could still be available after the passing of such a considerable amount of time. The transitory nature of this type of record leads to the choice of larger scale projects, possibly those of national importance, or projects which were undertaken by large corporations with large archives and who's subsequent company history of mergers etc. can be traced. This all but rules out the analysis of small everyday projects undertaken by entities that could not afford the luxury of keeping, or establishing, long-term archives and who could not see, or foresee, the benefits of doing so. This reality shaped the approach of this study and caused it to focus on a large military project of national importance, this suggests that any future research is likely to be skewed away from the ordinary everyday projects.

Within the larger project selected, it has proved possible to find documents from over a hundred years ago which have been recognised by Project Managers of today as Project Management documents, showing that the Essence of Project Management was present within the Construction of HMS Barham. It demonstrates a project lifecycle that is commensurate with today's lifecycles, indicating a commonality in overall approach and methods.

The documents found display all the key facets of the Systems Model as described in Chapter 3. The important variables which were the subject of planning and control are visible within the records as Figures 7.7 and 7.8, (for example), show. It is possible to review the organisational structure behind large government projects (Figure 7.19) and to reveal both the roles and tasks in building the First of Class ships at the Royal Dockyards. It is possible to see echoes of this structure within the commercial yards as HMS

Barham, the fourth in its class, was constructed, proved through trials (see photograph 9.1) and commissioned into HM Navy.

It has been proved possible to take documents pertaining to a project, over a hundred years old, to review them with project managers of today and to show that there is a strong alignment with the elements of a Systems Model (Figure 7.1). In addition, this association with the elements of the Systems Model was shown widely throughout the range of archives investigated (Figure 7.3) which suggests that both the Admiralty and the Constructors were following an approach aligned to the principles of the Systems Model well in advance of Systems Theory being formally established. The evidence tells a similar story when the Essence of Project Management is considered.

The literature review revealed some interesting quotes which have a bearing on the assessment of HMS Barham's construction process.

Kelley and Walker (1959) listed four points which they presented as the minimum requirement necessary for project delivery in 1959. These were:
(1) To have a basis for prediction and planning
(2) To be able to evaluate alternative plans for accomplishing the objective
(3) To check progress against current plans and objectives, and
(4) To form a basis for obtaining the facts so that decisions can be made and the job can be done.

These were all proved to be evident in Barham's construction. Dates were agreed in advance for future production milestones (see Figures 7.14, 7.15, 7.31 and 7.43). Alternative plans or designs were considered (see slide 6.17 and Figure 7.12 showing the selection of design no. III.) Progress was monitored and reviewed as shown, all too publicly, in the cutting from the Glasgow Herald (Figure 7.45) and from details in, for example, Figure 7.22 showing costing details, and in the Yard Diary (see Figure 7.26.) The last element required by Kelley and Walker was the ability to obtain the facts so that decisions could be made. The construction of Barham demonstrates

this throughout, not least in numerous of the letters to and from the Admiralty, for example, Figures 7.12, 7.25 and 7.32.

By the very definition of the times, Barham therefore exhibited the requirements of a 1959 project (the date of Gaddis' article,) but it did so forty-five years earlier.

Atkinson (1999) advanced the view that success in terms of a project should be measured by more than just the yardsticks of Time, Cost and Quality. Figure 7.33 has shown that the Admiralty were particularly focused on the delivery times for each ship, other documents discussed have shown that cost and delivered quality or performance were also paramount.

Given that the case study was delivered some eighty-five years before Atkinson was writing, what the study has shown is that the dominant aspects or measures of MPM success were also critical, and more importantly, managed, at the time of Barham's build. The extreme nature of times of conflict, the need to maintain a numerical superiority, and the indeterminant nature of the in-service phase of the project, would suggest that if these processes were able to succeed, they were the well-established management processes of the time.

The 'range of focus' required by Havranek (1998, p.6) (see Section 2.3), of an MPM project was also evidenced within the Barham construction documents. Management of quality, human resources, leadership, organisational structure and information systems were all shown in the records found for HMS Barham as was evidence of practices such as change control and testing. (See Section 7.3).

Sapolsky (1972, p.94) claimed that 'techniques such as project management, program budget, management control centres and charting are often acknowledged to have been developed or perfected by the Special Projects Office' but they can be seen too, in their early forms, within the

control of the HMS Barham build, future work could perhaps establish how these processes were ‘developed or perfected.’

In addition to supporting Keiser’s view, the research speaks to Elton’s (1967) belief that an awareness of history helps to root an identity, leading to the opinion that this research will ‘contribute to defining and redefining project management as a particular scientific enquiry’ (Söderlund and Lenfle, 2013, p.661). The possibility for future researchers to build on this research in order to contribute to PM research and theory development follows from this. Indeed Kozak-Holland (2013, p.88) expresses exactly this, saying that future researchers could use historical PM studies ‘towards establishing the discipline, and researching a theory of project management.’

9.2.3 Potential Failings of the data found

The inability for the study to find any significant amount of evidence for soft skills or synergistic benefits is addressed in section 6.2.2. The second element of the Essence of Project Management which was poorly represented was ‘soft skills – an understanding of personalities, characteristics and attitudes is required.’ The relative lack of evidence for both of these two areas (see Figure 7.7), is perhaps due to the more intangible nature of these two elements.

The example of the references found in the shipyard diary show, perhaps, that these ‘softer’ elements are more likely to be found within the social histories such as diaries as opposed to formal production management records. This suggests that there is the possibility that additional research could be directed towards the exploration of the social history within John Brown’s yard and that this might provide evidence of these more esoteric aspects of Project Management.

9.2.4 Limitations of the study that impact on the generalisability of results

The study undertaken also has two other potential limitations.

Firstly, it is an in-depth study of one case – HMS Barham. The study did not set out to prove that what was found as part of the HMS Barham case study was indicative of Project Management techniques being used across all production within the John Brown yard. If it was the aim to prove that what was found evidenced a process, rather than as a unique approach, then studies of additional ships constructed would need to be completed. It could be assumed that the presence of printed forms and formalised logs, such as those presented at Figure 7.30 and Figure 7.40 is evidence that the processes described above were indeed more widespread than just HMS Barham. This could well be true but as things stand is not fully substantiated, nor was it meant to be within the scope of this study.

The second limitation is that the only significant research undertaken by the study relates to HMS Barham and the methods employed within the John Brown shipyard. In terms of addressing whether or not these methods were used in other yards such as Fairfield's (which built the Queen Elizabeth class HMS Valiant,) or Armstrong Whitworth's (which built the Queen Elizabeth class HMS Malaya,) no evidence has either been found within this study and nor looked for. Early parts of the research, prior to the identification of HMS Barham as the case study, suggested that similar approaches might have been used at Vickers in respect of HMS Agincourt, but compared to the John Brown archives, there was insufficient archival evidence found to establish this and, on that basis, no detailed work at the Vickers' archive was undertaken. A wider study of other manufacturers and their archives would add interesting insight into how prevalent the methods found at John Browns were and whether they were the exception or the rule. But, the research has found an example of a large project managed in a way consistent with MPM, prior to the date of the Manhattan Project, so it can be concluded that the oft quoted view that no project was managed in a way consistent with MPM pre Manhattan is indeed false.

It has proved to be possible to research historic projects, or more accurately this historic project. A considerable amount of evidence has been gathered, analysed and validated in support of adding to the existing knowledge, both

of how this particular project was managed and delivered and also in order to discover the degree to which it is possible to study historic project management and the difficulties therein. As stated above however, it has been limited to just one ship. Not only does this impact on the ability to generalise across ship constructors but it also limits the ability to comment on how possible it is to investigate, more widely, the history of projects. It has certainly been possible to gather data in the case of HMS Barham, as has been demonstrated, but how successfully the history of project management could be investigated on a wider basis depends upon the quality and depth of records retained within the other relevant business archives. This will be, in all probability, a factor of two chief constraints.

The first of these constraints is the length of time since the ‘project’ was completed. This will potentially affect the nature of any records kept. The further into the past that any project is rooted, the more reasonably it could be expected that the records kept at that time would have tended to be verbal in nature and that the attitude to the importance, or use, of any written records that were produced might have been transient in nature. As a result, it could be questionable how important the archiving of these records was considered to be at the time of ‘project’ completion. We inevitably view the importance of record keeping and the detail to which records should be kept, through the lens of our own day. This is therefore a limiting factor with regard to the possible length of time which we can go back in history, since as Kozak Holland’s (2014) work on Florence Duomo Project (1420-1436) illustrates, the further projects go back into history, the fewer the management records available to the researcher there are. Perceptions of our own day also impact on what we expect to find and hence how we are predisposed to judge it. This is a limitation present in all historical work or indeed work comparing different cultures within the same time period. The researcher must be wary of the ‘self-reference’ and weigh-up the dangers that this introduces to any conclusions drawn.
The potential scarcity of records may of course be due to other factors.

The further back into history the research goes, the longer the duration for which these records would need to have survived becomes. The simple length of the temporal gap between the research being carried out and the delivery of the project itself also becomes a determining factor in the survival of any management records. What has helped to increase the probability of the success of this research, alongside it's comparatively recent delivery, is the size and national importance of the project in terms of cost and management across multiple contracts and hence the perceived need for it to be monitored.

The account of the recovery of the John Brown archives in Section 7.5 above shows just how much the survival of these archives is open to the vagaries of chance which dictate the potential each archive has to survive the passage of time.

Only further exploration of historical projects will establish how far back into history it is possible to delve and to explore the roots of project management. This study has proved that it is possible to recover and research the detail from a hundred and seven years ago but how much further it is possible to explore will need to be the subject of further research.

9.3 Practical applications and implications of the study

This study has produced evidence of the management and methodology behind the delivery of what we would today term a 'project' from a time period earlier than anything of comparable detail within Project Management research known to the author. As such it shows the processes used to undertake project delivery and the 'lifecycle' approach taken to HMS Barham's construction. It pushes back the boundaries of our knowledge with regard to project delivery and adds to the conversation referred to earlier in the study which calls for more studies focused on early project

management. It helps in identifying possible areas of difficulty for future researchers in this field, but also gives hope to those wishing to push back the frontiers of our knowledge of early projects even further. It demonstrates that it is possible to find a valid research case study even after a considerable passage of time. It suggests the type of project where the required archives might exist and how they might be analysed. It answers, in the affirmative, the question which Morris (2013) poses – the previously unproven supposition that this type of research from this kind of time period is possible.

The study provides an insight into project delivery that, whilst it is not as early as Kozak Holland's work, it is earlier than any of comparable detail in terms of the identification, analysis and discussion of management methods and tools used.

This is important in the study of this academic subject since it sheds light on the understanding of Project Management in one of its earlier phases. The development of this perspective allows the practitioner to sharpen his perspective of the present, not the past, (Lawrence, 1984). The worth of this reflection on history, on the past, is shown uniquely in all PhDs, all of which have an early chapter entitled 'Literature Review', or similar, the primary aim of which, is to establish what is already known of a subject in order that this might be reflected and built upon.

It can often be seen that the study of a subject in light of its past can be overlooked and hence understanding can be lost. Nisbet (2017) suggests that this is due, at least in part, to the idea that all things develop and improve as they progress. Indeed, the idea of 'progress' is that things change, almost unrelentingly, from lower to higher states. This danger has also been recognised by Söderlund and Lenfle (2013) who state, as recorded elsewhere in this study, that it is a form of scholarly hubris to ascribe to the idea that we are smarter merely because we are from a time later than the historical example. This study therefore has relevance and

can add potential value to future studies that seek to develop project management, either from a practical or theoretical stance.

9.4 Implications of this study for project management theory/ practice and contribution to knowledge

As stated, the study pushes back the previously known timeline in terms of tracing the beginnings of MPM methodologies. This achievement offers future studies the opportunity to base their observations over a time period fifty percent longer than that provided by, for example, the Polaris Project of the 1950s, or the Manhattan project of the 1940s. New tools have been provided that will help enable examination of project management records from any time in the past against a framework which is consistent with MPM.

A majority of the project histories written to date do not establish the full range of project management tools and are not written from the perspective of a project manager, so the claimed extension of the timeline in this respect could be even greater, depending upon the definition of 'project delivery methodologies' proposed.

In doing this, the study adds significantly to the 'Contribution' focus of PM research and to what has been termed the 'power of examples' as outlined in Chapter 4.The research therefore extends the audience for which PM research is relevant and by challenging taken for granted assumptions and gaining a greater understanding of the facts surrounding the way in which the delivery of early projects was managed, the study can help others in advancing PM theory

The diagram previously shown at Figure 7.8 and reproduced at Figure 9.1 below, clearly demonstrates the management processes evidenced during the research.

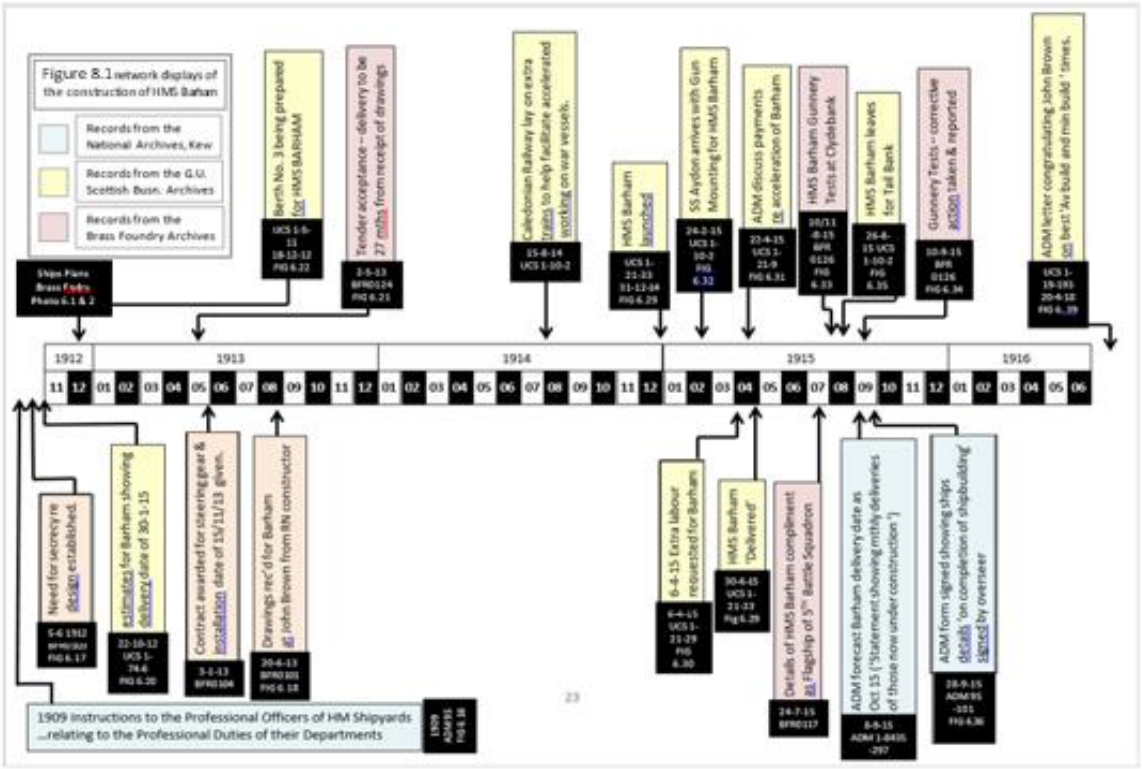
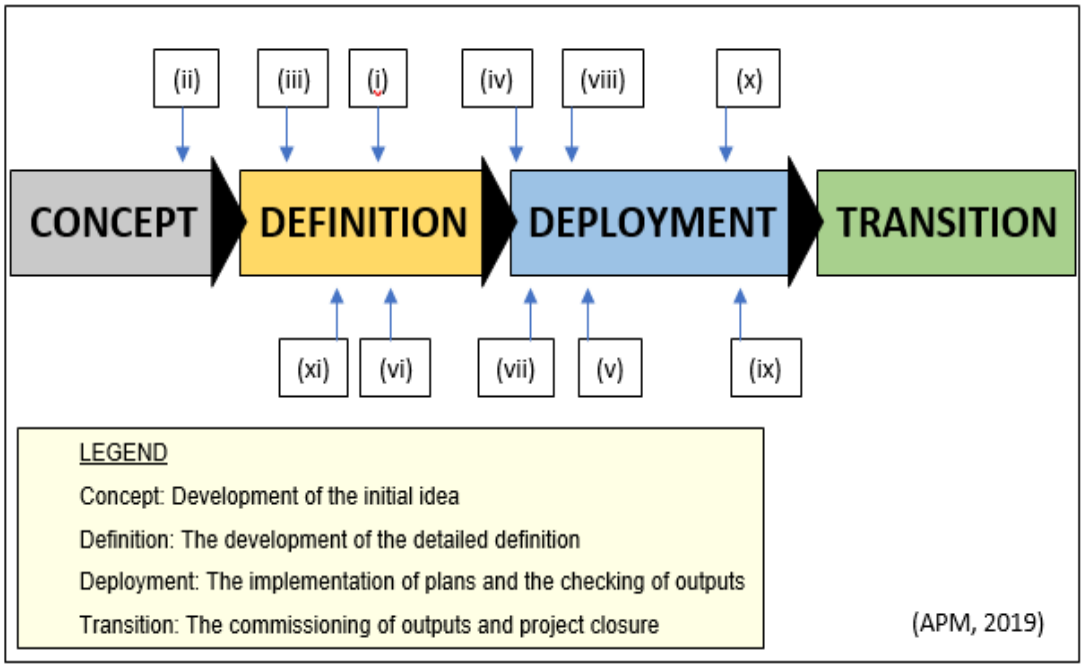


Figure 9.1 the management processes evidenced during the construction of HMS Barham (Figure 7.8 reproduced)

The research required to produce this diagram has shown that it is indeed possible to detect the Essence of Project Management as highlighted in the title of the study - 'Detecting the early essence of 'modern' Project Management – A historic case study approach (HMS Barham 1912-1915)' . The approach to the project management of HMS Barham bears a high level of similarity to ship building project lifecycles of today. This was borne out by Figure 7.51 (reproduced at Figure 9.2) where the comments from the naval PMs directly aligned the elements of the Essence of Project Management with the APM's project lifecycle.



Where the numbers (i)-(xi) relate to:

(i)	Costs, costings and estimates
(ii)	Setting of expectations or requirements
(iii)	Emerging design and the option analysis
(iv)	Use of a baseline
(v)	Progress reporting, capacity planning, planning in general and scheduling
(vi)	Estimating
(vii)	Delivery milestones planning.
(viii)	Monitoring of spend against the estimated amounts or budgets.
(ix)	Trade-offs between quality and time.
(x)	Quality testing
(xi)	Tendering

Figure 9.2 – Elements of PM identified in the focus group plotted against the APM's Project Lifecycle (Figure 7.51 reproduced.)

The study has therefore contributed directly to the knowledge of how projects were managed before what has come to be known as MPM came into being. It shows direct lines back from the methods used today and contributes new knowledge in the areas detailed in Section 9.3 above. Following the study, it is now possible to say with certainty which project management tools and techniques, as defined by the Essence of Project Management, were being used between 1912 and 1916.

It is also possible to pass direct comment on whether or not historical research of this nature can be undertaken in this field. Chapter 4 discussed Historical Studies in Project Management and revealed that there was a paucity of research on the landmark projects of our past. Difficulties in so doing have been highlighted above within Chapter 7, but despite these it has been possible to prove that this type of research is deliverable.

The possible contributions of this type of research have wide potential use and implications. As noted in chapter 4, not only can project management scholars benefit from a better understanding of projects of our past, but they also have something to contribute to the study of history — through gaining a better understanding of the capabilities of project managers, the practices and techniques used in the projects of our past, and the effects those capabilities and practices have had on subsequent projects and, perhaps even their effect on the general societal and industrial development.

This study talks directly to these areas by providing a ‘better understanding’ of the practices and techniques of previous projects. As noted in Chapter 3, despite multiple authors calls for such research, this study is unique in providing research, from a PM perspective of a major UK historic project addressing in detail, how project management tools and techniques were used to deliver the flagship projects of the past. The need indicated in Chapter 4, to provide a broader picture of project and project management history, particularly from outside the United States and from outside the defence industry, identifying practices critical for the success of projects and to document the emergence of key PM practices has been addressed.

The study could still be seen as a defence project, but it could also be viewed as a commercial ship building project delivered by a commercial yard. The research does however clearly contribute to the wider picture due to the age of the project studied and lack of association to the United States.

The clear gaps in knowledge described above are therefore filled, by this study.

This study also directly contributes to the knowledge of past project management techniques called for by recent articles discussed in Chapter 4 and also to the question of whether or not this type of research is possible state the expressed aim of their article as being the development of research that enables Project History to be taken more seriously in order that the knowledge data base can be increased enabling the historical perspectives of projects and project management to continue to be at the heart of the development of new perspectives in current research so that current research generally can be informed by past practice and past empirical explorations.

9.5 Recommendations for further research

To quote Lawrence's view of historical research (1984, p.311) it is 'a simple but crucial tool in understanding the present context of research. It pushes thinking about alternative explanations for phenomena, helps identify more and less stable concepts, and expands research horizons by suggesting new ways of studying old questions….The use of historical perspective is necessary to frame theory and research', and can be considered a necessary 'inclusion into everyday consideration of methodological thinking.'

This suggests that this study does indeed have potential implications for future research and also acts as a 'frame' within which the questions of Project Management theory, so much the focus of Turner's (2006) work, can be both further researched and re-examined.

The recent calls for further examination of project histories discussed above, were made on the basis of enhancing the ability for researchers to judge the direction of travel of Project Management as a topic. It can be seen clearly where it is today, but where has it come from and at what speed and over what timeframe? The degree of similarities to today's practices, attested to

within the construction of HMS Barham would suggest that the speed of change is relatively slow. This could mean that the development of Project Management in terms of its canon of beliefs, its methodology is more or less complete, or merely developing at a slow pace. Further research, building on this, both across other projects and other timeframes could help establish whether or not this is a valid view. This research also opens up the question of direction in terms of how the profession should look to take the development of Project Management forward. If it is accepted that the Essence of Project Management has remained relatively stable over recent time, then this might lead future research to be focused on other areas. How, for instance can we best harness developing technologies, such as social media, in order to enable project teams to have better flexibility without losing the day to day on site interaction which can be so valuable to projects? In future years could this topic become part of the Essence of Project Management?

The first step in further research should however, be focused on the conduct of other studies similar to this one in order to establish whether these processes and methods of control were unique to the John Brown shipyard, unique to warship construction, or potentially prevalent throughout the United Kingdom in terms of projects of a certain size. For endeavours such as large infrastructure project, railways for example, is it possible to construct a lifecycle for projects similar to that shown at Figure 7.8? If this can be established, a wider picture of early project management methodologies would be available and able to inform research directed at both determining the development of a PM theory and the direction of travel for the profession. This is discussed by Gaddis (2002) where he considers the need for some kind of ‘process tracing’ or pattern recognition within historical project research – can evidence of a particular pattern be seen to emerge, can evidence of any deviations in the identified patterns be found, and what could possibly explain these deviations? Having provided a view of one historical project in terms of the processes used, evidence of these patterns should now be looked for by future research using this research as the comparator. The purpose of undertaking this research can once again

be summed up by Gaddis: '…if we can draw upon the experiences of others who've had to confront comparable situations in the past, then – although there are no guarantees – our chances of acting wisely should increase proportionately.' (Gaddis, 2002, p.9).

The purpose of this research can also be summed up in the quote from Biesenthal (2016, p.11) in that it aims to provide case study-based insight that can help in 'creating new contextual theories, and thus knowledge, through case studies' which 'means that the theoretical foundation of project management grows steadily. This steady growth means that our theoretical understanding of the variety of different working solutions to different project management improves our overall knowledge'

We can learn only from the past, from things that have already happened. History therefore offers a rich base to draw upon and one which requires systematic research.

If the management of projects, how they were managed, controlled and ultimately completed, is to be fully understood, then research is needed into both the application and use of project management tools within projects of a greater age than have been studied before. This requirement has been identified as a gap in the literature and this study is therefore thought to be unique in that:

- it researches a project over a hundred years old and
- it focuses on discovering the actual management artefacts used within the delivery of the project.

The research presented here therefore helps, as described above, to fill a number of important pre-existing research gaps in current professional and academic knowledge identified in recent journals by leading academics.

References

Adler, P. S., Mandelbaum, A., Nguyen, V., and Schwerer, E. (1995). From project to process management: an empirically-based framework for analyzing product development time. *Management Science.* 41(3), pp. 458-484.

Afila, D. and Smith, N.J. (2007). Risk management and value management in project appraisal. *Proceedings of the Institution of Civil Engineers-Management, Procurement and Law.* 160(2), pp. 63-67.

Alonso, M. O., and Barredo, D. (2013). International comparative studies: Towards the integration of quantitative and qualitative methods. *European Scientific Journal.* 9(17), pp. 207-228.

Andersen, E. S. (2006). Toward a project management theory for renewal projects. *Project Management Journal.* 37(4), pp. 15-30.

Andrade, A. (2009). Interpretive research aiming at theory building: Adopting and adapting the case study design. *The Qualitative Report*. 14(1), pp. 42-60.

Association for Project Management. (1992). *APM Body of Knowledge* (1st ed.). Princes Risborough: Association for Project Management.

APM. (2006). *APM Body of Knowledge* (5th ed.). Princes Risborough: Association for Project Management.

APM. (2012). *APM Body of Knowledge* (6th ed.). Princes Risborough: Association for Project Management.

Atkinson, R. (1999). Project management: cost, time and quality, two best guesses and a phenomenon, it's time to accept other success criteria. *International Journal of Project Management.* 17(6), pp. 337-342.

Atkinson, S.R. (2008). Design to Fight. *The Naval Review of the UK Royal Navy*. 2, pp. 55-60.

Attarzadeh, I., and Ow, S. H. (2008) Modern Project Management: Essential Skills and Techniques. *Communications of the IBIMA*. 2, pp. 1-9.

Azzopardi, S. (2016) *The evolution of PM.* Available from: https://www.projectsmart.co.uk/evolution-of-project-management.php accessed 15/9/2015 [Accessed 15 September 2015].

Baccarinni, D. (1996). The concept of project complexity – a review*. International Journal of Project Management.* 14(4), pp. 201-204.

Badewi, A. (2016). The impact of project management (PM) and benefits management (BM) practices on project success: Towards developing a project benefits governance framework. *International Journal of Project Management.* 34(4), pp. 761-778.

Baker, A. R. (1997). 'The dead don't answer questionnaires': Researching and writing historical geography. *Journal of Geography in Higher Education.* 21(2), pp. 231-243.

.

Baker, B. N., Fisher, D., and Murphy, D. C. (1974). *Factors affecting project success. National Technical Information Services*. New York, NY: John Wiley & Sons.

Baker, N.R., Green, S.G. and Bean, A.S., (1986). Why R&D projects succeed or fail. *Research Management. 29*(6), pp. 29-34.

Baker, R. J. S. (1962). *Management of Capital Projects*. London: G Bell & Sons.

Baumgartner, J. S. (1963). *Project Management.* Homewood: Richard D. Irwin, Inc.

Baxter, P. and Jack, S. (2008). Qualitative case study methodology. Study design and implementation for novice researchers. *The Qualitative Report.* 13(1) pp. 544-559.

Beresford, C. (1912). *The Betrayal – being a record of Facts Concerning Naval Policy and Administration from the Year 1902 to the Present Time.* London: King & Son.

Biesenthal, C. E. (2016). The current state of project management knowledge: A misunderstanding. *Proceedings of the British Academy of Management (BAM) Conference 2016 - Thriving in Turbulent Times.* Newcastle, UK, 6-8 September 2016. Available from: https://opus.lib.uts.edu.au/handle/10453/74226 [Accessed 7 July 2018].

Birkler, J., Rushworth, D., Chiesa, J., Pung, H., Arena, M. and Schank, J. (2005). *Differences between Military and Commercial Shipbuilding: Implications for the United Kingdom's Ministry of Defence.* Santa Monica, CA and Arlington, VA: RAND Corporation.

Blackbourn, D. (2007) *The Conquest of Nature: Water, Landscape and the Making of Modern Germany.* London: Pimlico.

Bloomberg, L., D. and Volpe, M., (2016). *Completing your Qualitative Dissertation (3rd ed.).* Los Angeles: Sage.

Boje, D.M. and Boje, D.M. (2001). *Narrative Methods for Organizational and Communication Research*. London: Sage.

Boulding, K. E. (1956). General Systems Theory—the Skeleton of Science. *Management Science. 2*(3), pp. 197-208.

Brown, D.K.. (1983). *A Century of Naval Construction: The History of the Royal Corps of Naval Constructors 1883-1983*. Conway Maritime Press.

Brown, D., K. (1997*). The Grand Fleet Warship Design and Development 1906 – 1922.* Barnsley: Seaforth Publishing.

Bryman, A., and Bell, E. (2003). *Business Research Methods*. Oxford: Oxford University Press.

Buck, R. C. (1956). *On the logic of general behaviour systems theory.* Available from: https://conservancy.umn.edu/bitstream/handle/11299/184257/1_09_Buck.pdf?sequence=1 [Accessed 25 September 2021].

Burgher, P.H. (1964). PERT and the Auditor. *The Accounting Review. 39*(1), pp. 103.

Burke R. (2013). *Project Management: Planning and Control Techniques* (5th ed.). New Jersey: John Wiley & Sons.

Butterick, R. (2009). *The Project Workout* (4th ed.). Harlow: Prentice Hall.

Carr, E., H. (2018). *What is history?* London: Penguin.

Carter, S. M., and Little, M. (2007). Justifying knowledge, justifying method, taking action: Epistemologies, methodologies, and methods in qualitative research. *Qualitative Health Research.* 17(10), pp. 1316-1328.

Cepeda, G. and Martin, D. (2005), A review of case studies publishing in management decision 2003-2004: guides and criteria for achieving quality in qualitative research. *Management Decision*. Vol. 43 No. 6, pp. 851-876.

Checkland, P. B. (1981). *Systems thinking, systems practice.* Chichester: Wiley.

Chenail, R.J. (2011). Interviewing the investigator: Strategies for addressing instrumentation and researcher bias concerns in qualitative research. *Qualitative Report*, *16*(1), pp.255-262.

Churchman, C., W. (1971). *The design of inquiring systems.* New York: Basic Books.

Cicmil, S., Williams, T., Thomas, J. and Hodgson, D. (2006a). Rethinking project management: researching the actuality of projects. *International Journal of Project Management. 24*(8), pp. 675-686.

Cicmil, S. (2006b). Understanding project management practice through interpretative and critical research perspectives. *Project Management Journal. 37*(2), pp. 27-37.

Clark, W., Polakov, W., and Trabald, F. W. (1922). *The Gantt Chart, a Working Tool of Management.* New York: The Ronald Press Company.

Cleland, D., and Ireland, L. (2008). *Project Management Strategic Design and Implementation* (5th ed.). New York: McGraw Hill.

Cohen, J., (1960). A coefficient of agreement for nominal scales. *Educational and psychological measurement*, *20*(1), pp.37-46.

Cooper, K.G., (1980). Naval ship production: A claim settled and a framework built. *Interfaces. 10*(6), pp. 20-36.

Cooper, R.G. (1993). *Winning at new products*. Reading. MA: Addison–Wesley.

Corker, C. (2018), Continuity and change in the Sheffield armaments industry 1919-1930. *Journal of Management History.* 24(2), pp. 174-188.

Coyne, I. T. (1997). Sampling in qualitative research. Purposeful and theoretical sampling; merging or clear boundaries? *Journal of advanced nursing*. *26*(3), pp. 623-630.

Crawford, L. and Pollack, J. (2007). How generic are project management knowledge and practice?. *Project Management Journal. 38*(1), pp. 87-96.

Crawford, L., Pollack, J., and England, D. (2006). Uncovering the trends in project management: Journal emphases over the last 10 years. *International Journal of Project Management. 24*(2), pp. 175-184.

Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, Calif: Sage Publications.

Creswell, J. W. (2002) *Research design: Qualitative, quantitative and mixed method approaches*. London: Sage

Czarniawska-Joerges, B. and De Monthoux, P. eds., (2005). *Good novels, better management: Reading organizational realities in fiction*. Abingdon: Routledge.

Davis, M.S. (1971). That's interesting! Towards a phenomenology of sociology and a sociology of phenomenology. *Philosophy of the Social Sciences. 1*(2), pp. 309-344.

DDG Type 45: *Britain's Shrinking Air Defense Fleet*. (2019). Available from: http://www.defenseindustrydaily.com/ddg-type-45-britains-shrinking-air-defense-fleet-04941/ [Accessed 25 September 2021].

Defence Equipment and Support. (2019). Unique projects, critical outcomes. Retrieved from http://des.mod.uk/careers/project-management-roles/ [Accessed 6 December 2019].

Denzin, N. K. (1989). *Interpretive biography* (Vol. 17). Thousand Oaks, Calif: Sage Publications.

of ambiguity on project task structure in new product development. *Knowledge and Process Management. 13*(4), pp. 239-251.

Easterby-Smith, M., Thorpe, R., and Jackson, P. (2013). *Management Research.* London: Sage.

Easterby-Smith, M., Thorpe, R., and Lowe, A. (1996): *Management research: An introduction* London: Sage.

Easterby-Smith, M., Thorpe, R., and Jackson, P. (2012): *Management research* London: Sage

Edwards, G. (2014). *How the Dreadnought sparked the 20th Century's first arms race.* Available from: http://www.bbc.co.uk/news/magazine-27641717 [Accessed 25 September 2021].

Elton, G. R. (1967). *The Practice of History*. Sydney: Sydney University Press.

Erzberger, C. and Kelle, U. (2003). Making inferences in mixed methods: the rules of integration. In: A. Tashakkori and C. Teddlie eds.(2003) *Handbook of Mixed Methods in Social and Behavioural Research*. Thousand Oaks CA: Sage, pp. 457-488.

Esin, C. (2011). Narrative analysis approaches. In N. Frost (Ed.), Qualitative Research Methods in Psychology. New York, NY: McGraw Hill.

Everitt, B. S. (2006). *Medical statistics from A to Z: a guide for clinicians and medical students*. Cambridge: Cambridge University Press.

Fazar, W. (1959). Progress reporting in the Special Projects Office. *The Navy Management Review.* 4(1), pp. 9-15.

Ferraby, H., C. (1917). *The Grand Fleet.* London: Herbert Jenkins Ltd.

Ferraro, F., Pfeffer, J. and Sutton, R.I. (2005). Economics language and assumptions: How theories can become self-fulfilling. *Academy of Management review.* 30(1), pp. 8-24.

Festle, M. (2019). T*he Challenges of Learning History: What Students and SOTL Tell us.* Available from: https://tah.oah.org/content/the-challenges-of-learning-history-what-students-and-sotl-tell-us/ [Accessed 25 September 2021].

Fewings, P. and Henjewele, C. (2019). *Construction project management: an integrated approach*. Abingdon: Routledge.

Field, M., and Keller, L. (1998). *Project Management.* London: Thomson Business Press/Open University.

Fisher, C. (2007). *Researching and writing a dissertation: a guidebook for business students*. New Jersey: Prentice Hall.

Flick U. (2004). Triangulation in qualitative research. In: Flick U, von Kardoff E, Steinke I, eds. A companion to qualitative research. London: Sage.

Flick, U. (1998). *An Introduction to Qualitative Research*. London: Sage.

Floricel, S., Bonneau, C., Aubury, M., and Sergi, V. (2014). Extending project management research: Insights from social theories. *International Journal of Project Management.* 32(7), pp. 1091-1107.

Flyvbjerg, B. (2006). From Nobel Prize to project management: Getting risks right. *Project management journal. 37*(3), pp. 5-15.

Flyvbjerg, B. (2014). What you should know about megaprojects and why: An overview. *Project management journal. 45*(2), 6-19.

Fortune, J., and White, D. (2006). Framing of project critical success factors by a systems model. *International Journal of Project Management. 24*(1), pp. 53-65.

Frame, J. (2002). *The New Project Management* (2nd ed.). San Francisco: Jossey Bass.

Fusch, G. E. and Ness, L. R. (2017). How to conduct a mini-ethnographic case study: A guide for novice researchers. *The Qualitative Report. 22(3),* pp. 923-941.

Gaddis, J. (2002). *The Landscape of History: How Historians Map the Past*. New-York: Oxford University Press.

Gaddis, P. O. (1959). *The project manager*. Boston: Harvard University.

Galdas, P. (2017). Revisiting bias in qualitative research: Reflections on its relationship with funding and impact. *International Journal of Qualitative Methods*, *16*(1).

Garel, G. (2003). Pour une histoire de la gestion de projet. *Gérer et comprendre*, *74*(1). pp. 77-89.

Gay, L. R., Mills, G. E., and Airasian P. W. (2011). *Educational research: Competencies for analysis and applications* (10th ed.). Harlow: Pearson Education.

Glaser, B.G. (1978) Theoretical Sensitivity. Mill Valley, California: Sociology Press.

Geraldi, J. G., Lee-Kelley, L., and Kutsch, E. (2010). The Titanic sunk, so what? Project manager response to unexpected events. *International Journal of Project Management. 28*(6), pp. 547-558.

Geraldi, J., and Söderlund, J. (2018). Project Studies: What it is and where it is going. *International Journal of Project Management.* 36(1), pp. 55-70.

Geraldi, J., and Lechter, T. (2012). Gantt Charts revisited: A critical analysis of its roots and implications to the management of projects today. *International Journal of Managing Projects in Business.* 5(4), pp. 578-594.

Glasgow University. (2018). *Ship Building, Ship repair and Allied Industries.* Available from: https://www.gla.ac.uk/media/Media_60314_smxx.pdf [Accessed 25 September 2021].

Glasgow University. (2019). Death on the Clyde. Available from: https://www,gla.ac.uk/myglasgow/archives/news/dunaskinnews200207/deathontheclyde/ [Accessed 20 July 2019].

Gilbert M. (1969). *Winston S Churchill. Companion Volume 11, Part 3.* London: Heineman.

Grattan, R.. (2008). Crafting management history. *Journal of Management History*. 14 (2), pp. 174–183.

Groves, G. L. R. (1962). *Now it Can be Told – The Story of the Manhattan Project.* New York: Harper.

Hammersley, M. (2008). Troubles with triangulation. In Bergman M., ed. (2003) *Advances in mixed methods research.* Thousand Oaks, CA: Sage, Pp. (22-36).

Harding, S. G. (Ed.). (1987). *Feminism and methodology: Social science issues*. Bloomington: Indiana University Press.

Hansard HL Deb vol 197 cols 25-65 (November 1908).

Haussmann, T. (1991). Erklären und Verstehen: Zur Theorie und Pragmatik der Geschichtswissenschaft. Frankfurt: Suhrkamp.

Havranek, T. (1998). *Modern Project Management Techniques for the Environmental Remediation Industry.* Bocca Raton: CRC Press.

Heagney, J. (2016). *Fundamentals of project management*. New York: Amacom.

Higgins, K.L. (2018). MGT 408: *The Art and Science of Project Management. Claremont Graduate University.* Available from: http://www.academia.edu/28700886/MGT_408_The_Art_and_Science_of_Project_Management [Accessed 25 September 2021].

Hodgson, D. (2002). Disciplining the Professional: The Case for project Management. *UMIST Journal of Management Studies.* 39(6) pp. 803-821.

Hodgson, D., and Cicmil, S. (2008). The other side of projects: the case for critical project studies. *International Journal of Managing Projects in Business.* 1(1), pp. 142-152.

Hodgson, D. and Cicmil, S.(2016). Making projects critical 15 years on: a retrospective reflection (2001-2016). *International Journal of Managing Projects in Business*. 9(4) pp. 744–751.

Hoepfl, M. C. (1997). Choosing qualitative research: A primer for technology education researchers. *Journal of Technology Education.* 9(1) pp. 47-63.

Hornstein, H. A. (2015). The integration of project management and organizational change management is now a necessity. *International Journal of Project Management.* 33(2), pp. 291-298.

Hume, J. R., and Moss, M. S. (1979). *Beardmore: the history of a Scottish Industrial Giant.* London: Heineman.

Hughes, T. (1998). *Rescuing Prometheus*. New York: Vintage.

Jaafari, A.. (2003). Project management in the age of complexity and change. *Project Management Journal. 34*(4), pp. 47-57.

Jacobsson, M. and Söderholm, A. (2011). Breaking out of the straitjacket of project research: in search of contribution*. International Journal of Managing Projects in Business*. 4(3), pp. 378–388.

Jackson, R. (2010). *101 Great Warships*. New York: Rosen.

Jellicoe, E. J. R. J. (1919). *The Grand Fleet, 1914 – 1916: Its Creation, Development and Work.* New York: Doran Company.

Johnson, S. B. (2002). *The secret of Apollo: Systems management in American and European space programs.* Baltimore: JHU Press.

Johnston, F. R. (1993). *Scotts of Greenock - Shipbuilders and Engineers. 1820-1920, A Family Enterprise.* (Unpublished doctoral thesis). University of Glasgow, Glasgow.

Johnston, I. (2000). *Ships for a Nation: John Brown & Company, Clydebank*. London: Orbit Books.

Johnston, I. (2011). *Clydebank Battlecruisers.* Barnsley: Seaforth.

Johnston, I., and Buxton, I. (2013). *The Battleship Builders: Constructing and Arming British Capital Ships.* Barnsley: Seaforth.

Jonker, J., and Pennink, B. (2010). *The essence of research methodology: A concise guide for master and PhD students in management science*. New York: Springer.

Joshi, J.B. and Bertino, E. (2006). Fine-grained role-based delegation in presence of the hybrid role hierarchy, *Proceedings of the eleventh ACM symposium on Access control models and technologies* SACMAT. Lake Tahoe, (CA), 7-9 June 2006. Available from: https://dl.acm.org/doi/pdf/10.1145/1133058.1133071?casa_token=4x-sPeguxnAAAAAA%3A3rFHMm5Gw-MILP3WzkTYr9GYwrcFH4nZVpl5Wh-nycS373HD7TD-woulq5vhUMVze5PFXvMxys3o [Accessed 17 October 2015]

Kakabadse, N.K., and Steane, P. (2010). Meaning and interpretation: insights and discourse. *Journal of Management History.* 16(3) pp. 346-366.

Kast, F. E., and Rosenzweig, J. E. (1972). General systems theory: Applications for organization and management. *Academy of Management Journal.* 15(4), pp. 447-465.

Keane, R.G. and Tibbitts, B.F. (1996). A revolution in warship design: Navy-industry integrated product teams. *Journal of ship production.* 12(04), pp. 254-268.

Kelley, J. E., and Walker, M. R. (1959) Critical-path planning and scheduling. Proceedings of Eastern Joint Computer C:onference, December 1959, 160-173.

Kerzner, H. R. (2009). *Project management: a systems approach to planning, scheduling, and controlling*. New Jersey: John Wiley & Sons.

Kerzner, H. R. (2013). *Project Management: A Systems Approach to Planning, Scheduling, and Controlling* (11th ed.). New Jersey: John Wiley & Sons.

Kloppenborg, T.J. (2012). *Contemporary Project Management.* 2nd ed. Mason: Southwestern.

Klopper, H. (2008). The qualitative research proposal. *Curationis*, *31*(4), pp. 62-72.

Kieser, A. (1994). Why organization theory needs historical analyses—and how this should be performed. *Organization Science.* 5(4), pp. 608-620.

Koskela, L., and Howell, G. (2002). The underlying theory of project management is obsolete. *Proceedings of PMI Research Conference 2002* (pp. 293–301). Newtown Square, PA: Project Management Institute.

Kozak-Holland, M. (2005). *Churchill's Adaptive Enterprise: Lessons for Business Today*. Ontario: Multi-Media Publication Inc.

Kozak-Holland, M. (2007). *Project lessons from the great escape (Stalag Luft III)*. Ontario: Multi-Media Publication Inc.

Kozak Holland, M. (2011). *The History of Project Management.* Ontario: Multi-Media Publication Inc.

Kozak-Holland, M. (2013). *The relevance of historical project lessons to contemporary business practice.* (Unpublished doctoral thesis). University of Salford, Salford.

Kozak-Holland, M., and Procter, C. (2014). Florence Duomo project (1420–1436): Learning best project management practice from history. *International Journal of Project Management*. 32(2), pp. 242-255.

Kristeller, P.O. (1961). Some problems of historical knowledge. *The Journal of Philosophy.* 58(4), pp. 85-110.

Lambert, N. A. (2012). *Planning Armageddon – British Economic Warfare and the First World War.* London: Harvard University Press.
Lander, B. (2011). *Empires Apart: A History of American and Russian Imperialism.* Cambridge: Pegasus Books.

Landis, J. R., and Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics.* 33(1), pp. 159-174.
Langston, C. (2013). Development of generic key performance indicators for PMBOK using a 3D project integration model. *Construction Economics and Building*. 13(4), pp. 78-91.

Last, J. M. (2001). A Dictionary of Epidemiology. *American Journal of Epidemiology*, *154*(4), pp. 389-389.

Lawrence, B. S. (1984). Historical perspective: Using the past to study the present. *Academy of Management Review.* 9(2), pp. 307-312.

Lee, S. J. (1992). Quantitative versus qualitative research methods—Two approaches to organisation studies. *Asia Pacific Journal of Management.* *9*(1), pp. 87-94.

Lee-Kelley, L., and Kin Leong, L. (2003). Turner's five-functions of project-based management and situational leadership in IT services projects. *International Journal of Project Management.* 21(8), pp. 583-591.

Lee-Kelley, L. (2011). *Projects managers: lessons learned?* Cranfield University. Available from:

http://www.dspace.lib.cranfield.ac.uk/bitstream/handle/1826/6501/Project_managers_lessons_learned.pdf?sequwncw=1 [Accessed 23 May 2015].

Leech, N. L., and Onwuegbuzie, A. J. (2008). Qualitative data analysis: A compendium of techniques and a framework for selection for school psychology research and beyond. *School Psychology Quarterly.* 23(4), pp. 587.

Lenfle, S., and Loch, C. (2010). Lost roots: how project management came to emphasize control over flexibility and novelty. *California Management Review.* 53(1), pp. 32-55.

Lenfle, S. (2014). Toward a genealogy of project management: Sidewinder and the management of exploratory projects. *International Journal of Project Management.* 32(6), pp. 921-931.

Levering, R., Ligthart, R., Noorderhaven, N. and Oerlemans, L. (2013). Continuity and change in interorganizational project practices: The Dutch shipbuilding industry, 1950–2010. *International Journal of Project Management.* 31(5), pp. 735-747.

Levi, K. and Arsanjani, A. (2002). A goal-driven approach to enterprise component identification and specification. *Communications of the ACM.* 45(10), pp. 45-52.

Lewis, K. (2003). *End of Construction.* Available from: http://www.pancanal.com/eng/history/history/end.html [Accessed 25 September 2021].

Lipke, W. (1999). Applying management reserve to software project management. *Journal of Defense Software Engineering.* 3(1), pp. 17-21.

Lock, D. (2013). Project Management, 10th Edition, Gower, Farnham

Long, R. G., Wite, M. C., Friedman, W. H., and Brazeal, D. V. (2000). The Qualitative Versus Quantitative Research Debate: A Question of Metaphorical Assumptions? *International Journal of Value-Based Management.* 13(2), pp. 189-197.

Lorko, M., Servátka, M. and Zhang, L. (2019). Anchoring in project duration estimation. *Journal of Economic Behavior and Organization.* 162, pp. 49-65.

Lu, Y., Luo, L., Wang, H., Le, Y., and Shi, Q. (2015). Measurement model of project complexity for large scale projects from task and organisation perspective. *International Journal of Project Management.* 33(3), pp. 610-622.

Luo, L., He, Q., Jaselskis, E.J. and Xie, J. (2017). Construction project complexity: research trends and implications. *Journal of construction engineering and management*, *143*(7), p.04017019.

Lyneis, J.M. and Ford, D.N. (2007). System dynamics applied to project management: a survey, assessment, and directions for future research. *System Dynamics Review: The Journal of the System Dynamics Society.* 23(2-3), pp. 157-189.

Marshall, N., and Bresnen, M. (2013). Tunnel vision? Brunel's Thames Tunnel and project narratives. *International Journal of Project Management*. 31(5), pp. 692-704.

Marshall, C. and Rossman, G. B. (2014). *Designing qualitative research.* London: Sage.

Martino, R. L. (1964). *Project Management and Control Volume I – Finding the Critical Path.* New York: The American Management Association.

Martino, R. L. (1965). *Project Management and Control Volume III – Allocating and Scheduling Resources.* New York: The American Management Association.

Maylor, H. (2005). *Project Management* (3rd ed.) Harlow: Prentice Hall.

Mays, N., and Pope, C. (1995). Rigour and qualitative research. *BMJ: British Medical Journal*. 311(6997), pp. 109-112.

McCahon, C. S. (1993). Using PERT as an approximation of fuzzy project-network analysis. *IEEE Transactions on Engineering Management.* 40(2), pp. 146-153.

McDowell, W. H. (2002). *Historical research. A guide for writers of dissertations, theses.* London: Pearson.

McHugh, M. L. (2012). Interrater reliability: the Kappa statistic. *Biochemia Medica*. 22(3), pp. 276-282.

Meredith, J. R., and Mantel Jr, S. J. (2003). *Project management: a managerial approach* (5th ed.). New Jersey: John Wiley & Sons.

Meredith, J. R., and Mantel Jr, S. J. (2011). *Project management: a managerial approach* (8th ed.). New Jersey: John Wiley & Sons.

Merriam, S. B. (2009). *Qualitative Research: a guide to design and interpretation*. San Francisco: Jossey-Bass.

Miles, M. B., Huberman, A. M., Saladana, J. (2014). *Qualitative Data Analysis A Methods Sourcebook*. London: Sage.

Minami, N.A., Soto, L.L. and Rhodes, D.H.(2010). Dynamic lean management of the naval construction process. *Engineering Management Journal. 22*(2), pp. 36-43.

Morris, P. W. G. (1997). *The Management of Projects.* London: Telford.

Morris, P.W.G. (2001). Updating the project management bodies of knowledge. *Project Management Journal.* 32(3), pp. 21-30.

Morris, P. W. G. (2013). *Reconstructing Project Management.* Chichester: Wiley

Morris, P.W., Crawford, L., Hodgson, D., Shepherd, M.M. and Thomas, J. (2006). Exploring the role of formal bodies of knowledge in defining a profession–The case of project management. *International Journal of Project Management.* 24(8), pp. 710-721.

Morris, P. W. G., Patel, M. B., and Wearne, S. H. (2000). Research into revising the APM project management body of knowledge. *International Journal of Project Management.* 18(3) pp. 155-164.

Morris, P.W. and Hough, G.H. (1987). *The Anatomy of Major Projects: A study of the reality of project management*. New York: Wiley.

Morris, P. W. G., Jamieson, A., and Shepherd, M. M. (2006). Research updating the APM body of knowledge 4th edition. *International Journal of Project Management.* 24(6), pp. 461-473.

Morse, J. M. (2003). A review committee's guide for evaluating qualitative proposals. *Qualitative Health Research*. 13(6), pp. 833-851.

Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods.* 1, 13–22

Moss, M. (2002). *Death on the Clyde.* Available from: www.gla.ac.uk/myglasgow/archives/news/dunaskinnews200207/deathontheclyde/ [Accessed 28 June 2016].

Munns, A.K. and Bjeirmi, B.F. (1996). The role of project management in achieving project success. *International Journal of Project Management*. 14(2), pp. 81-87.

Murphy, J.G. (1998). Kant on theory and practice. In Murphy, J.G. ed. (1998) *Character, Liberty, and Law.* New York: Springer, pp, 5-32.

Muzio, E., Fisher, D. J., Thomas, E. R., and Peters, V. (2007). Soft Skills Quantification (SSQ) For Project Manager Competencies. *Project Management Journal*. 38(2), pp. 30-38.

NAO. (2015). *Major Projects Report 2014 and the Equipment Plan 2014 to 2024.* Available from: https://www.nao.uk/wp-content/uploads/2015/01/Major-projects-reports-2014-and-the-equipment-plan-2014-to-20151.pdf [Accessed 15 July 2016].

Nasa. (2019). *EVM Tutorial* Available from: https://www.nasa.gov/evm/tutorial [Accessed 28 December 2016].

Naughton, E., Education, I.P.M.A., and Barnes M. (2013). The Iron triangle under threat. *PM Word Journal.* 2(12), pp. 1-4.

Naval Technology (2021) Type 26 Global Combat Ship (GCS) Programme Retrieved from: https://www.naval-technology.com/projects/global-combat-ship-gcs-programme/ [Accessed 24 September 2021]'

Naz, A. N., Gementiza, M. A., Sicio, A., Zhang, H. (2008). PERT: *The Polaris Missile Project Case.* Available from: http://www.academia.edu/11933878/PERT_The_Polaris_Missile_Project_Case [Accessed 12 January 2016].

Nicholas, J. M. (1990). *Managing Business and Engineering Projects.* New Jersey: Prentice-Hall.

Nisbet, R. (2017) *History of the idea of progress.* Abingdon: Routledge.

Norden, P. V. (1960). On the anatomy of development projects. *IRE Transactions on Engineering Management.* 7(1), pp. 34-42.

Norris, N. (1997). Error, bias and validity in qualitative research. *Educational action research*, *5*(1), pp.172-176.

OGC. (2009). *Managing Successful Projects with Prince 2* (5th ed.). London: The Stationary Office.

Oisen, R. P. (1971). *Can project management be defined?* Available from: https://www.pmi.org/learning/library/project-management-defined-concept-1950 [Accessed 12 January 2016].

Onwuegbuzie, A. J., and Leech, N. L. (2005). Taking the 'Q' out of research: Teaching research methodology courses without the divide between quantitative and qualitative paradigms. *Quality and Quantity.* 39(3), pp. 267-295.

Oxford Dictionary. (2014). Available from: http://www.oxforddictionaries.com/definition/english/beginning [Accessed 13 January 2016].

Pant, I., and Baroudi, B. (2008). Project management education: The human skills imperative. *International Journal of Project Management.* 26(2), pp. 124-128.

Patton, M. Q. (1990). *Qualitative evaluation and research methods*. London: Sage.

Patton, M. Q. (2015). *Qualitative research and methods: Integrating theory and practice.* London: Sage.

Peart, A. T. (1971) *Design of Project Management Systems and Records*. Aldershot: Gower.

Peebles, H. B. (1987). *Warship Building on the Clyde: Naval orders and the prosperity of the Clyde shipbuilding industry 1889-1939.* Edinburgh: John Donald.

Pinney, B. (2001). *Projects, Management and Protean Times: Engineering Enterprise in the United States.* (Unpublished doctoral thesis.) Massachusetts Institute of Technology, Massachusetts.

Pinto, J. K., and Trailer, J. W. (1998). *Leadership skills for project managers.* Newtown Square, PA. Project Management Institute.

PMI (2017) A guide to the project management body of knowledge (PMBOK guide) sixth edition. Newtown Square, PA. Project Management Institute.

Pollalis, S. N., Otto, C., Hembre, D., Payette, J., and Pingree, G. (1988). *The Golden Gate Bridge: The 50th Anniversary Celebration*. Cambridge: Harvard University.

Pollock, D. H. (1905). *The Shipbuilding Industry: Its History, Practice, Science and Finance.* London: Methuen & Co.

Pollack, J., Helm, J. and Adler, D., 2018. What is the Iron Triangle, and how has it changed?, *International Journal of Managing Projects in Business*. 11(2), pp. 527–547.

Power, W.D. (1962). *PERT Program evaluation and review technique; CPM Critical Path Method.* Available from: http://www.egrove,olemiss.edu/cgi/viewcontent.cgi?article=1128&context=dl_tr [Accessed 25 September 2021].

Procter, C. and Kozak-Holland, M. (2019). The Giza pyramid: learning from this megaproject. *Journal of Management History*. 25 (3), pp. 364–383.

Procter, C.T. and Kozak-Holland, M.P.(2015). Developing a project management case study from history. In *BAM2015 Conference Proceedings.* Portsmouth, 2015. British Academy of Management. Available from: http://usir.salford.ac.uk/id/eprint/45167/3/MKCP%20BAM%20Paper%202015.pdf [Accessed 19 March 2016].

Project Management Institute. (2015). *About Us.* Available from: http://www.pmi.org/About-Us.aspx [Accessed 20 May 2015].

Ramadan, W.H. and Tu, Z. (2012). *Project management literature: Gaps and opportunities*. Berlin: E-Leader.

Reay Atkinson, S., Skinner, C.J., Joiner, K.F., Caldwell, N. and Swidan, A. (2020). Important trends and junctures in warship design-Redux. *The NAVY-Journal of the Navy League of Australia*. *82*(3), pp. 7-13.

Reiners, G. M. (2012). Understanding the differences between Husserf's (descriptive) and Heidegger's (interpretive) phenomenological research. *Journal of Nursing Care.* 1(5), Pp. 1-3.

Reiss, G. (2015). The Beginnings of Construction Projects. *Project Manager Today. 16-19.*

Reybold, L. E., Lammert, J., and Stribling, S. M. (2013). Participant selection as a conscious research method: Thinking forward and deliberation of 'emergent' findings. *Qualitative Research.* 13, pp. 699–716.

Riley, R.C. (1985). The Evolution of the Docks and Industrial Buildings in Portsmouth Royal Dockyards 1698-1914. Portsmouth: Portsmouth City Council.

Ritchie, L. A. (Ed.). (1992). *The Shipbuilding Industry: A Guide to Historical Records*. Manchester: Manchester University Press.

Roseboom, M. D. G., Clark, J. H., and Fazar, W. (1959). Application of a technique for research and development program evaluation. *Operations Research.* , 7(5), pp. 646-669.

Rosen, D.E., Schroeder, J.E. and Purinton, E.F. (1998). Marketing high tech products: lessons in customer focus from the marketplace. *Academy of Marketing Science Review.* 6, pp. 1-17.

Rossman, G. B., and Wilson, B. L. (1985). Numbers and words: Combining quantitative and qualitative methods in a single large-scale evaluation study. *Evaluation Review*. 9(5), pp. 627-643.

Royal Navy(i). (2014). *Queen Elizabeth Class Support Plans*. Royal Navy News. Available from: http://www.royalnavy.mod.uk/the-equipment/ships/future-ships/aircraft-carrier [Accessed 2 August 2016].

Royal Navy (ii). (2014). *Latest Look at Navy's Future Frigates as Type 26 Design Nears Completion.* Available from: http://www.royalnavy.mod.uk/news-and-latest-activity/news/2013/september/11/ 130911-type-26 [Accessed 2 August 2016].

Salisbury Cathedral (2021) History and Conservation. Available from: https://www.salisburycathedral.org.uk/history/new-start [Accessed 31 August 2021].

Sampson, P. M. (1996). Common sense in qualitative research. *International Journal of Market Research*. 38(4), pp. 329.

San Cristóbal, J.R. 2017. Complexity in project management. *Procedia Computer Science*, *121*, pp.762-766.

Sankaran, S. (2018). Megaproject management and leadership: a narrative analysis of life stories–past and present. *International Journal of Managing Projects in Business.* 11 (1), pp. 53–79.

Sapolsky, H. M. (1972). *The Polaris System Development – Bureaucratic and Programmatic Success in Government.* Cambridge: Harvard University Press.

Schwartz, J. M., and Cook, T. (2002). Archives, records, and power: The making of modern memory. *Archival Science. ,* 2(1-2), pp. 1-19.

Scott, J. D. (1962). *Vickers, a History.* London: Weidenfeld and Nicolson.

Scranton, P. (2008). Le management projet. Nouvel objet de l'histoire d'entreprise. *Revue Française de Gestion.* 34, pp. 188–189.

Seale, C. (1999). Quality in qualitative research. *Qualitative inquiry*. 5(4), pp. 465-478.

Seymour, T., and Hussein, S. (2014). The History of Project Management. *International Journal of Management and Information Systems. 18*(4), pp. 233-240.

Shenhar, A. J., and Dvir, D. (1996). Toward a typological theory of project management. *Research Policy.* 25(4), pp. 607-632.

Shenhar, A.J. and Dvir, D. (2007). *Reinventing project management: the diamond approach to successful growth and innovation*. Brighton, (Ma):Harvard Business Review Press.

Shipley, M. F., de Korvin, A., and Omer, K. (1997). BIFPET methodology versus PERT in project management: fuzzy probability instead of the beta distribution. *Journal of Engineering and Technology management.* 14(1), pp. 49-65.

Snyder, J. R. (1987). *Modern Project Management: how Did We Get Here--where Do We Go?* Newtown Square, PA: Project Management Institute.

Söderlund, J., and Lenfle, S. (2011). Project history*. International Journal of Project Management.* 29(5), pp. 491-493.

Söderlund, J., and Lenfle, S. (2013). Making project history: Revisiting the past, creating the future. *International Journal of Project Management.,* 31(5), pp. 653-662.

Söderlund, J., and Maylor, H. (2012). Project management scholarship: Relevance, impact and five integrative challenges for business and management schools. *International Journal of Project Management*. 30(6), pp. 686-696.

Special Projects Office Bureau of Naval Weapons Department of the Navy – Washington D.C. (1958). *PERT Program Evaluation Research Task Summary Report* Phase 1. Available from: http://www.dtic.mil/dtic/tr/fulltext/u2/735902.pdf [Accessed 1 August 2019].

Spectator. (1967). *Table-talk.* Available from: http://archive.spectator.co.uk/article/29th-september-1967/7/ [Accessed 10 June 2017].

Staff, G. (2014). *German Battlecruisers of World War One: Their Design, Construction and Operations.* Barnsley: Seaforth.

Stevenson, D.H. and Starkweather, J.A. (2010). PM critical competency index: IT execs prefer soft skills. *International Journal of Project Management.* 28(7), pp. 663-671.

Stratmann, J.P., Wilson, P.A., Molland, A.F. and Courts, M.D. (2006). Project management of early stage warship design. *Transactions of The*

Royal Institution of Naval Architects Part A: International Journal of Maritime Engineering. 148(2), pp. 1-14.

Strauss, A. L., and Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques.* Newbury Park, (CA): Sage.
Stretton, A. (2007). A short history of modern project management. *PM World Today.* 9(10), pp. 1-18.

Stroobants, V. (2005). Stories about learning in narrative biographical research. *International Journal of qualitative studies in education.* 18(1), pp. 47-61.

Sumida, J. T. (2004). Re-imagining the History of Twentieth-century Navies. In: D. Finamore (ed.), (2004) *Maritime History as World History.* Salem MA: History Press, pp.167–82.

Surrey University (2017). Available from: https://libweb.surrey.ac.uk/library/skills/Introduction%20to%20Research%20and%20Managing%20Information%20Leicester/page61.htm [Accessed 15 October 2017].

Tatikonda, M.V. and Rosenthal, S.R. (2000). Technology novelty, project complexity, and product development project execution success: a deeper look at task uncertainty in product innovation. *IEEE Transactions on engineering management*, *47*(1), pp.74-87.

Taylor, T. (2015). The future is bright. *Construction Journal.* 12(3), pp.12-13.

Tellis, G.J. and Golder, P.N. (1996). First to market, first to fail? Real causes of enduring market leadership. *MIT Sloan management review.* 37(2), pp. 65-75.

Thabane, L., Ma, J., Chu, R., Cheng, J., Ismaila, A., Rios, L. P., and Goldsmith, C. H. (2010). A tutorial on pilot studies: the what, why and how. *BMC Medical Research Methodology.* 10(1), 1.

Thomas, R.D. and Patterson B. (2010). *Dreadnoughts a Photographic History*. Stroud: The History Press.

Thurmond, V. A. (2001). The point of triangulation. *Journal of nursing scholarship.* 33(3), pp. 253-258.

Tonchia, S. (2018). *Industrial Project Management*. Berlin: Heidelberg.

Tourish, D. (2019). *Management studies in crisis: Fraud, deception and meaningless research*. Cambridge: Cambridge University Press.

Turnbull, D. (1993). The ad hoc collective work of building gothic cathedrals with templates, string, and geometry. *Science, Technology, and Human Values.* 18(3), pp. 315-340.

Turner, J. R. (2006a). Towards a theory of project management: The nature of the project governance and project management. *International Journal of Project Management.* 2(24), pp. 93-95.

Turner, J. R. (2006b). Towards a theory of project management: The nature of the project. *International Journal of Project Management.* 24(1), pp. 1-3.
Turner, J. R. (2006c). Towards a theory of project management: the functions of project management. *International Journal of Project Management.* 3(24), pp. 187-189.

Turner, J. R. (2006d). Towards a theory of project management: The nature of the functions of project management. *International Journal of Project Management.* 4(24), pp. 277-279.

Turner, J. R. (2018). *Rodney Turner Innovation Academy Lille CV.* Available from: http://www.skema,edu/Lists/skCV/TURNER-skema.pdf [Accessed 5 November 2018].

Vahidi, R., and Greenwood, D. (2009). *Triangles, trade-offs and success: A critical examination of some traditional project management paradigms*. In CIB Joint International Symposium 2009-Construction Facing Worldwide Challenges. 27-30.

VanWynsberghe, R., and Khan, S. (2007). Redefining case study. *International journal of qualitative methods*, *6*(2), pp.80-94.

Vocabulary.com. (2019). Available from: https://www.vocabulary.com/dictionary/ synergistic [Accessed 12 July 2019]

von Eye, A., and von Eye, M. (2005). Can one use Cohen's Kappa to examine disagreement? *Methodology.* 1 (4), pp. 129-142.

Webster Dictionary. (2014). Available from: http://www.merriam-webster.com/ dictionary/start [Accessed 17 October 2014].

Walker. A., and Hughes, W. P. (1984). Private Industrial Project Management: a systems based case study. *Construction Management and Economics.* 2(2), pp. 93-110.

Warrens, M.J. (2010). Cohen's kappa can always be increased and decreased by combining categories. *Statistical Methodology*, *7*(6), pp.673-677.

Westminster Abbey (2021) History of Westminster Abbey. Available from: https://www.westminster-abbey.org/about-the-abbey/history/history-of-westminster-abbey [Accessed 1 September 2021].

White, D., and Fortune, J. (2009). The project-specific formal system model. *International Journal of Managing Projects in Business. 2*(1), pp. 36-52.

Whitty, S. J., and Schulz, M. F. (2007). The impact of Puritan ideology on aspects of project management. *International Journal of Project Management.* 25(1), pp. 10-20.

Wilde, R. (2001). The Creation of St Petersburg. Available from: http://europeanhistory.about.com/library/weekly/aa021201a.htm [Accessed 25 September 2021].

Wilson, V. (2014). Research methods: triangulation. *Evidence Based Library and Information Practice.* 9(1), pp. 74-75.

Willis, B.E. (1995). APM project-management body of knowledge: the European view. *International Journal of Project Management.* 13(2), pp. 95-98.

Wren, D. A. (1994). *The Evolution of Management Thought.* New York: John Wiley & Sons.

Yeo, K. T. (1993). Systems thinking and project management—time to reunite. *International Journal of Project Management*. 11(2), pp. 111-117.

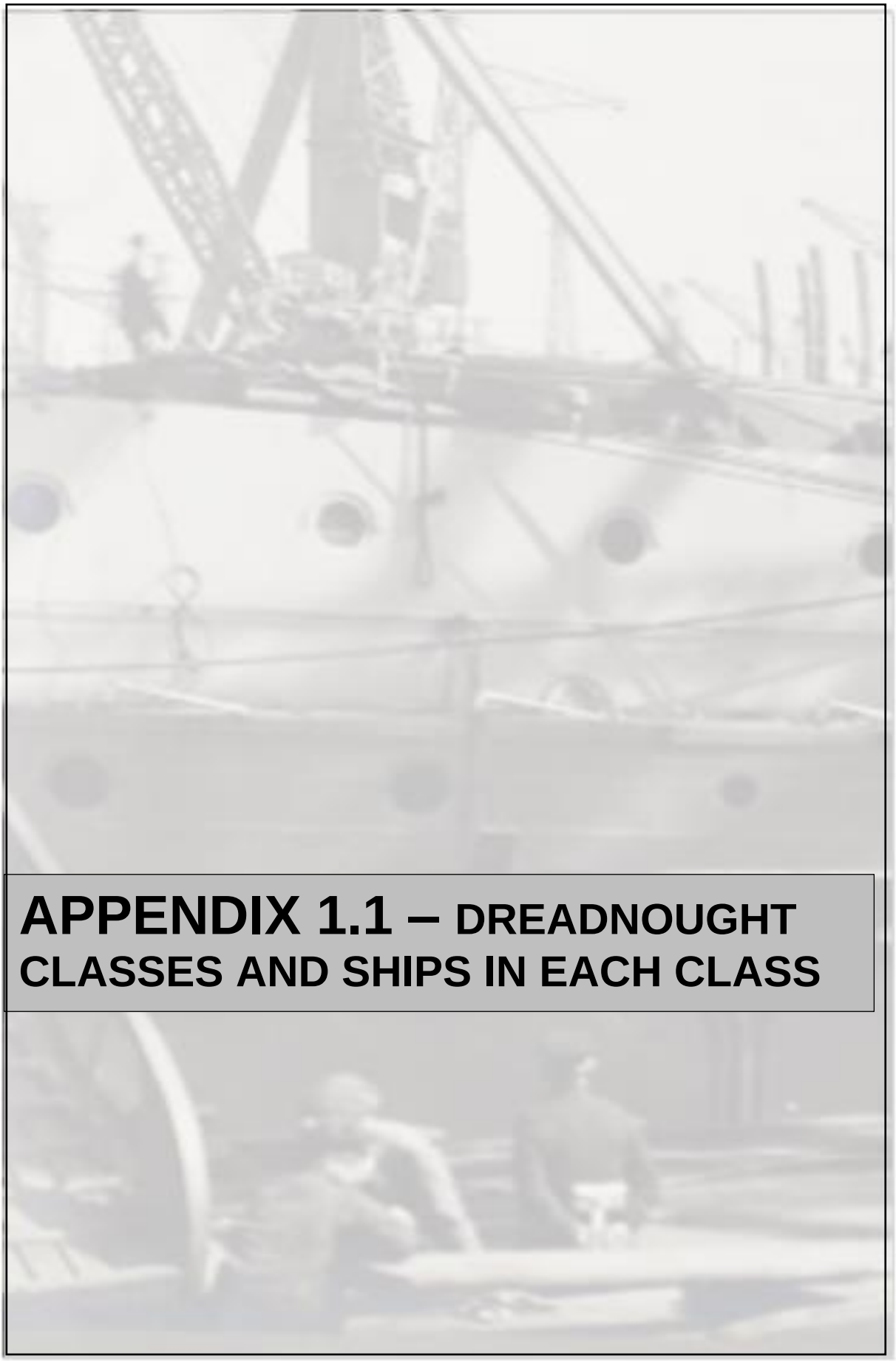
Yin, R.K. (1994). Case study research: Design and methods. London: Sage.

Young, K. (2002). The Royal Navy's Polaris lobby, 1955–62. *Journal of Strategic Studies.* 25(3), pp. 56-86.

Zwikael, O. (2009). The relative importance of the PMBOK Guide's nine Knowledge Areas during project planning. *Project Management Journal.* 40(4), pp. 94-103.

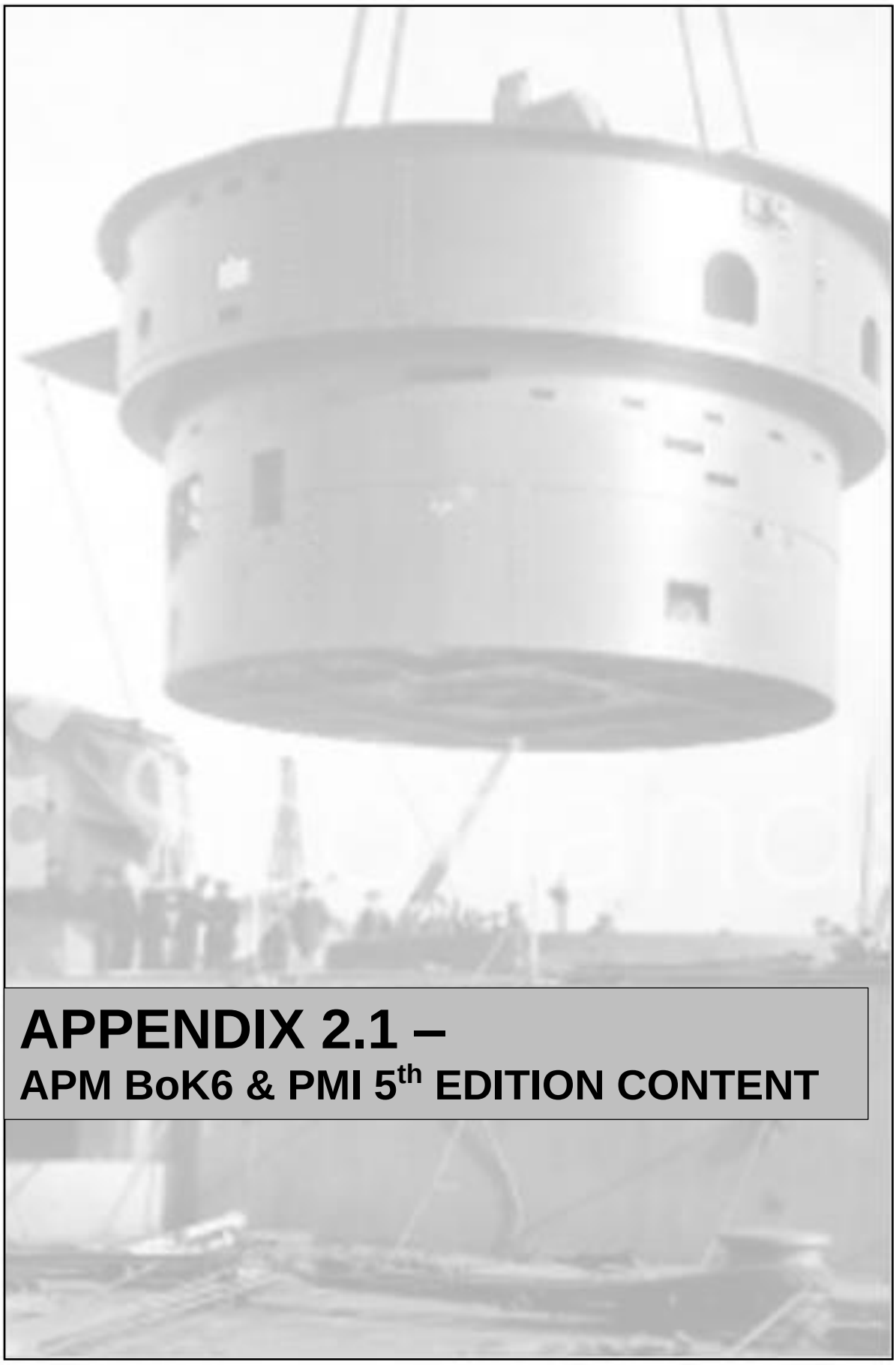
Zwikael, O., Chih, Y. Y., and Meredith, J. R. (2018). Project benefit management: Setting effective target benefits. *International Journal of Project Management, 36(4),* 650-658.

APPENDICS



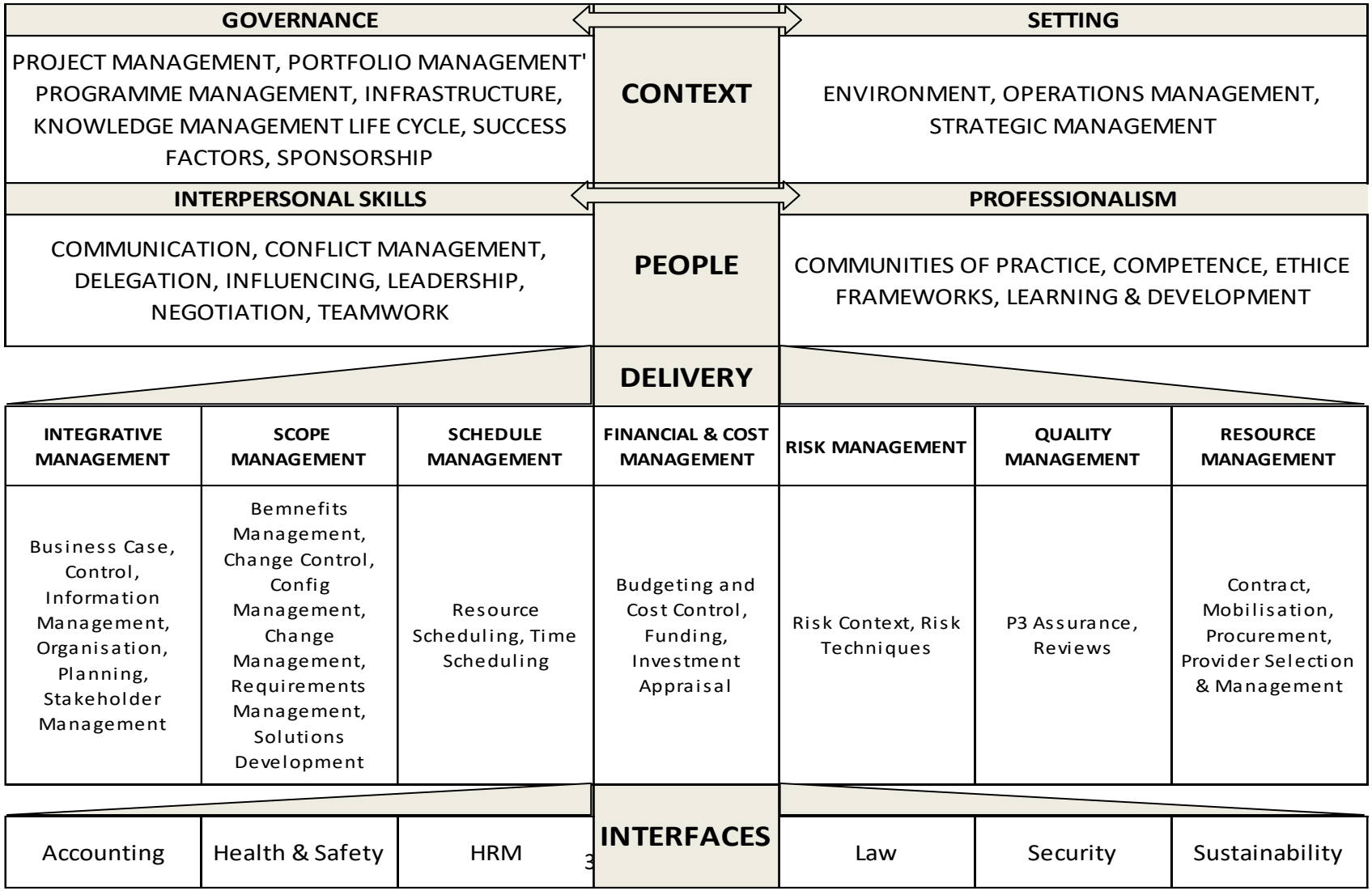
APPENDIX 1.1 – DREADNOUGHT CLASSES AND SHIPS IN EACH CLASS

1ST OF CLASS - HMS	YEAR (of commission)	COVERSHELD AT BRASS FOUNDRY	BUILT AT/ COST/ LAID DOWN	OTHERS IN CLASS (HMS..)/ BUILT BY:
DREADNOUGHT	1906	2 X COVERS: 213 & 213a	Portsmouth Dockyard Cost: £1,785,683 Laid down: Oct 1905	
NEPTUNE	- see NEPTUNE 1911 below.	- see NEPTUNE 1911 below.		
ROYAL SOVEREIGN	1916	3 X COVERS FOR THE CLASS: 305, 305a AND 305b	Portsmouth Dockyard Cost: £2,570,504 Laid down: Jan 1914	REVENGE - (VICKERS) RESOLUTION - (PALMERS) ROYAL OAK - (DEVONPORT) RAMILLES - (BEARMORE)
RAMILLES	1916	None - see Royal Sovereign.		
BELLEROPHON	1909	2 x covers: 222 and 223	Portsmouth Dockyard Cost: £1,763,491 Laid down: Dec 1906	SUPERB - (ELSWICK) TEMERAIRE - (PORTSMOUTH)
ST. VINCENT	1909	1 x cover for the class: 237	Devonport Dockyard Cost: £1,721,970 Laid down: May 1909	COLLINGWOOD - (VICKERS) VANGUARD - (DEVONPORT)
NEPTUNE	1911	1 x cover: 243	Portsmouth Dockyard Cost: £1,668,916 Laid down: Jan 1911	
COLOSSUS	1911	1 x cover: 247	Built by Scotts (Clyde) Cost: £1,672,103 Laid down: July 1911	HERCULES - (PALMERS)
ORION	1912	2 x covers: : 248 and 248a	Portsmouth Dockyard Cost: £ Laid down:	CONQUEROR - (BEARMORE) MONARCH - (ARMSTRONG) THUNDERER - (THAMES IRON WORKS)
KING GEORGE V	1913	2 x covers: 260 and 260a	Portsmouth Dockyard Cost: £1,961,096 Laid down: Jan 1911	CENTURION - (PORTSMOUTH) AUDACIOUS - (CAMMELL LAIRD) AJAX - (SCOTTS)
IRON DUKE	1914	3 x covers: 268, 268a and 268b	Portsmouth Dockyard Cost: £1,945,824 Laid down: Jan 1914	MARLBOROUGH - (PORTSMOUTH) BENBOW - (BEARDMORE) EMPEROR OF INDIA - (VICKERS)
ERIN	1914	1 x cover: 334	Built by Vickers Cost: £2,500,000 est. Laid down: Dec 1911	
AGINCOURT	1914	1 x cover: 332	Built by Armstrong Cost: £ Laid down: Sep 1911	
QUEEN ELIZABETH	1916	6 x covers: 294, 294a, 294B, 294c, 294d, 294e	Portsmouth Dockyard Cost: £3,014,103 Laid down: Oct 1912	WARSPITE - (DEVONPORT) BARHAM - (JOHN BROWN) VALIANT - (FAIRFIELD MALAYA - ARMSTRONG WHITWORTH
CANADA	1915	1 x cover: 332 (as for Agincourt)	Cost: £2,500,000 est. Laid down: Dec 1911 Laid down:	

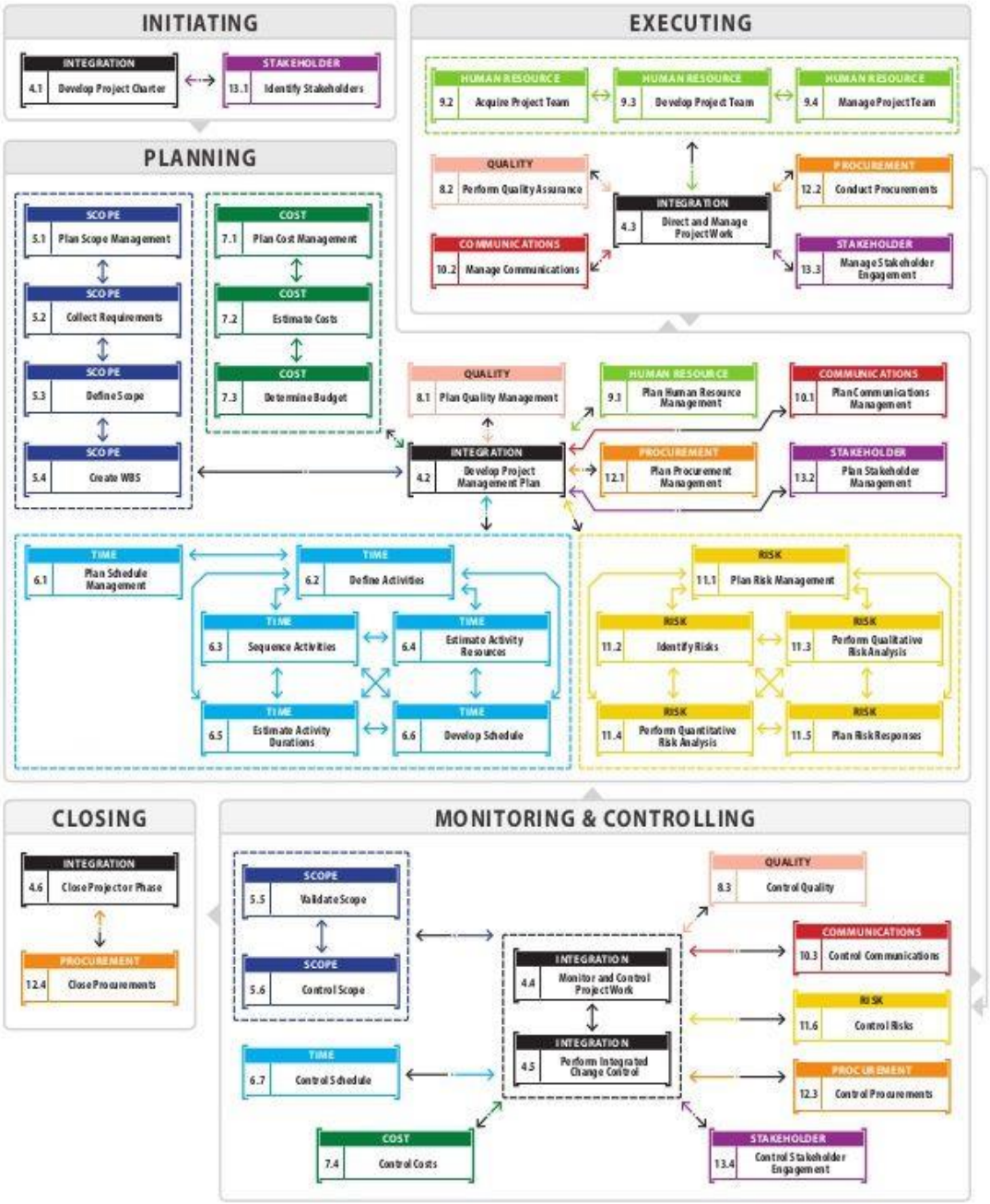


APPENDIX 2.1 –
APM BoK6 & PMI 5th EDITION CONTENT

APM BoK6 CONTENT:



PMBOK® GUIDE 5TH EDITION - 47 PROJECT MANAGEMENT PROCESSES



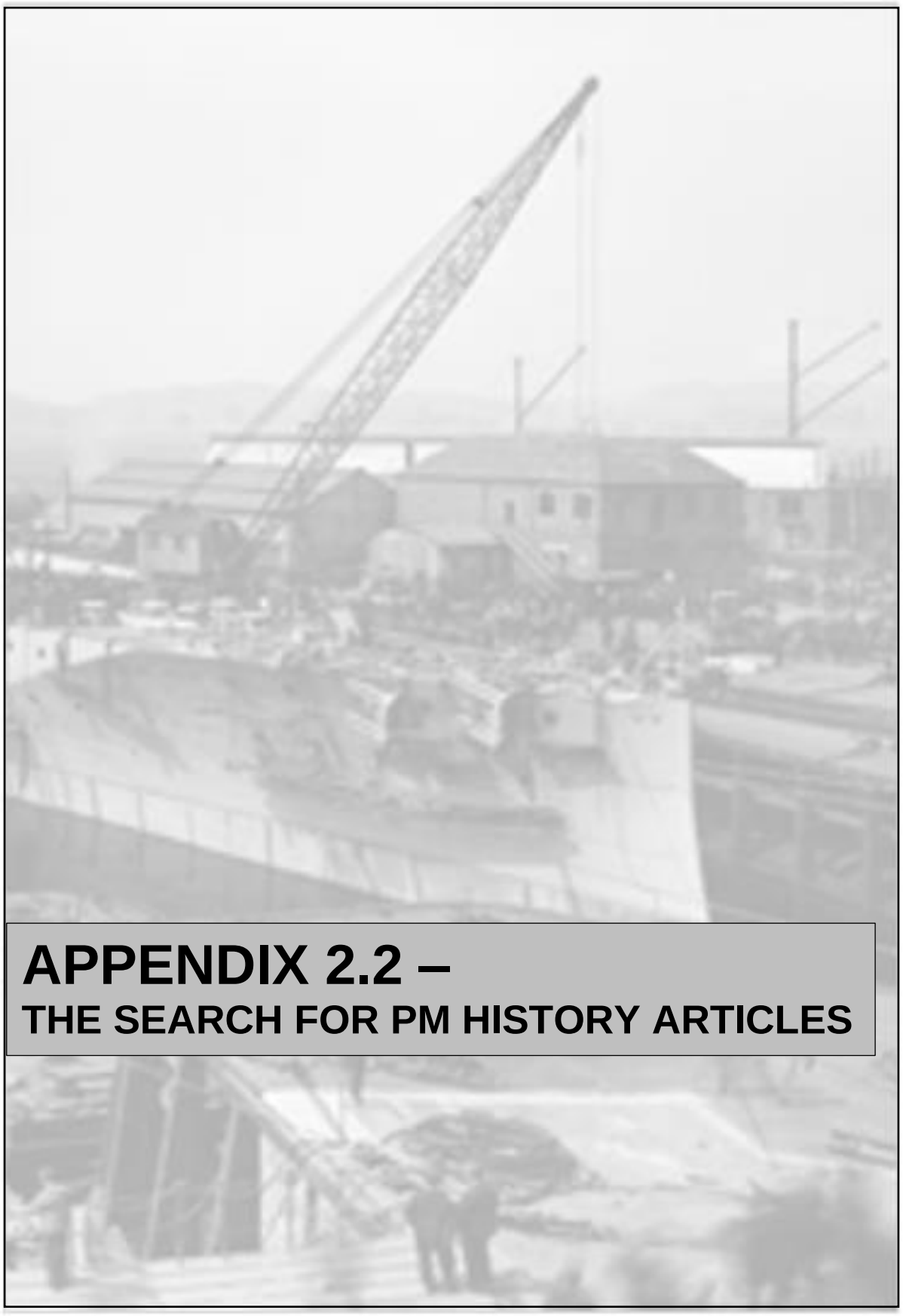
PMBOK® GUIDE 5TH EDITION - 47 PROJECT MANAGEMENT PROCESSES

Based on the PMBOK® Guide 5th Edition (English Version)

Explanatory Note: The represented process flow is based on figures of the PMBOK® Guide. Only a few connections are depicted in the flow. To see the detailed relationships, please see all the process data flow diagrams in the PMBOK® Guide. This flow *does not replace* the need for reading the PMBOK® Guide. The PMBOK® Guide contains a deep explanation of all processes including Inputs, Tools & Techniques and Outputs that are not listed in this flow.

Adaptation: Ricardo Viana Vargas, MSc, CSM, PRINCE2® Practitioner, PMI-RMP, PMI-SP, PMP
Review: Wagner Mocsen, Kaplan-Norton BSC Certified Graduate, PMP, PRINCE 2 Practitioner, PMI-RMP
Graphic Design: Sérgio Jardim, PMP

RICARDO VARGAS
www.ricardo-vargas.com



APPENDIX 2.2 –
THE SEARCH FOR PM HISTORY ARTICLES

Search engine	Term searched under:	Returns:
Google Scholar	History of project management	4,740,000
Emerald insight	History of project management	Over 48,000
Google Scholar	History of project management development	4,650,000
Emerald insight	History of project management development	Over 48,000
Google Scholar	Project Management histories	1,210,000
Emerald insight	Project Management histories	Over 48,000
Google Scholar	Manhattan project	368,000
Emerald insight	Manhattan project	Over 1,000
Google Scholar	Project management Dreadnought battleships	2,020 Articles centre on the history angle, rather than project management
Emerald insight	Project management Dreadnought battleships	1 (Paper: 'The hidden taxable capacity of land: enough and to spare' – not relevant.)
Google Scholar	History of project management tools	4,230,000
Emerald insight	History of project management tools	Over 29,000
Google Scholar	History of project management tools pre 1920	232,000
Emerald insight	History of project management tools pre 1920	536

APPENDIX 5.1 –
FOCUS GROUP LIST OF QUESTIONS

FILE No.:

DATE: 30-7-18 / 010

Q1

Do the slides being reviewed show any of the following Systems theory processes?

How strong do you consider the correlation to be?

Please indicate if you consider that the slide you are reviewing contributes to any of the following parts of the Systems Model.
Please mark a maximum of 2 areas and mark those which you consider to have the strongest correlation.

		VERY WEAK				VERY STRONG
☐	(A) formulating initial design	1	2	3	4	5
☐	(B) Providing resources	1	2	3	4	5
☐	(C) Setting Expectations	1	2	3	4	5
☐	(D) Decision making sub-system	1	2	3	4	5
☐	(E) Subsystem & components that carry out transformations	1	2	3	4	5
☐	(F) Performance monitoring subsystem	1	2	3	4	5
☐	(G) None of the above					

Q2

Please explain your thinking behind your answer(s) to Q1.

Q3

Does Slide Set 1 represent any of the facets of the 'essence' of project management (please tick any or all that you consider appropriate):

Please indicate if you consider the slide you are reviewing to exhibit any of the traits listed below:
Please mark any that you consider applicable.

		VERY WEAK				VERY STRONG
		1	2	3	4	5
	THE OVERALL ACTIVITY IS BROKEN DOWN INTO TASKS	1	2	3	4	5
	THERE IS MANAGEMENT OF OTHERS BY 'PM'	1	2	3	4	5
	INDIVIDUAL TASKS HAVE A FINITE DURATION (ESTIMATED IN ADVANCE)	1	2	3	4	5
	THE OVERALL ACTIVITY HAS STRUCTURE AND ORGANISATION	1	2	3	4	5
	DELIVERY WITHIN TIME, COST AND TO SPECIFICATION IS REQUIRED	1	2	3	4	5
	ADVANCE PLANNING IS EVIDENCED	1	2	3	4	5
	PROGRESS REPORTING IS EVIDENCED	1	2	3	4	5
	THE DELIVERY HAS DISTINCT STAGES e.g. DESIGN/ MANUFACTURE/ CLOSE OUT	1	2	3	4	5
	TASKS ARE DELEGATED	1	2	3	4	5
	THE WORKERS ARE TAILORED TO THE ACTIVITY ACCORDING TO SPECIFIC SKILLS	1	2	3	4	5
	THE TEAM IS STRUCTURED TO DELIVER SYNERGISTIC BENEFITS	1	2	3	4	5
	SOFT SKILLS – AN UNDERSTANDING OF PERSONALITIES, CHARACTERISTIC & ATTITUDES IS REQUIRED	1	2	3	4	5
	TWO WAY COMMUNICATION IS EVIDENCED	1	2	3	4	5
	CHANGE CONTROL IS EVIDENCED	1	2	3	4	5
	ACTIVITY IS DRIVEN BY PRE PLANNED GOALS	1	2	3	4	5
	AN INITIAL APPRAISAL/ PLAN OF THE ACTIVITY IS PRODUCED	1	2	3	4	5
	MANAGEMENT OF PLANT AND MACHINERY IS NECESSARY	1	2	3	4	5
	MANAGEMENT OF INTERNAL AND EXTERNAL RESOURCE IS REQUIRED					

Q4 – Please see over

Q4

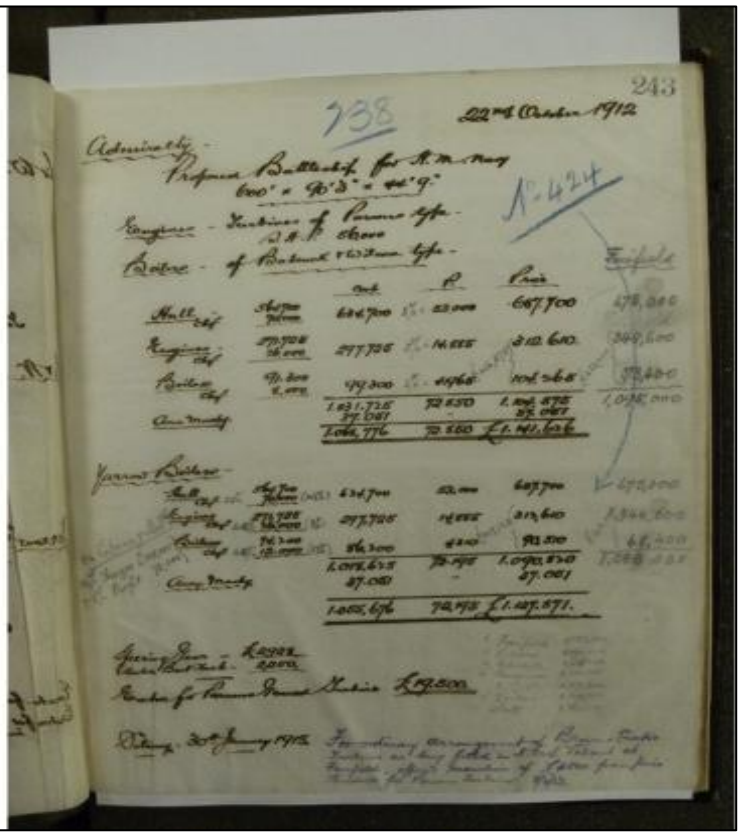
Please explain your thoughts and reasoning in arriving at your answer(s) to Q3.

Q5

Do you think that the slide suggests the use or existence of any project process not outlined in Q3 above? What does this show or how could it be used to demonstrate a link to other PM processes?

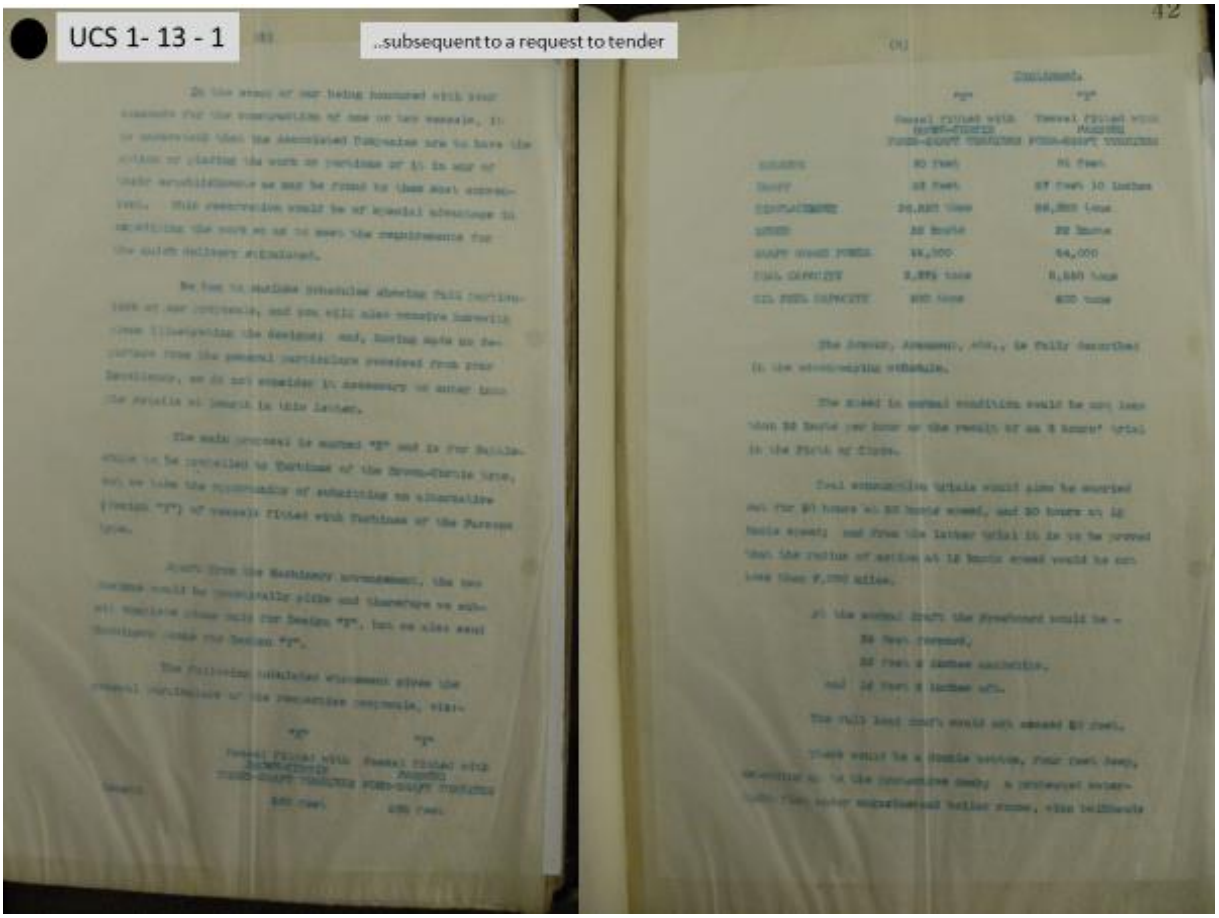
APPENDIX 5.2 –
SUBSET OF RECORDS USED FOR PILOT TEST & NAVAL PM VERIFICATION

UCS 1-74-6

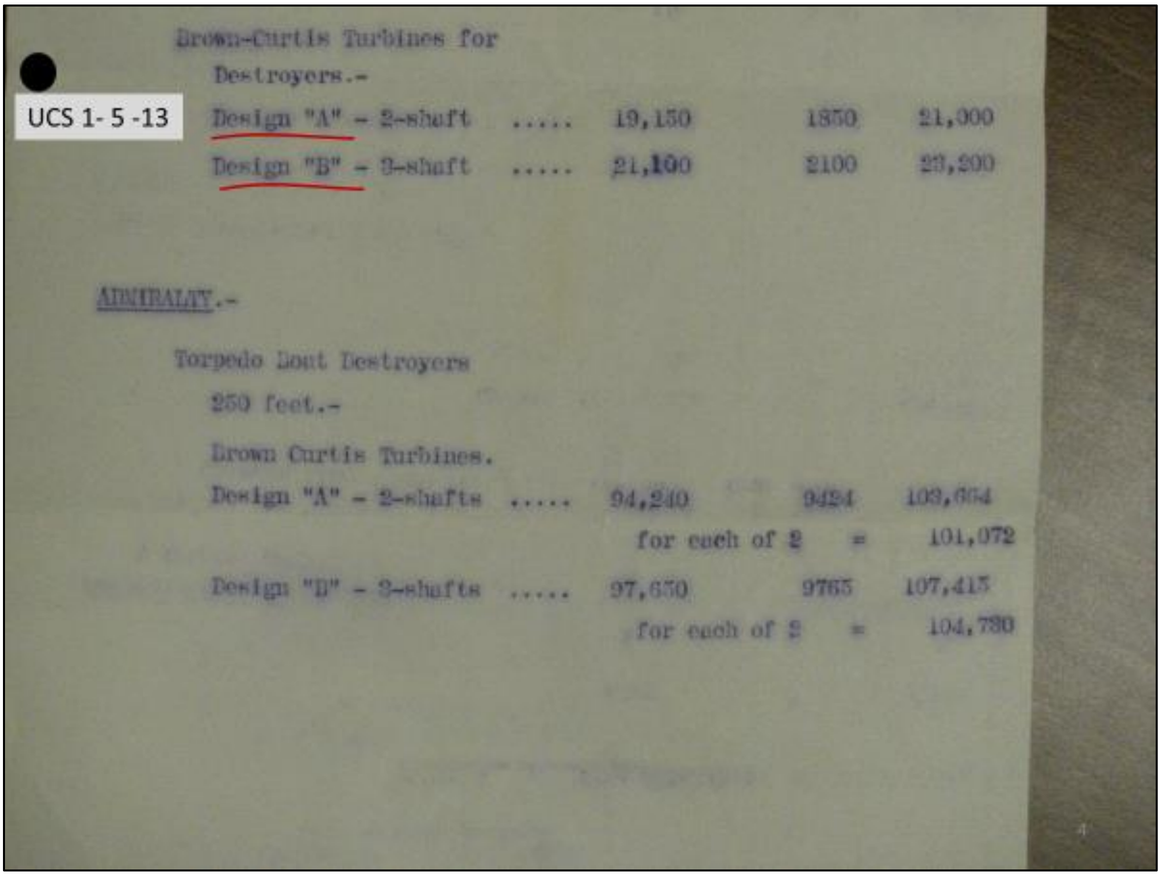


UCS 1- 13 - 1

..subsequent to a request to tender



UCS 1- 5 -13



Brown-Curtis Turbines for Destroyers.-			
Design "A" - 2-shaft	19,150	1850	21,000
Design "B" - 3-shaft	21,100	2100	23,200

ADMIRALTY.-

Torpedo Boat Destroyers

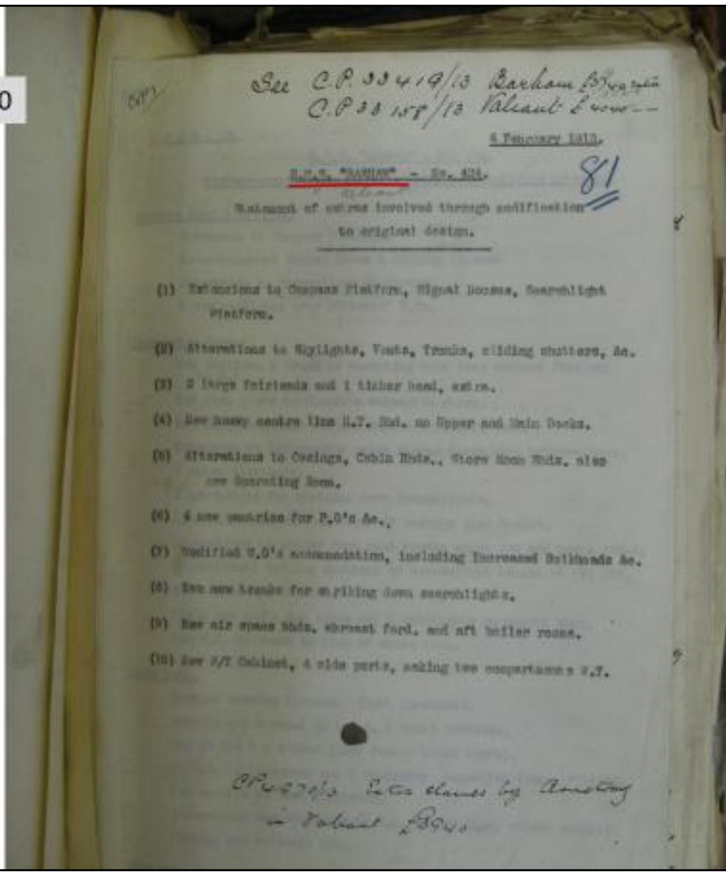
250 feet.-

Brown Curtis Turbines.

Design "A" - 2-shafts	94,240	9424	103,664
	for each of 2	=	101,072
Design "B" - 3-shafts	97,650	9765	107,415
	for each of 2	=	104,780

4

Br/Fndry DSCF 3510



See C.P. 33419/13 Barham [illegible]
C.P. 38158/13 Valiant [illegible]

[illegible] February 1913.

H.M.S. "[illegible]" - No. 424.

81

Statement of extras involved through modification to original design.

(1) Extensions to Compass Platform, Signal Houses, Searchlight Platform.

(2) Alterations to Skylights, Vents, Trunks, sliding shutters, &c.

(3) 2 large fairleads and 1 [illegible] head, extra.

(4) New heavy centre line [illegible] on Upper and Main Decks.

(5) Alterations to Casings, Cabin [illegible], Store Room [illegible], also new [illegible] Room.

(6) [illegible] for P.O's &c.,

(7) Modified W.O's accommodation, including Increased Bulkheads &c.

(8) [illegible] for [illegible] down searchlights.

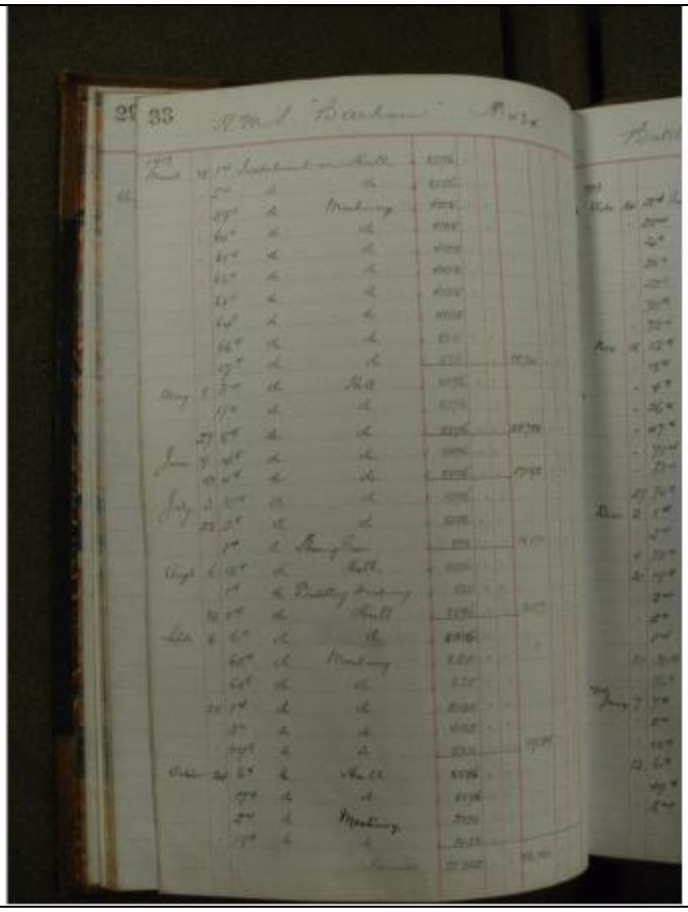
(9) New air space [illegible], abreast ford. and aft boiler rooms.

(10) New W/T Cabinet, [illegible] side ports, making two compartments W.T.

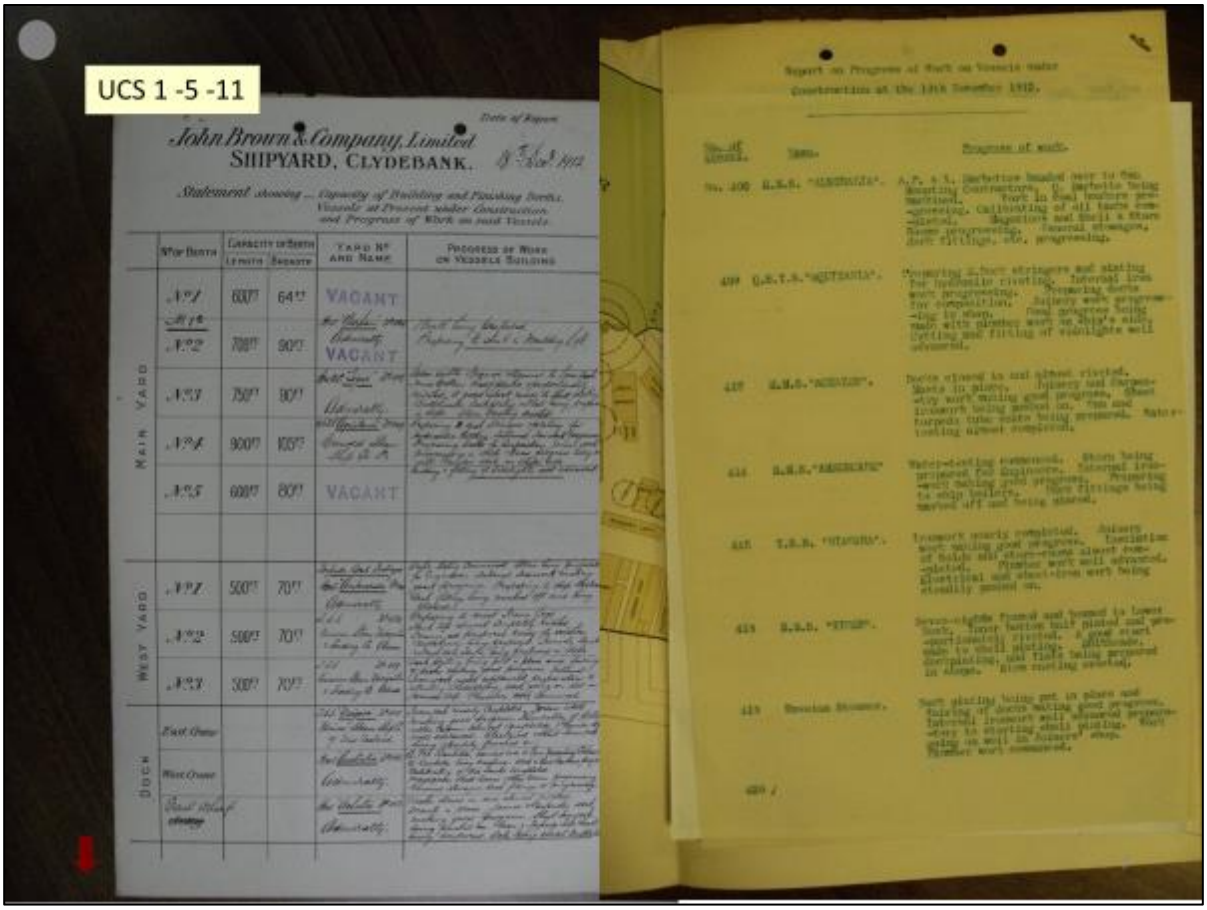
CP [illegible] Extra claimed by Armstrong [illegible] Valiant £[illegible]

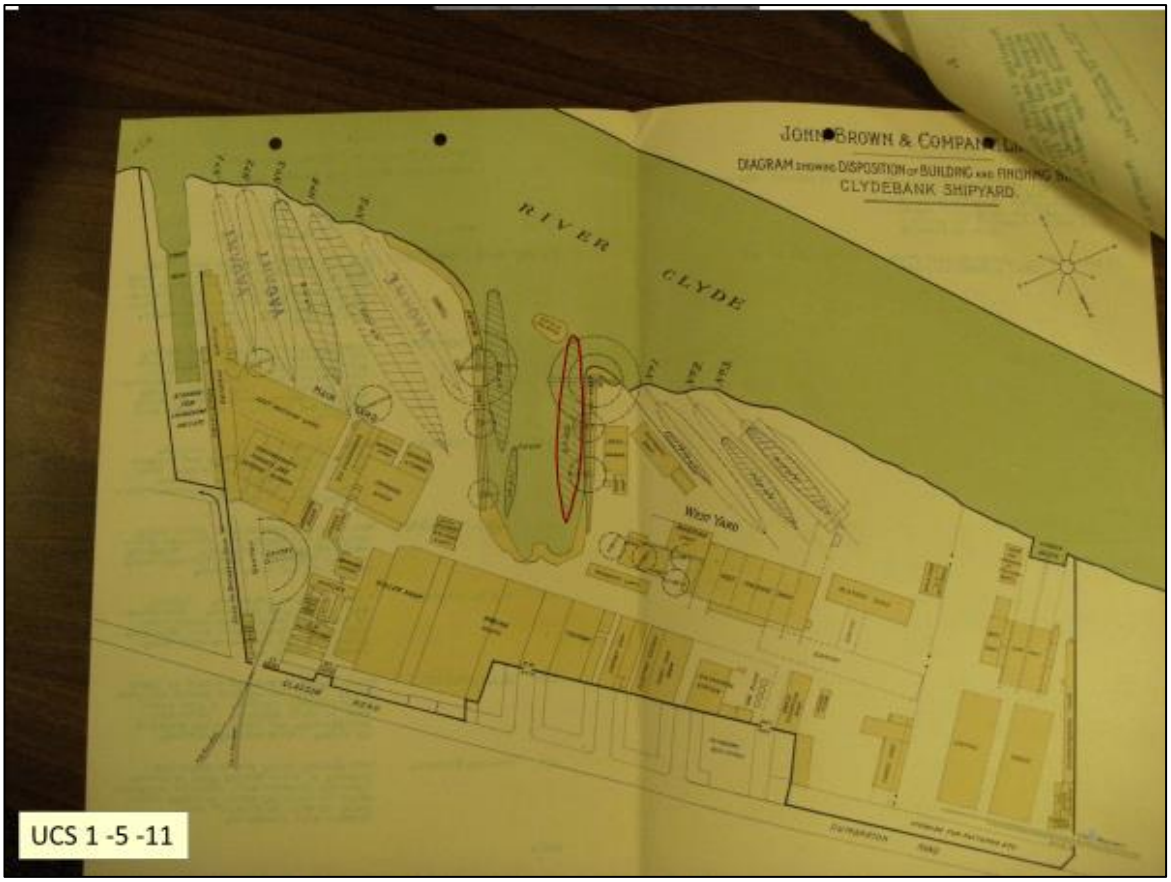
5

UCS 1- 61 - 2

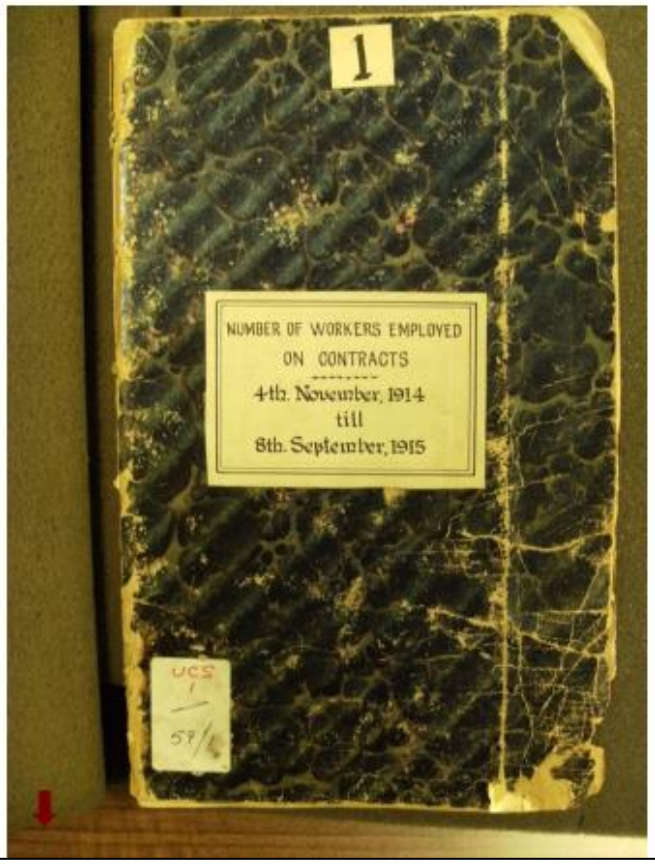


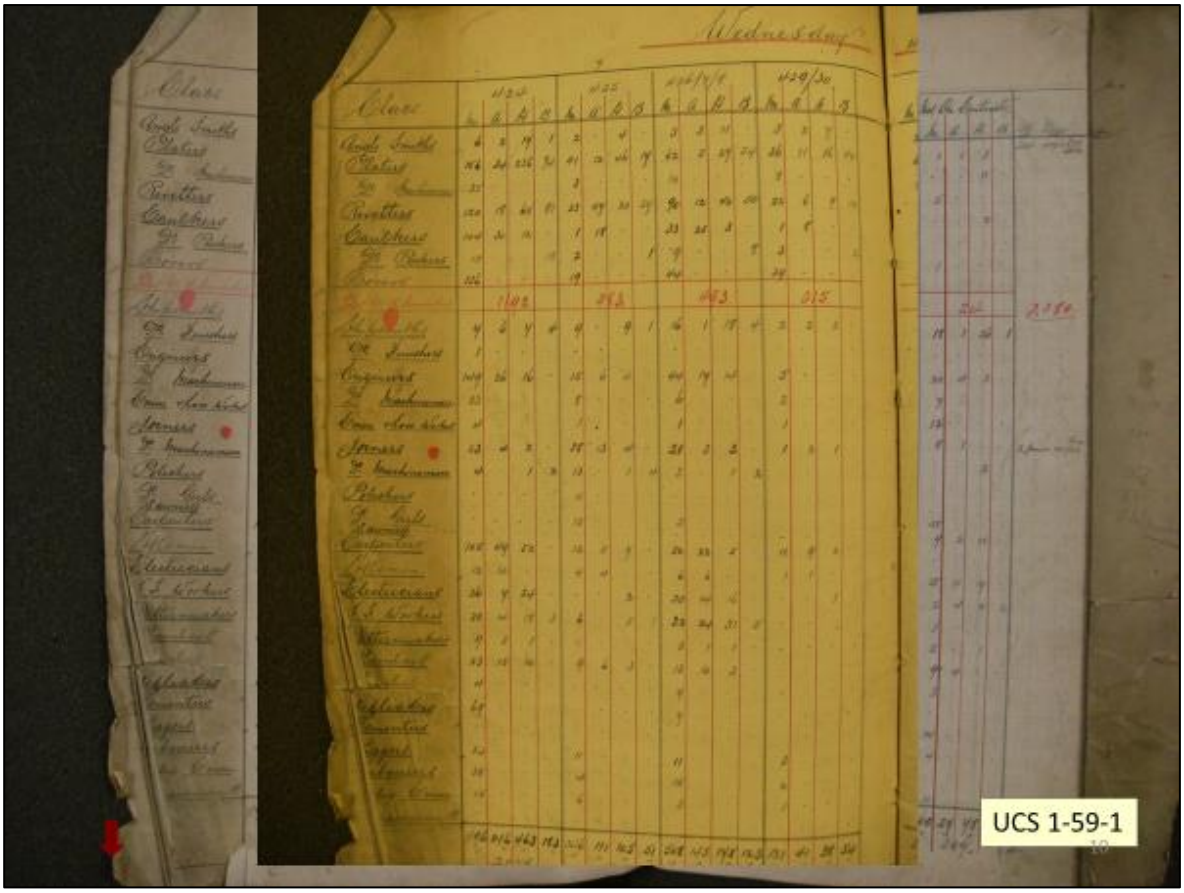
UCS 1 -5 -11

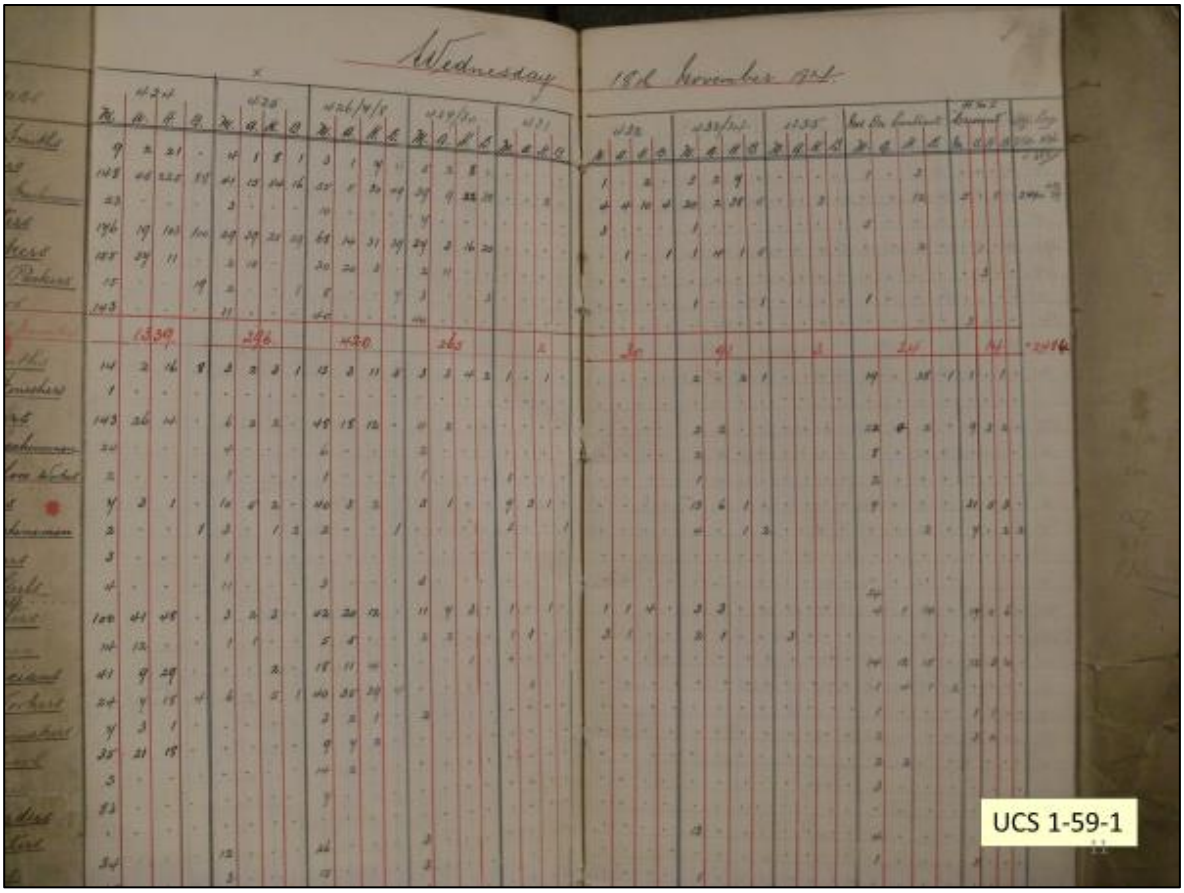



JOHN BROWN & COMPANY
CLYDEBANK SHIPYARD.
RIVER
CLYDE
West Yard
UCS 1 -5 -11

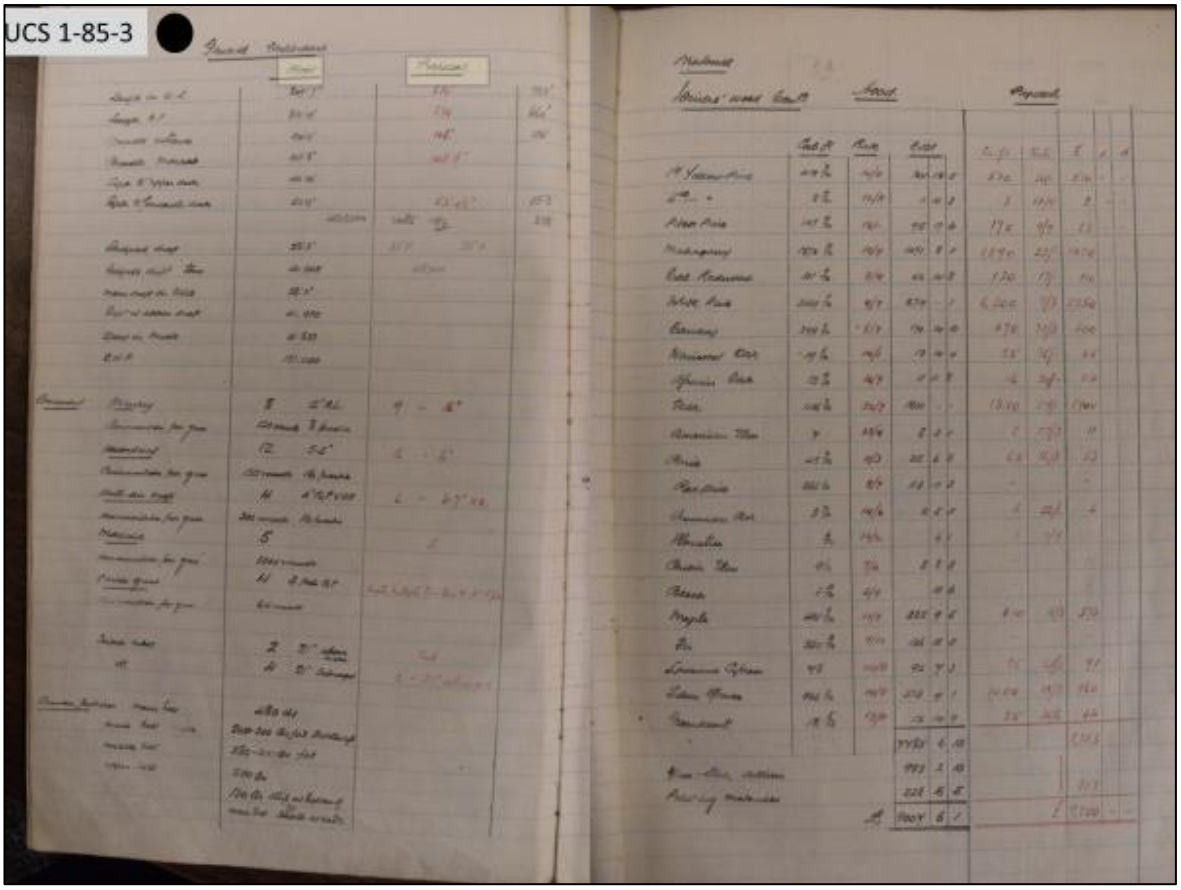
UCS 1-59-1


1
NUMBER OF WORKERS EMPLOYED
ON CONTRACTS
4th. November, 1914
till
8th. September, 1915
UCS
1
59/1

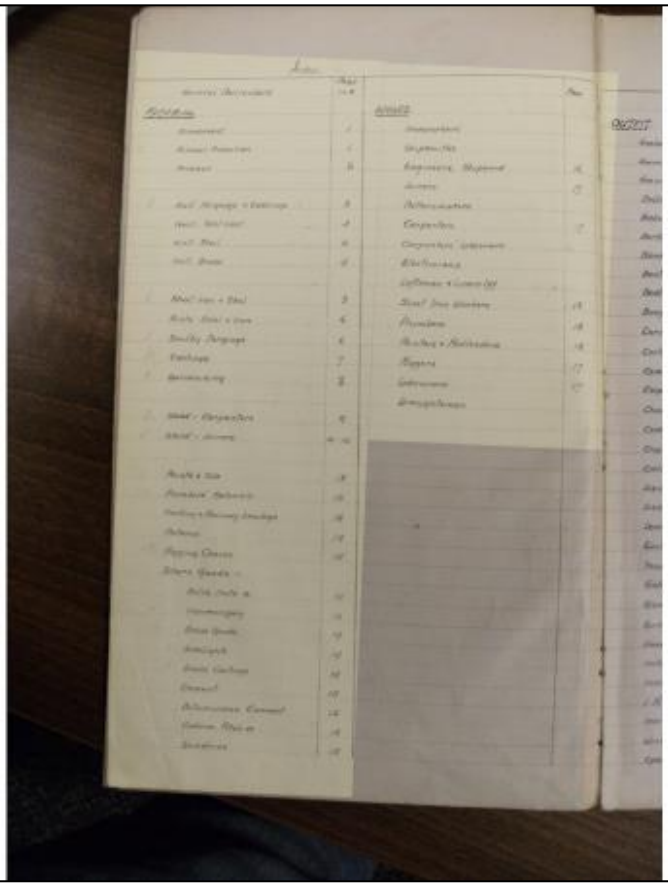

Wednesday
UCS 1-59-1

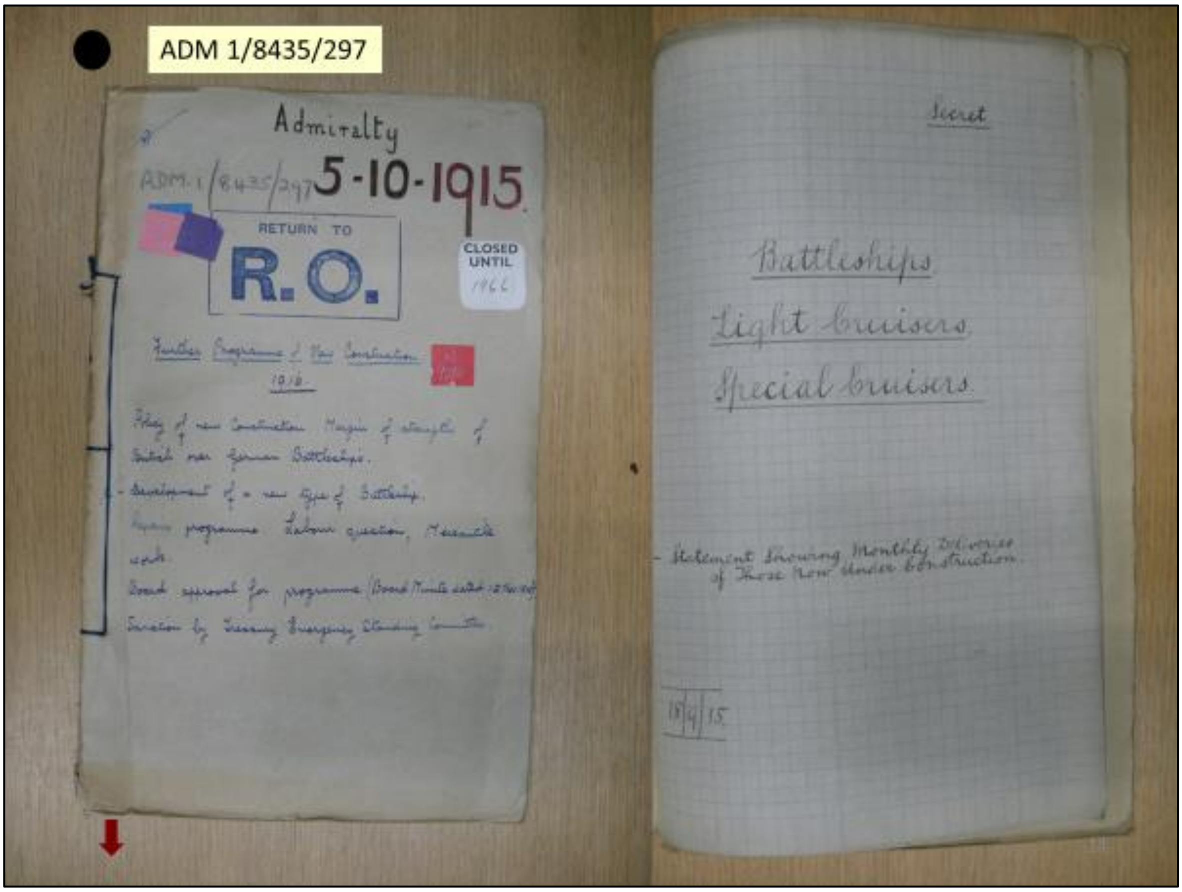

Wednesday
UCS 1-59-1

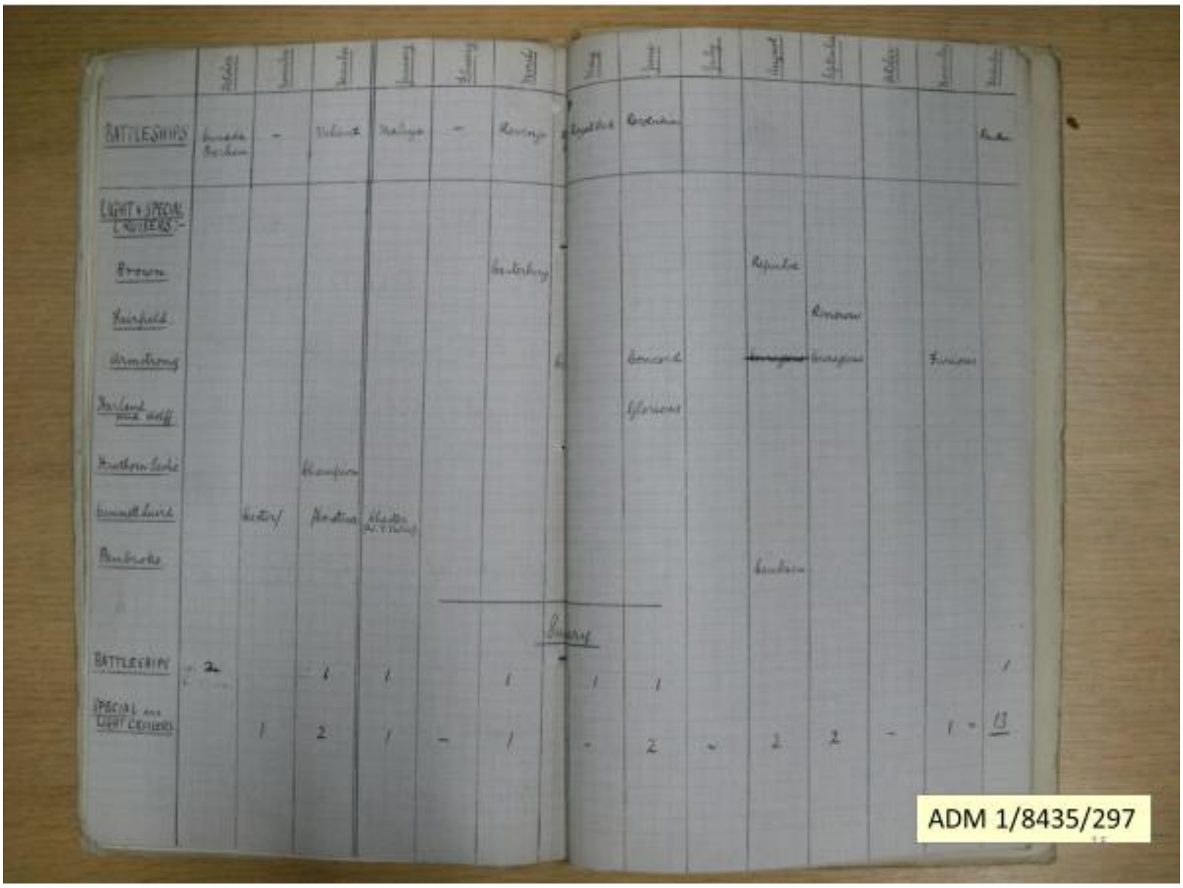
UCS 1-85-3



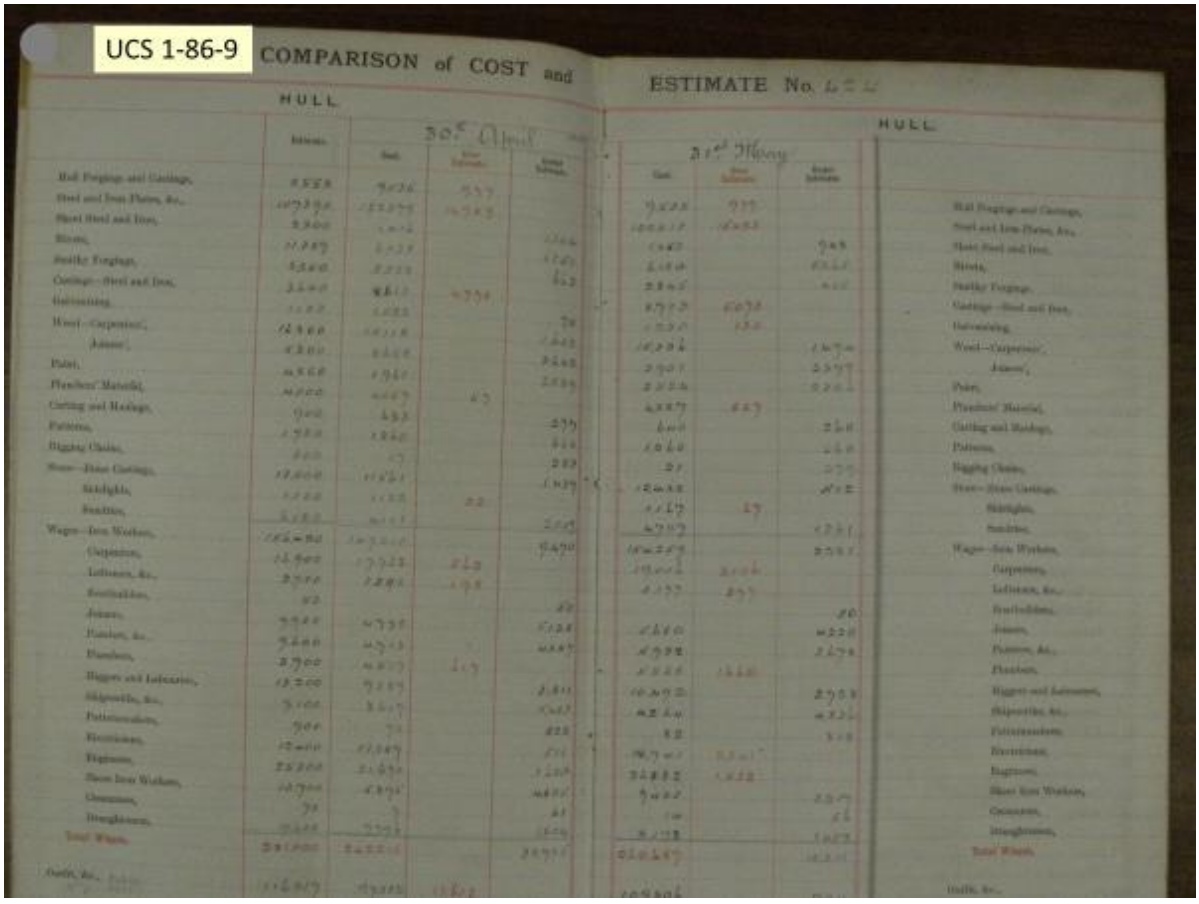
UCS 1-85-3




ADM 1/8435/297
Admiralty
ADM 1/8435/297 5-10-1915
RETURN TO
R.O.
CLOSED UNTIL
1966
Secret
Battleships
Light Cruisers.
Special Cruisers.
18/9/15


BATTLESHIPS
LIGHT & SPECIAL CRUISERS:-
Brown
Fairfield
Armstrong
Cammell Laird
Pembroke
Canterbury
Repulse
Renown
Courageous
Furious
Glorious
Summary
BATTLESHIPS
SPECIAL AND LIGHT CRUISERS
ADM 1/8435/297

UCS 1-86-9

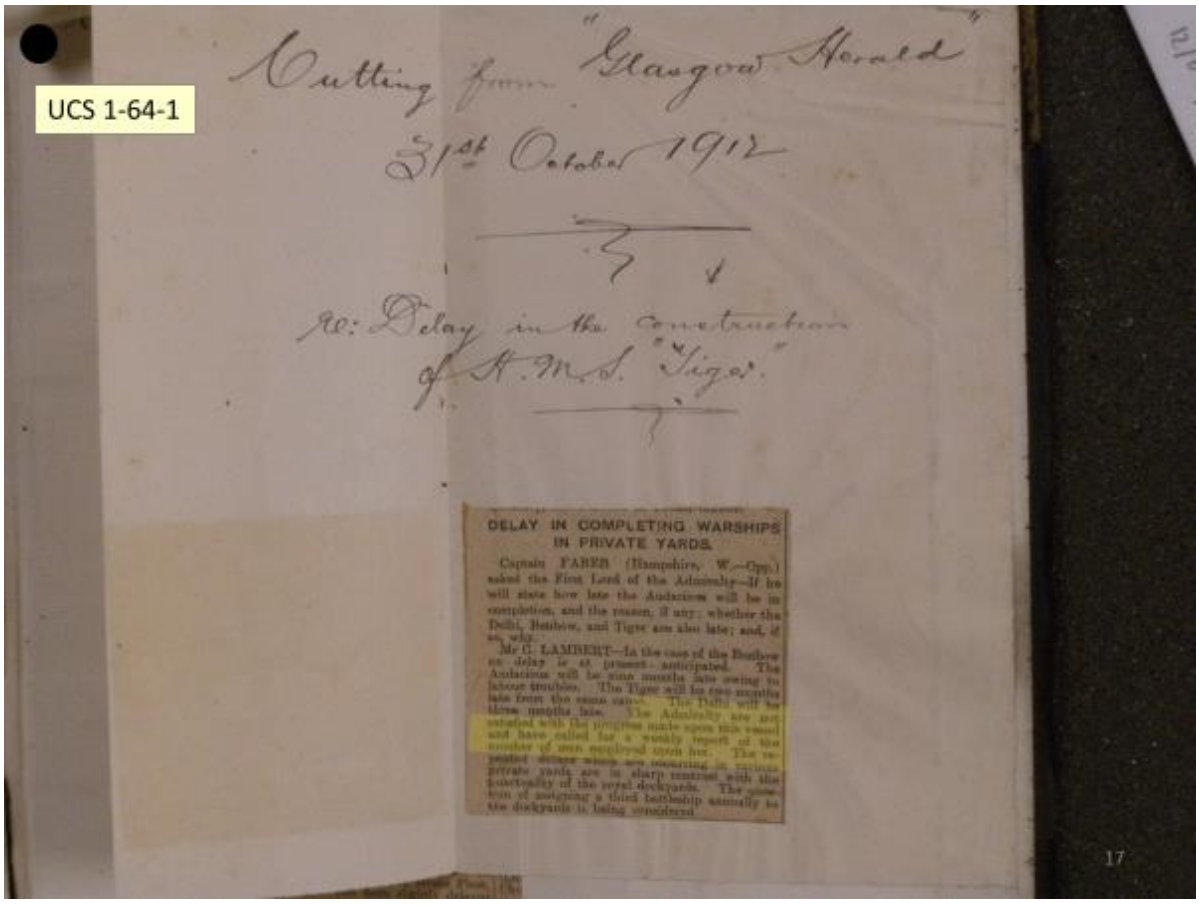


COMPARISON of COST and ESTIMATE No.

HULL

HULL

UCS 1-64-1



Cutting from "Glasgow Herald"

31st October 1912

Re: Delay in the Construction of H.M.S. "Tiger."

DELAY IN COMPLETING WARSHIPS IN PRIVATE YARDS.

Captain FABER (Hampshire, W.—Opp.) asked the First Lord of the Admiralty—If he will state how late the Audacious will be in completion, and the reason, if any; whether the Delhi, Benbow, and Tiger are also late; and, if so, why?

Mr C. LAMBERT—In the case of the Benbow no delay is at present anticipated. The Audacious will be nine months late owing to labour troubles. The Tiger will be two months late from the same cause. The Delhi will be three months late. The Admiralty are not satisfied with the progress made upon this vessel, and have called for a weekly report of the number of men employed upon her. The re-ported delays which are occurring in various private yards are in sharp contrast with the punctuality of the royal dockyards. The question of assigning a third battleship annually to the dockyards is being considered.

17

UCS 1-64-1

DELAY IN COMPLETING WARSHIPS.

Mr CHURCHILL, replying to Lord C. Beresford (Portsmouth—Opp.), gave the following information as to delay in completion of nine warships:—

Ship.	Contract Date for Completion.	Probable Date of Completion.
Conqueror	March 31, 1912	Nov., 1912
Princess Royal	March 31, 1912	Nov., 1912
Queen Mary	March 1, 1913	May, 1913
Audacious	Jan. 16, 1913	Sep., 1913
Centurion	Jan. 16, 1913	Apl., 1913
Delhi	Feb. 14, 1914	May, 1914
Tiger	March 31, 1914	May, 1914
Australia	Sep. 30, 1912	Apl., 1913
New Zealand	Sep. 30, 1912	Jan., 1913

He was advised that it would not be expedient for the Admiralty to give details of the reasons for the delays while the ships were still uncompleted.

DSCF 3626

full power trial of the Machinery and a short trial of the L.P. emergency fittings would take place of the Contract Steam Trial. and if these trials were successful, no opening up of the machinery would be required.

4. No water measuring trials will be required and the fittings should not be placed on board. Only absolutely necessary trials of other descriptions would then be carried out. The spare gear for Machinery including spare propellers should be completed and delivered with the ship.

5. The accelerated completion of the Machinery should be considered having regard also to the claims of the Machinery of "MATCHLESS" for accelerated completion.

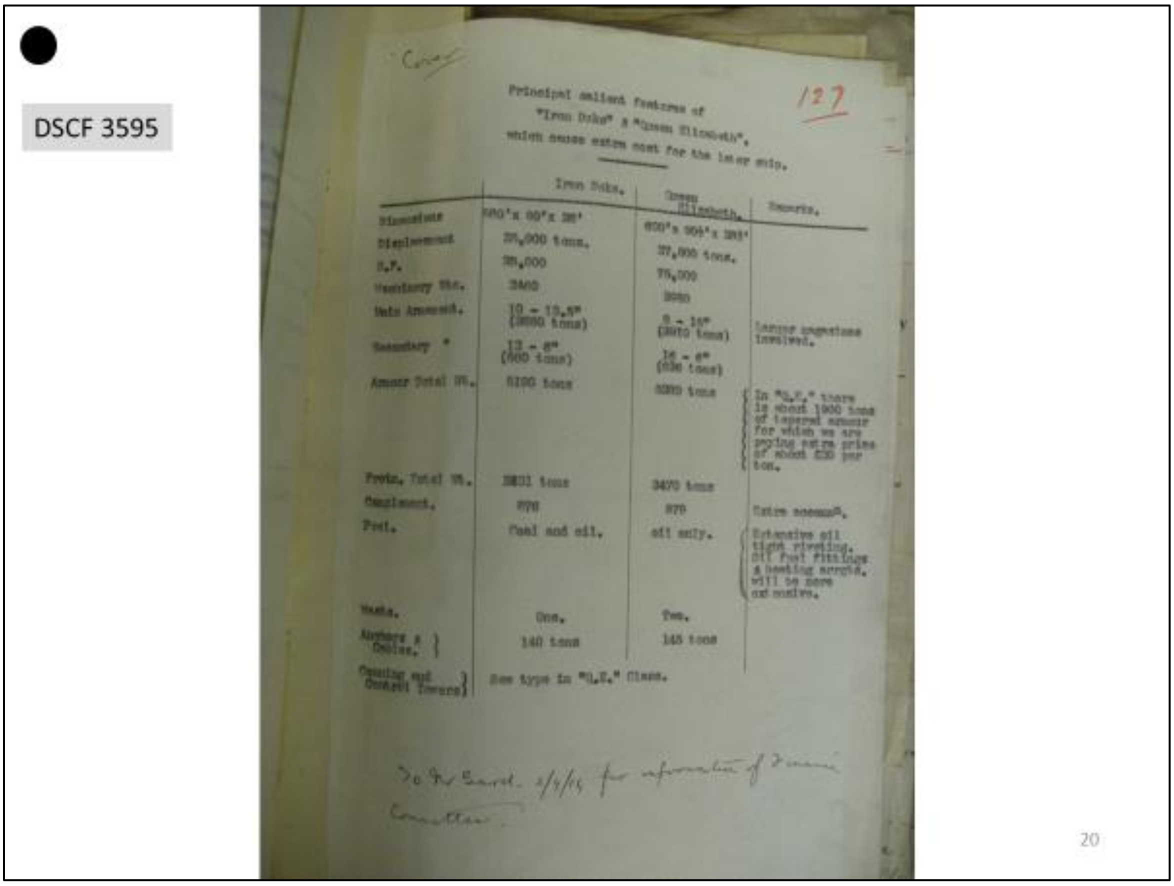
6. In the event of orders being given for emergency completion, it would be necessary that weekly reports of progress should be forwarded to the Admiralty through the usual channels, and the expected date of delivery reported therein.

7. Any adjustment which would be necessary to the contract price of the machinery would be settled later.

8. I have also to state that in the event of such emergency completion being ordered by wire as above indicated, it will be necessary for your leading representatives to attend at the Admiralty immediately for personal instructions.

I am,
Gentlemen,
Your obedient Servant,

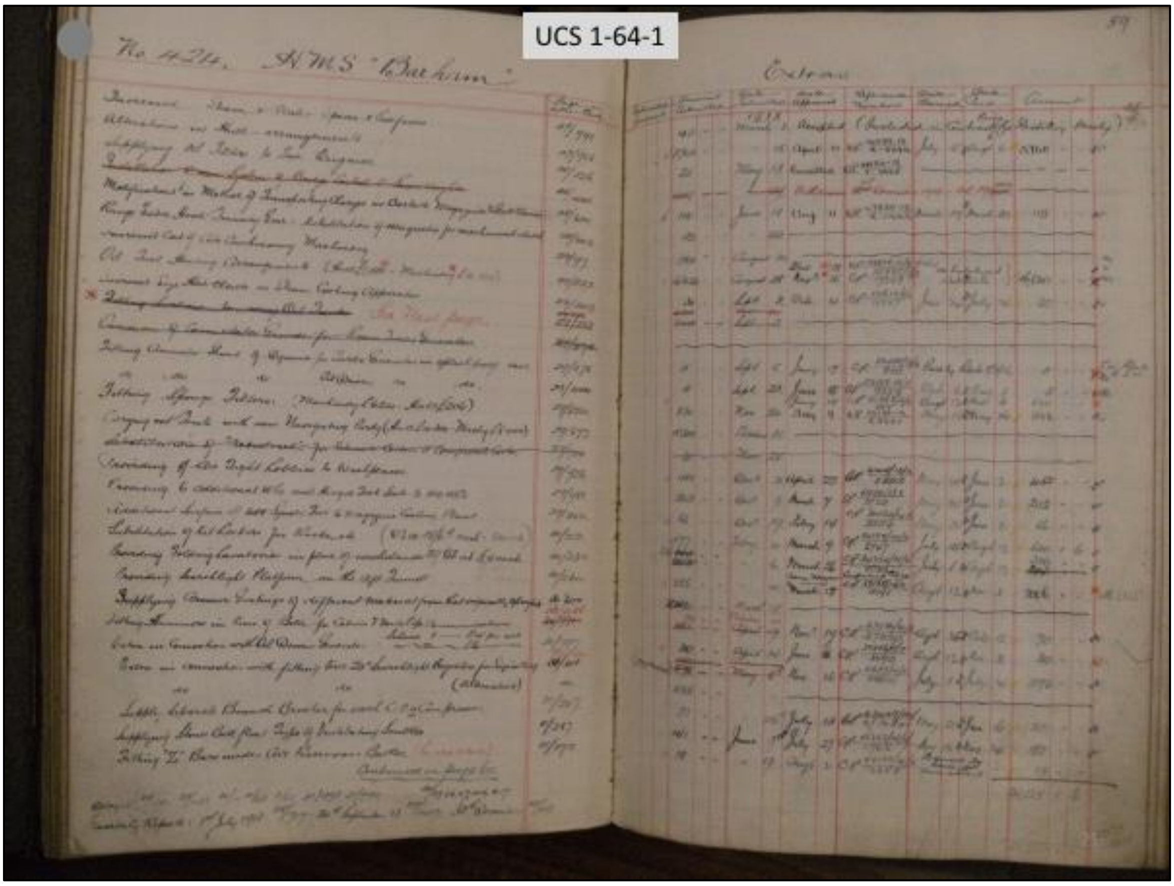
Director of Navy Contracts.

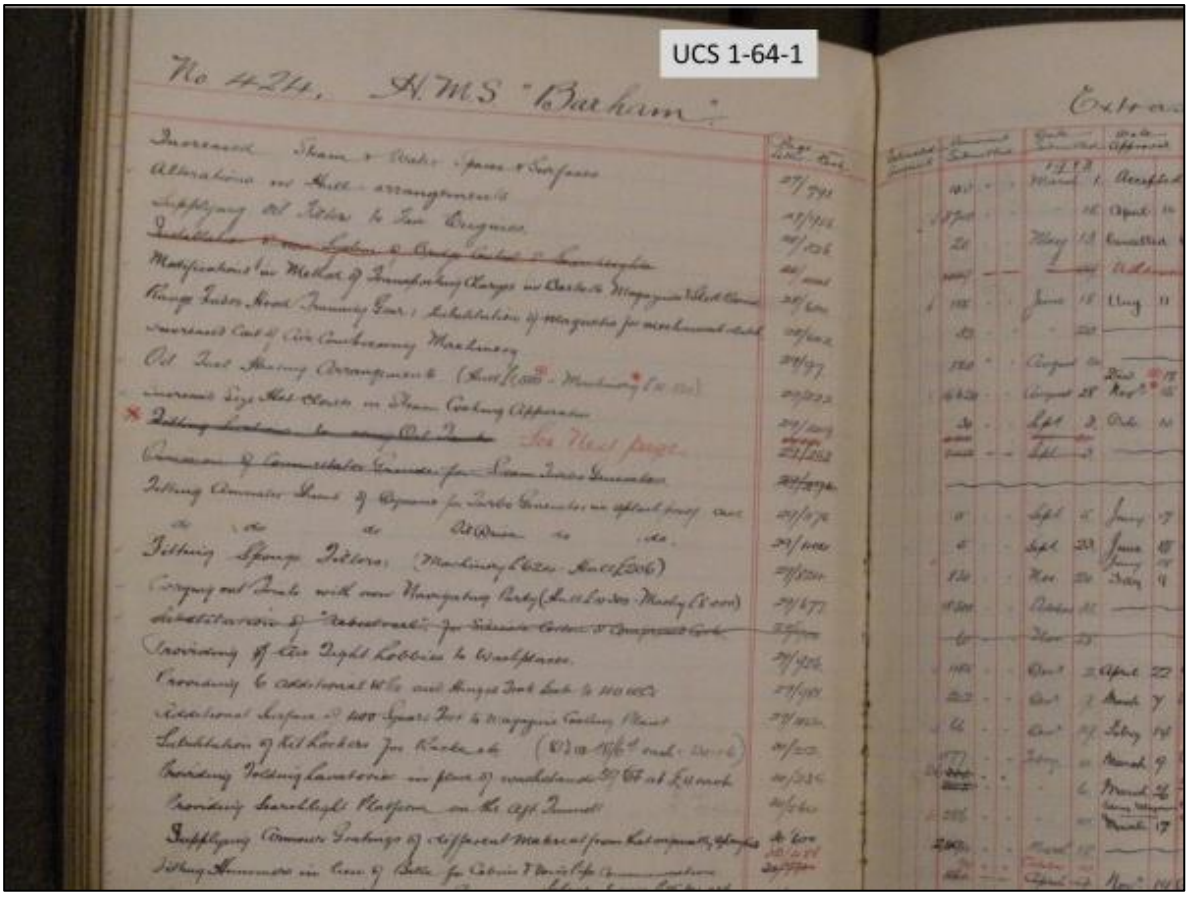


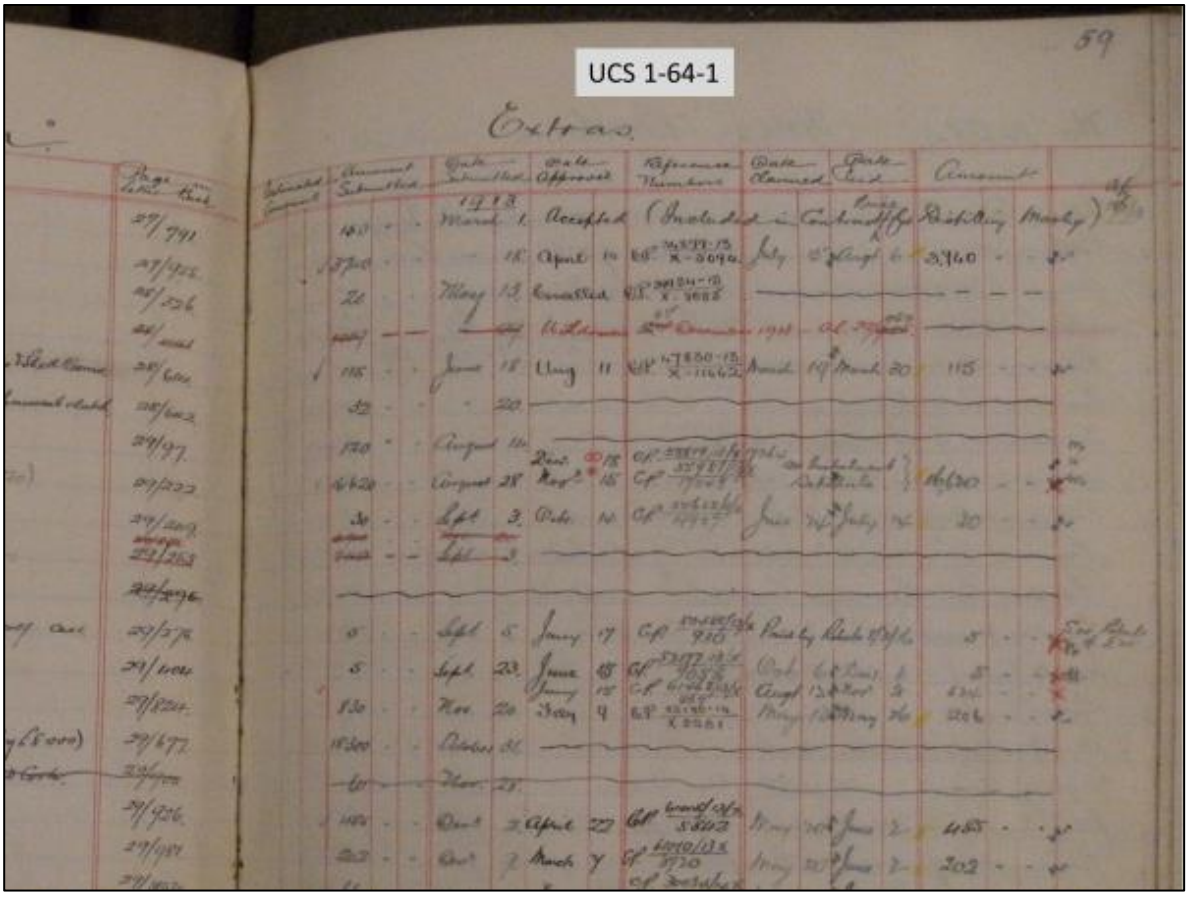
Principal salient features of
"Iron Duke" & "Queen Elizabeth",
which cause extra cost for the later ship.

	Iron Duke.	Queen Elizabeth.	Remarks.
Dimensions	620'x 90'x 28'	600'x 90½'x 28½'	
Displacement	25,000 tons.	27,500 tons.	
S.H.P.	29,000	75,000	
Machinery Wt.	2400	3950	
Main Armament.	10 - 13.5" (3000 tons)	8 - 15" (3610 tons)	Larger mountings involved.
Secondary "	12 - 6" (600 tons)	16 - 6" (636 tons)	
Armour Total Wt.	8100 tons	8300 tons	In "Q.E." there is about 1900 tons of tapered armour for which we are paying extra price of about £30 per ton.
Protn. Total Wt.	3831 tons	3470 tons	
Complement.	976	970	Extra accomm^{n}.
Fuel.	Coal and oil.	oil only.	Extensive oil tight riveting. Oil Fuel fittings & heating arrgts. will be more extensive.
Masts.	One.	Two.	
Anchors & Cables.	140 tons	145 tons	
Conning and Control Towers	See type in "Q.E." Class.		

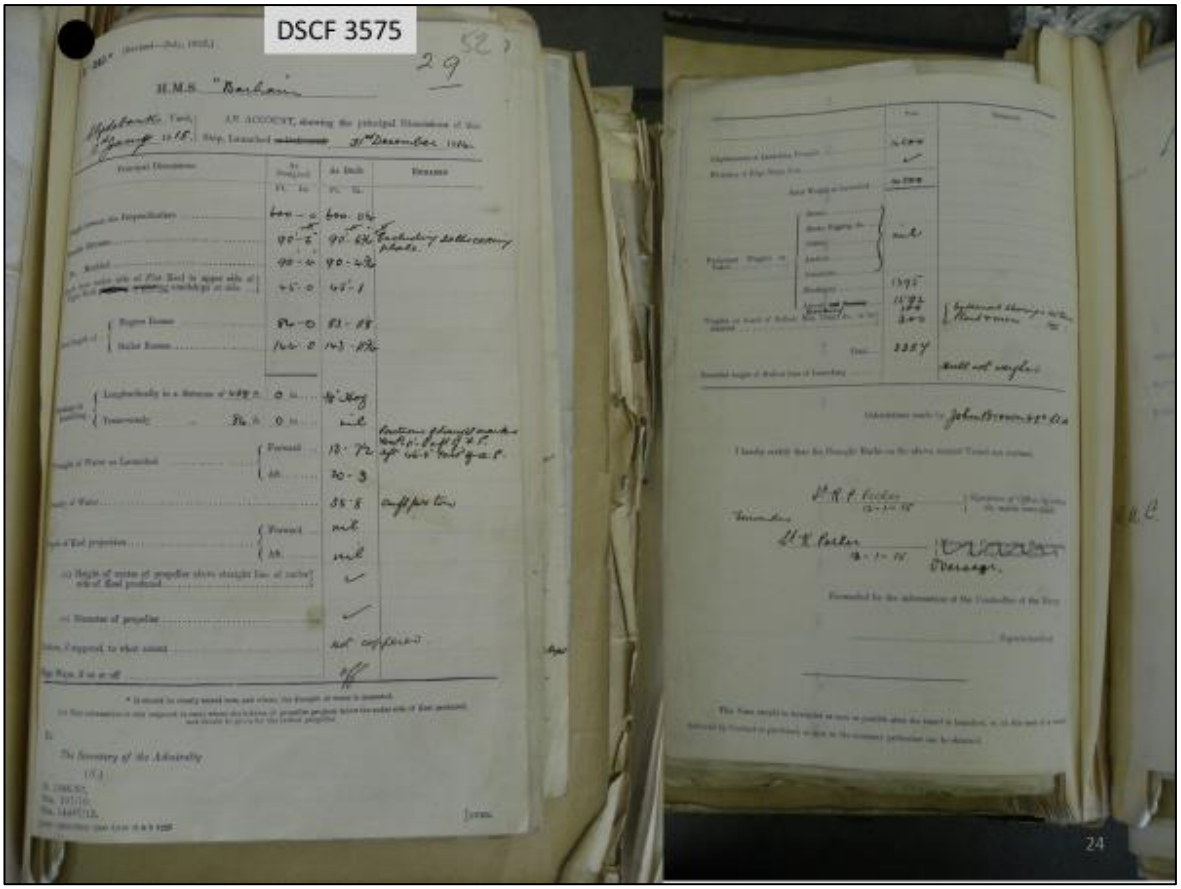
To Mr [illegible] 2/4/15 for information of [illegible] Committee.



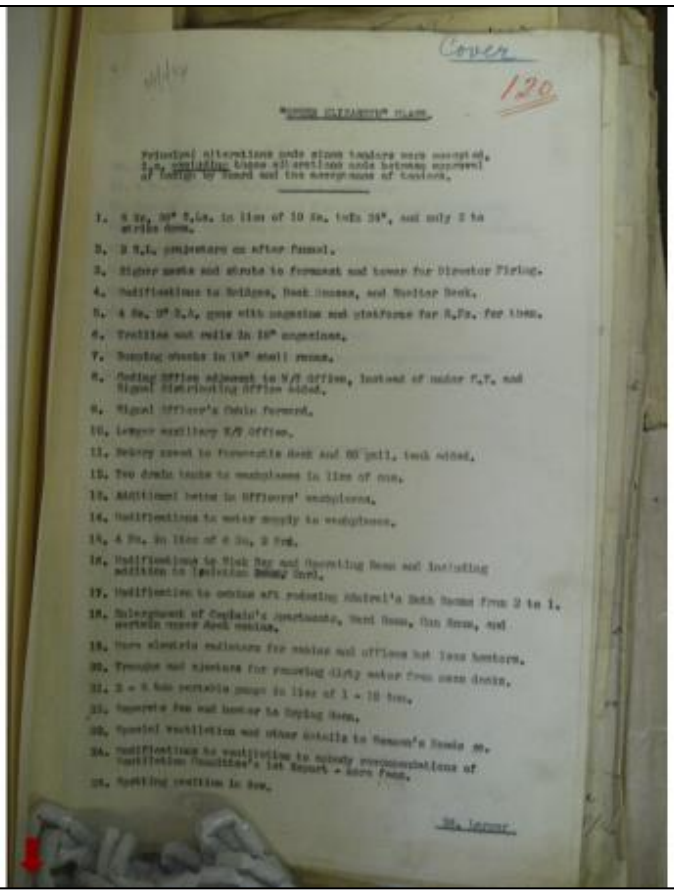

UCS 1-64-1
No 4244. H.M.S. "Barham"
Extras

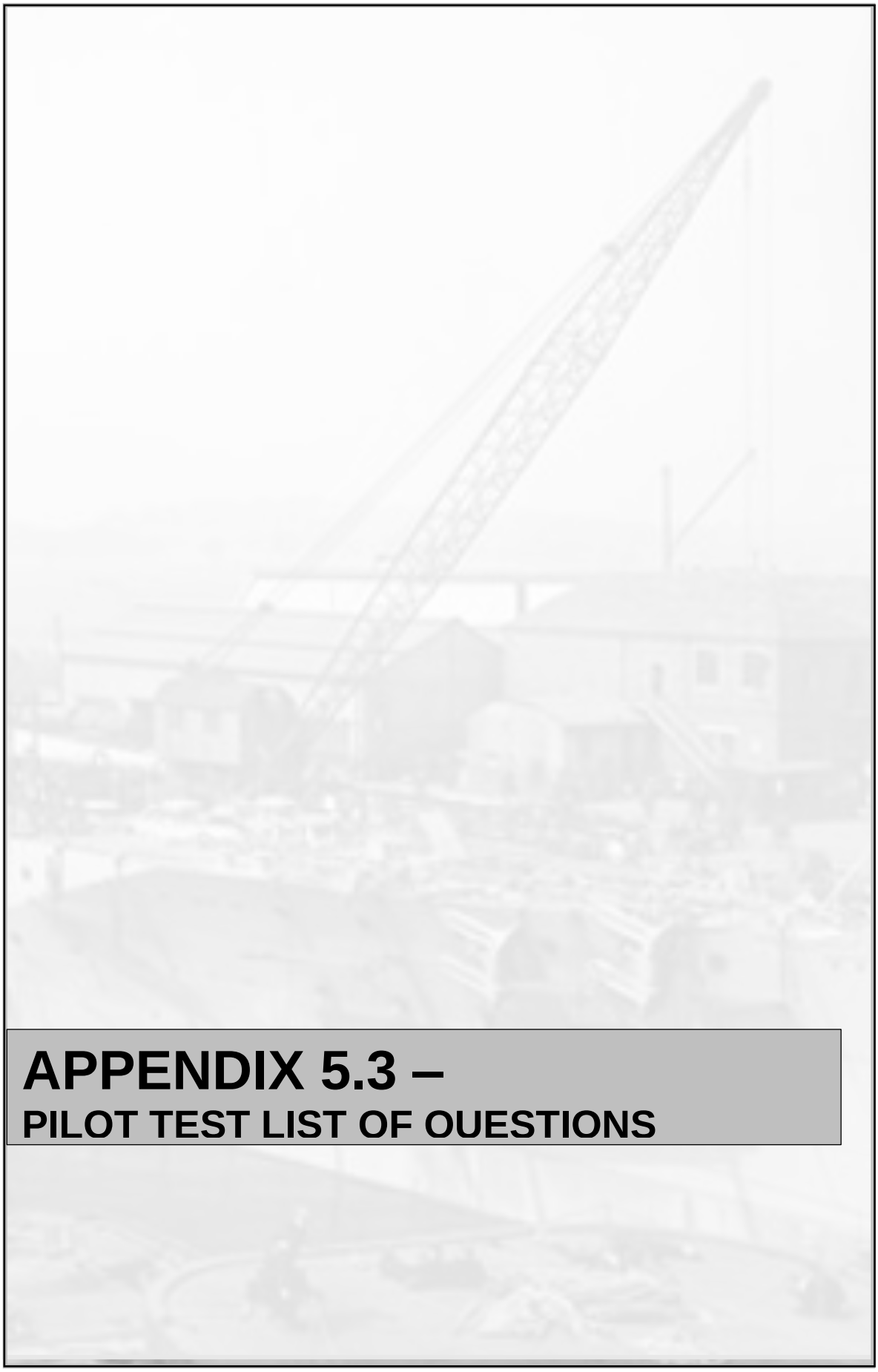

UCS 1-64-1
59
Extras.

DSCF 3575



DSCF 3589





APPENDIX 5.3 –
PILOT TEST LIST OF OUESTIONS

Q1

FILE: UCS 1-5-11

Noting that HMS Barham is ship 424, does Slide Set 1 show any of the following Systems theory processes (shown in Figure 1 above) - please tick the option you consider most appropriate:

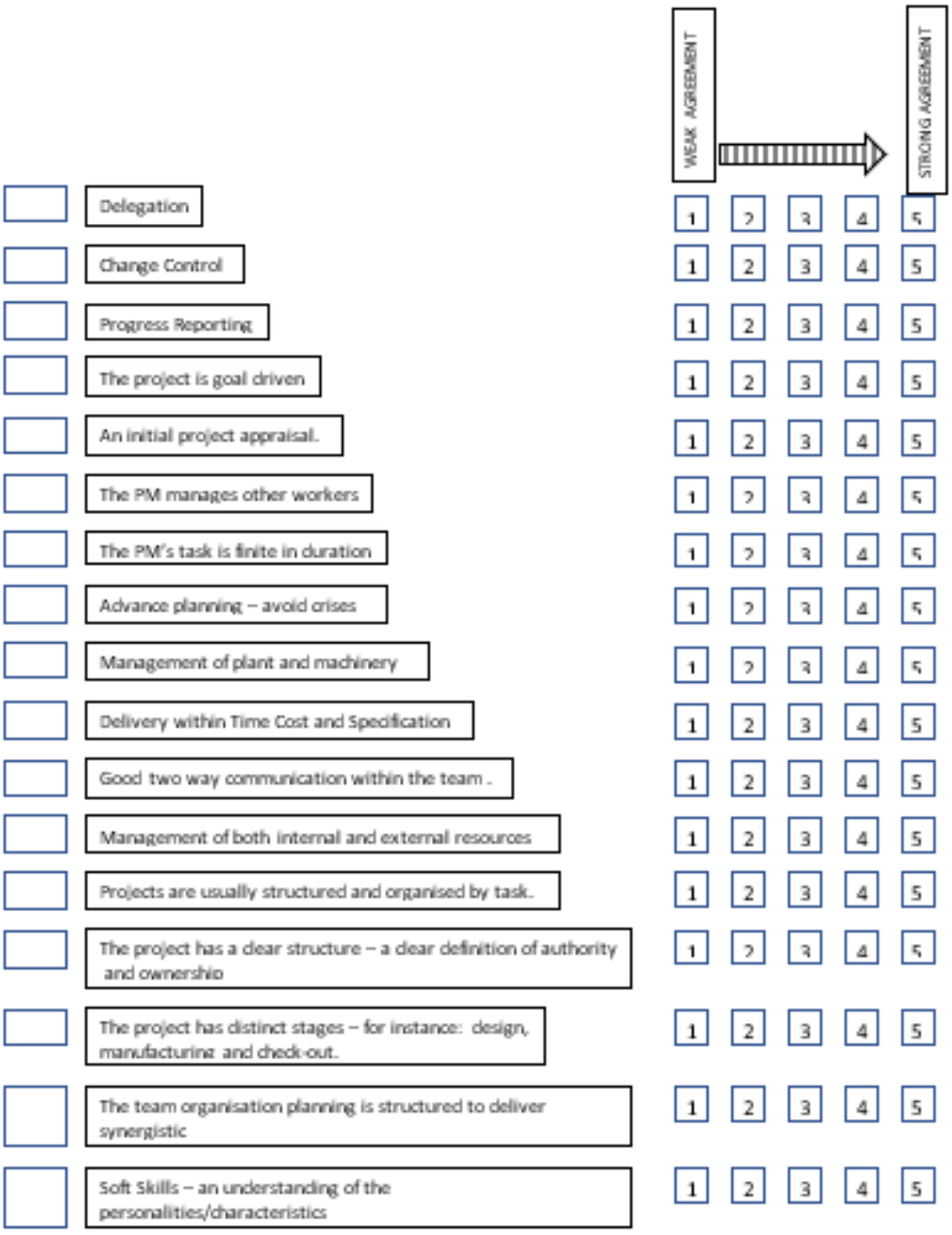
		WEAK AGREEMENT				STRONG AGREEMENT
☐	(A) formulating initial design	1	2	3	4	5
☐	(B) providing resources	1	2	3	4	5
☐	(C) setting expectations	1	2	3	4	5
☐	(D) a Decision making subsystem	1	2	3	4	5
☐	(E) a Subsystem and components that carries out transformations	1	2	3	4	5
☐	(F) a Performance Monitoring subsystem	1	2	3	4	5

Q2

Please briefly explain what you have considered relevant when ticking the categories in Q1.

Q3

Does Slide Set 1 represent any of the facets of the 'essence' of project management (please tick any or all that you consider appropriate):



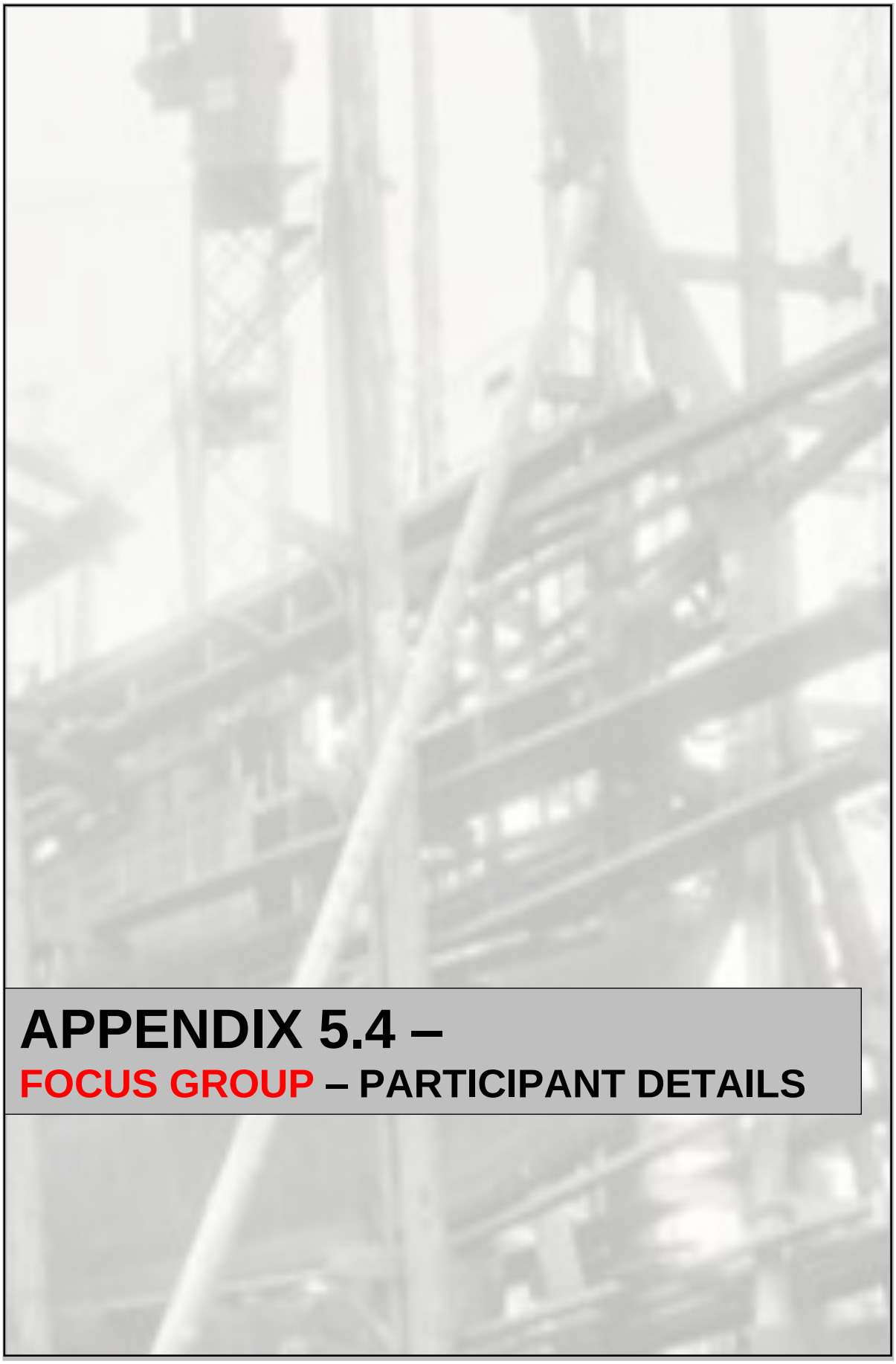
FILE: UCS 1-5-11

Q4

Please explain your thoughts and reasoning in arriving at your answer to Q3.

Q5

Do you think that the slide suggests the use or existence of any project process not outlined in Q3 above? What does this show or how could it be used in linking to other PM processes?



APPENDIX 5.4 –
FOCUS GROUP – PARTICIPANT DETAILS

DATE: 30-7-18 / 001

RESEARCH PROJECT:

'Is it possible to detect any signs of the essence of Project Management processes being used during the construction of HMS Barham (1912-1915)? [Did HMS Barham use Project Management?]'

Research Participant Information Sheet:

Please answer the questions below if you are happy too, if not please just leave them blank.

The reason for asking is to validate the overall level of expertise upon which the research draws.

Many thanks.

Your name: ----------

Current Job Title: ----------

What is the principle Project Management function of your job?

Contacts:

Would you be willing for me to contact you with regard to any follow up questions?

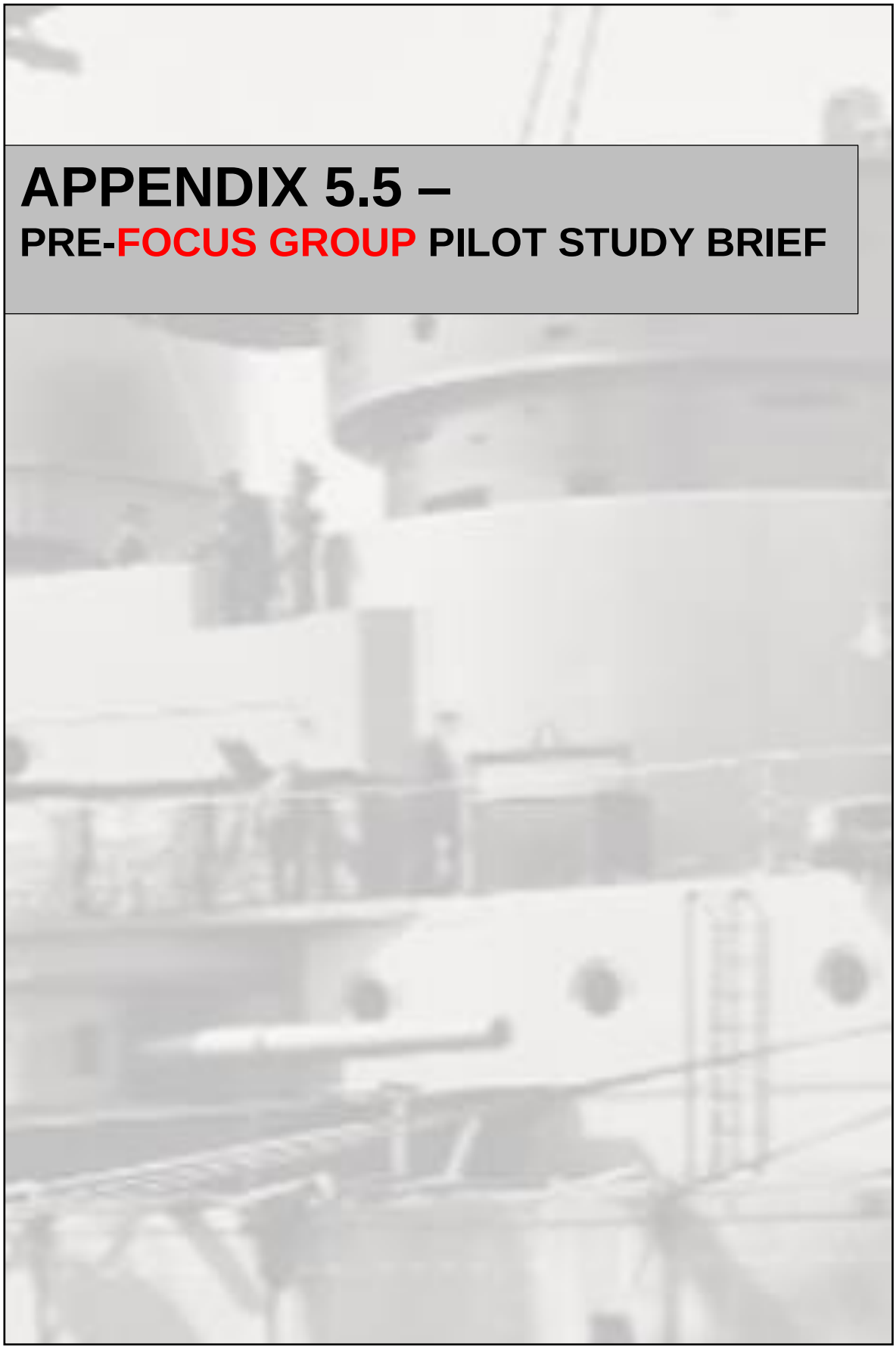
If so please could you provide the following contact details:

E-mail ----------

Phone no. ----------

In your role described above, are you currently employed working directly with the delivery of Naval Vessels? YES NO

Approximately how many years have you been involved in naval project management? <1yr 1-3yrs 3-5yrs >5yrs



APPENDIX 5.5 –
PRE-FOCUS GROUP PILOT STUDY BRIEF

Research into 'Manufacturing Management' Processes

CONSTRUCTION OF DREADNOUGHTS WITHIN THE GRAND FLEET OF WW1

An outline of the study

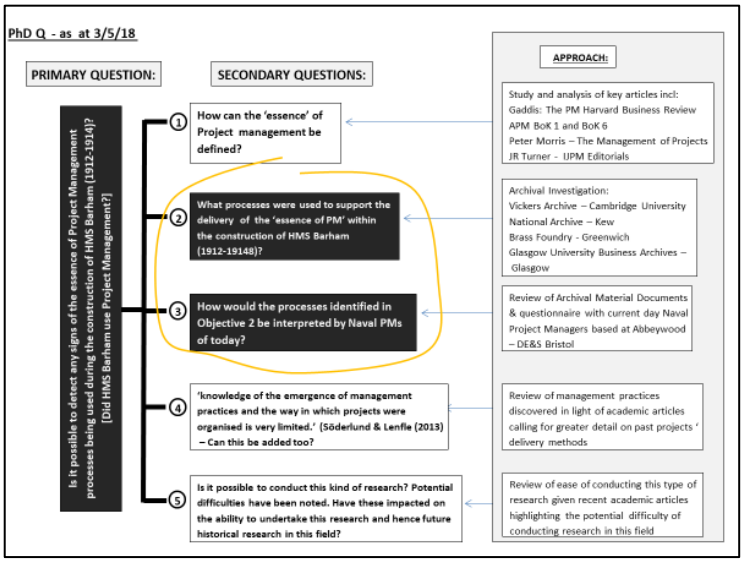
Questions....

What is (M)Project Management?

How do you look for it before it was established?

What exactly is being 'looked for'?

Search for the 'essence' of MPM



PM and Systems Theory

- **Fortune, J., & White, D. (2006). Framing of project critical success factors by a systems model. *International journal of project management*, *24*(1), 53-65.**

  - shows how a systems model, the Formal Systems Model, can be used as a framing device to deliver the benefits of taking account of 'critical success factors'

- **White, D., & Fortune, J. (2009). The project-specific formal system model. *International Journal of Managing Projects in Business*, *2*(1), 36-52.**

  - the purpose of this paper is to introduce a project-specific version of the Formal Systems Model that can be used by project managers and other professionals to identify actual or potential weaknesses in a project's structure or processes and to look for difficulties in the relationships between the project and the context in which it is or will be taking place.

What is the 'essence' of PM?

TOPICS HIGHLIGHTED IN P GADDIS ARTICLE 'THE PROJECT MANAGER' HARVARD BUSINESS REVIEW 1959	ARE 'GADDIS TOPICS' INCLUDED IN APM BoK1 B/OR I.JPM PAPERS? P. Gaddis - The Project Manager 1959 A	APM - BoK 1 1992 B	Articles in IJPM - R. Turner 2006 C	TOTAL OCCURRENCES OF TOPIC = (A+B+C)
Projects are usually structured and organised by task	✓	✓	✓	3
The PM manages other workers	✓	✓	✓	3
Delegation	✓	✓	×	2
The PM's task is finite in duration	✓	✓	✓	3
Team tailored specifically to the project	✓	✓	×	2
Lack of feedback information particularly in the early stages	✓	×	×	1
Structure – clear definition of authority and ownership	✓	✓	✓	3
Delivery within Time Cost and Specification is required	✓	✓	✓	3
Organisation Planning – 'shaping a team that can 'play over its head'" (Gaddis 1959 p 93)	✓	✓	×	2
Soft Skills – an understanding of the personalities/characteristic and attitudes of the team members	✓	✓	×	2
Advance planning – avoid crises	✓	✓	✓	3
Good two way communication within the team	✓	✓	×	2
Goal driven	✓	×	×	1
Progress Reporting	✓	✓	✓	3
The design, manufacturing and check-out stages	✓	✓	✓	3

TOPICS ADDRESSED IN THE APM BoK BUT NOT INCLUDING IN GADDIS	Are Topics included in the IJPM papers by R. Turner, but not in Gaddis? D	TOTAL OCCURRENCES OF TOPIC = (D+E)
MANAGEMENT DEVELOPMENT	×	1
PROJECT ENVIRONMENT	×	1
PROJECT APPRAISAL	×	1
INTEGRATION	×	1
SAFETY	×	1
DESIGN MANAGEMENT	×	1
VALUE ENGINEERING	×	1
CHANGE CONTROL	✓	2
PROCUREMENT	✓	2
MOBILISATION	×	1
MARKETING AND SALES	×	1
OPERATIONS/TECHNICAL MMENT	×	1
INFORMATION TECHNOLOGY	×	1
LAW	×	1
INDUSTRIAL RELATIONS	×	1

The Formal Systems Model:

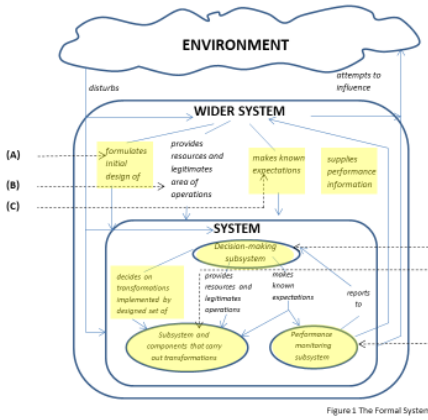


Figure 1 The Formal Systems Model (Fortune, J., & White, D (2006))

Figure 1 above shows that there are two key areas – the 'Wider System' delivers the functions of systems analysis and includes:

(A) formulating initial design
(B) providing resources
(C) setting expectations

The second key area is the 'System' itself which delivers the tasks of systems engineering consisting of 3 main subsystems:

(D) a Decision making subsystem
(E) a Subsystem and components that carry out transformations, and
(F) a Performance Monitoring subsystem.

The analysis process

Q1
Noting that HMS Barham is ship 424, does Slide Set 1 show any of the following Systems theory processes (shown in figure 1 above) - please tick the option you consider most appropriate:

WEAK AGREEMENT → STRONG AGREEMENT

Tick	Process					
☐	(A) formulating initial design	1	2	3	4	5
✓	(B) providing resources	1	2	3	(4)	5
☐	(C) setting expectations	1	2	3	4	5
☐	(D) a Decision making subsystem	1	2	3	4	5
☐	(E) a Subsystem and components that carries out transformations	1	2	3	4	5
☐	(F) a Performance Monitoring subsystem	1	2	3	4	5

Q2
Please briefly explain what you have considered relevant when ticking the categories in Q1.

SF GYUIOGYDJ UIGYURTC'#

Q3
Does Slide Set 1 represent any of the facets of the 'essence' of project management (please tick any or all that you consider appropriate):

WEAK AGREEMENT → STRONG AGREEMENT

Tick	Facet					
☐	Delegation	1	2	3	4	5
☐	Change Control	1	2	3	4	5
☐	Progress Reporting	1	2	3	4	5
☐	The project is goal driven	1	2	3	4	5
☐	An initial project appraisal.	1	2	3	4	5
☐	The PM manages other workers	1	2	3	4	5
✓	The PM's task is finite in duration	1	2	3	4	(5)
☐	Advance planning – avoid crises	1	2	3	4	5
☐	Management of plant and machinery	1	2	3	4	5
☐	Delivery within Time Cost and Specification	1	2	3	4	5
☐	Good two way communication within the team .	1	2	3	4	5
☐	Management of both internal and external resources	1	2	3	4	5
☐	Projects are usually structured and organised by task.	1	2	3	4	5
✓	The project has a clear structure – a clear definition of authority and ownership	1	2	(3)	4	5
☐	The project has distinct stages – for instance: design, manufacturing and check-out.	1	2	3	4	5
☐	The team organisation planning is structured to deliver synergistic benefits – 'shaping a team that can "play over its head"'	1	2	3	4	5
☐	Soft Skills – an understanding of the personalities/characteristics and attitudes of the team members.	1	2	3	4	5

Q4
Please explain your thoughts and reasoning in arriving at your answer to Q3.

Your comments, reflections views and thoughts

Q5
Do you think that the slide could be indicative of or be used to facilitate any other PM process?
Does it suggest the use or existence of any project process not outlined in Q3 above?

For example, a timeline showing the periodic spend on an item could be used to construct the project lifecycle used.

APPENDIX 5.6 –
ETHICS APPROVAL

Faculty of Environment
& Technology
Frenchay Campus
Coldharbour Lane
Bristol
BS16 1QY

Tel: 0117 328 1170

Our ref: MS/lt

7th January 2021

Aidan Turner

Dear Aidan

Application number: FET.21.01.021
Application title: Is it possible to detect any signs of the essence of Project Management processes being used during the construction of HMS Barham (1912-1914)? [Did HMS Barham use Project Management?]
University of Portsmouth REC Application Number: BAL/2018/E507/TURNER

Your University of Portsmouth ethics application and approval conditions have been considered by the Faculty Research Ethics Committee on behalf of the University. It has been given ethical approval to proceed with the following conditions:

- You comply with the conditions of the University of Portsmouth ethics approval.
- You notify the Faculty Research Ethics Committee of any further correspondence with the University of Portsmouth Ethics Committee.
- You must notify the Faculty Research Ethics Committee in advance if you wish to make any significant amendments to the original application.
- If you have to terminate your research before completion, please inform the Faculty Research Ethics Committee within 14 days, indicating the reasons.
- Please notify the Faculty Research Ethics Committee if there are any serious events or developments in the research that have an ethical dimension.
- Any changes to the study protocol, which have an ethical dimension, will need to be approved by the Faculty Research Ethics Committee. You should send details of any such amendments to the committee with an explanation of the reason for the proposed changes. Any changes approved by an external research ethics committee must also be communicated to the relevant UWE committee.
- Please note that the Research Ethics Sub-Committee (RESC) is required to monitor and audit the ethical conduct of research involving human participants, data and tissue conducted by academic staff, students and researchers. Your project may be selected for audit from the research projects submitted to and approved by the RESC and its committees.

Please note: In light of the current situation regarding COVID-19, we can only authorise an immediate start for activities that do not breach either national laws or University policies (for further information please click on the following link https://intranet.uwe.ac.uk/tasks-guides/Guide/research-and-enterprise-covid-19-information#part1). In these uncertain times, law and policy may change swiftly and frequently.

We are, however, continuing to scrutinise and grant ethical approval for activities that cannot take place at present, to ensure that once the situation changes and activities can go ahead, the research is not unnecessarily delayed.

What this means for your application:

1. If your application DOES NOT involve activities affected by the current crisis (e.g. online surveys or telephone interviews etc.) then you may start your research as soon as you receive this formal notification of your ethical approval;

2. If your application DOES involve activities affected by the current crisis then you must not start your research until you are lawfully and safely able to do so, and when it does not breach the University's policies. This will affect the dates you have supplied on your application form in relation to start and finish. When you have new dates, please can you write to us in order that we can add this information to your file.

If you are a doctoral student and this will affect your research timetable, please speak to your Director of Studies and the Graduate School for advice on how time delays will be supported by the University.

The Faculty and Research Ethics Sub-Committees (FRECs and RESC) are here to advise researchers on the ethical conduct of research projects and to approve projects that meet UWE's ethical standards. Please note that we are unable to give advice in relation to legal issues, including health and safety, privacy or data protection (including GDPR) compliance Whilst we will use our best endeavours to identify and notify you of any obvious legal issues that arise in an application, the lead researcher remains responsible for ensuring that the project complies with UWE's policies, and with relevant legislation https://intranet.uwe.ac.uk/whats-happening/sites/gdpr/updates/pages/research-and-gdpr-compliance-update-08-may-2019.aspx. If you need help with legal issues please contact safety@uwe.ac.uk (for Health and Safety advice), data.protection@uwe.ac.uk (for data protection, GDPR and privacy advice).

Please remember to populate the FET Research Governance Record with your ethics outcome via the following link: https://teams.uwe.ac.uk/sites/FETgovernance/SitePages/Home.aspx.

We wish you well with your research.

Yours sincerely

FORM UPR16

Research Ethics Review Checklist

Please include this completed form as an appendix to your thesis (see the Research Degrees Operational Handbook for more information

Postgraduate Research Student (PGRS) Information							
				Student ID:	UP713232		
PGRS Name:	Aidan Turner						
Department:	Business School	First Supervisor:	Dr. Philip Brabazon				
Start Date: (or progression date for Prof Doc students)	31/1/14						
Study Mode and Route:	Part-time ☒	Full-time ☐	MPhil ☐	PhD ☒	MD ☐	Professional Doctorate ☐	

Title of Thesis:	Is it possible to detect early signs of Modern Project Management processes during the construction of HMS Barham (1912-1914)? (Did HMS Barham use 'Project Management'? Does the study have implications for future PM research?)
Thesis Word Count: (excluding ancillary data)	66,754 (Sixty-six thousand, seven hundred and fifty four.)

If you are unsure about any of the following, please contact the local representative on your Faculty Ethics Committee for advice. Please note that it is your responsibility to follow the University's Ethics Policy and any relevant University, academic or professional guidelines in the conduct of your study

Although the Ethics Committee may have given your study a favourable opinion, the final responsibility for the ethical conduct of this work lies with the researcher(s).

UKRIO Finished Research Checklist:
(If you would like to know more about the checklist, please see your Faculty or Departmental Ethics Committee rep or see the online version of the full checklist at: http://www.ukrio.org/what-we-do/code-of-practice-for-research/)

a) Have all of your research and findings been reported accurately, honestly and within a reasonable time frame?	YES ☒ NO ☐
b) Have all contributions to knowledge been acknowledged?	YES ☒ NO ☐
c) Have you complied with all agreements relating to intellectual property, publication and authorship?	YES ☒ NO ☐
d) Has your research data been retained in a secure and accessible form and will it remain so for the required duration?	YES ☒ NO ☐
e) Does your research comply with all legal, ethical, and contractual requirements?	YES ☒ NO ☐

Candidate Statement:

I have considered the ethical dimensions of the above named research project, and have successfully obtained the necessary ethical approval(s)

Ethical review number(s) from Faculty Ethics Committee (or from NRES/SCREC):	BAL/2018/E507/TURNER

If you have *not* submitted your work for ethical review, and/or you have answered 'No' to one or more of questions a) to e), please explain below why this is so:

N/a.

Signed *(PGRS)*:

9th July 2018

Aidan Turner
Post Graduate Research Student
Operations and Systems Management
Faculty of Business and Law

Dear Aidan,

Study Title:	**Is it possible to detect any signs of the Essence of Project Management processes being used during the construction of HMS Barham (1912-1915)? [did HMS Barham use Project Management?]**
Ethics Committee reference:	**BAL/2018/E507/TURNER**

Thank you for submitting your documents for ethical review. The Ethics Committee was content to grant a favourable ethical opinion of the above research on the basis described in the application form, protocol and supporting documentation, revised in the light of any conditions set, subject to the general conditions set out in the attached document.

The favourable opinion of the EC does not grant permission or approval to undertake the research. Management permission or approval must be obtained from any host organisation, including University of Portsmouth, prior to the start of the study.

Summary of any ethical considerations:

Documents reviewed

The documents reviewed by Sara Hadleigh-Dunn [LCM] + FBAL Ethics Committee

Document	*Version*	*Date*
Application Form	1	31/05/18
Appendix 1 – Research ethics and Integrity Course Certificate	2	16/05/18
Appendix 2 – Primary and Secondary Research Questions	2	25/05/18
Appendix 3 – Consent Form	3	31/05/18
Appendix 4 – Voluntary Participation form	4	31/05/18
Appendix 5 – Confidentiality and Anonymity form	1	25/05/18
Appendix 6 – Draft Survey Questionnaire	3	25/05/18
Appendix 7 – Approach to Transparency	4	25/05/18
Appendix 8 – Invitation to take part in research	1	25/05/18
Appendix 5 – Confidentiality and Anonymity form	2	24/06/18
Appendix 8 – Invitation to take part in research	2	24/06/18

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements set out by the University of Portsmouth.

After ethical review

Reporting and other requirements

The attached document acts as a reminder that research should be conducted with integrity and gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments

- Notification of serious breaches of the protocol
- Progress reports
- Notifying the end of the study

Feedback

You are invited to give your view of the service that you have received from the Faculty Ethics Committee. If you wish to make your views known please contact the administrator, Christopher Martin.

Please quote this number on all correspondence:	**BAL/2018/E507/TURNER**

Yours sincerely and wishing you every success in your research

Chair

Email:

Enclosures: *'After ethical review – guidance for researchers'*

Copy to:

Philp Brabazon

Appendix 1

After ethical review – guidance for researchers

This document sets out important guidance for researchers with a favourable opinion from a University of Portsmouth Ethics Committee. Please read the guidance carefully. A failure to follow the guidance could lead to the committee reviewing and possibly revoking its opinion on the research.

It is assumed that the research will commence within 3 months of the date of the favourable ethical opinion or the start date stated in the application, whichever is the latest.

The research must not commence until the researcher has obtained any necessary management permissions or approvals – this is particularly pertinent in cases of research hosted by external organisations. The appropriate head of department should be aware of a member of staff's research plans.

If it is proposed to extend the duration of the study beyond that stated in the application, the Ethics Committee must be informed.

If the research extends beyond a year then an annual progress report must be submitted to the Ethics Committee.

When the study has been completed the Ethics Committee must be notified.

Any proposed substantial amendments must be submitted to the Ethics Committee for review. A substantial amendment is any amendment to the terms of the application for ethical review, or to the protocol or other supporting documentation approved by the Committee that is likely to affect to a significant degree:

(a) the safety or physical or mental integrity of participants

(b) the scientific value of the study

(c) the conduct or management of the study.

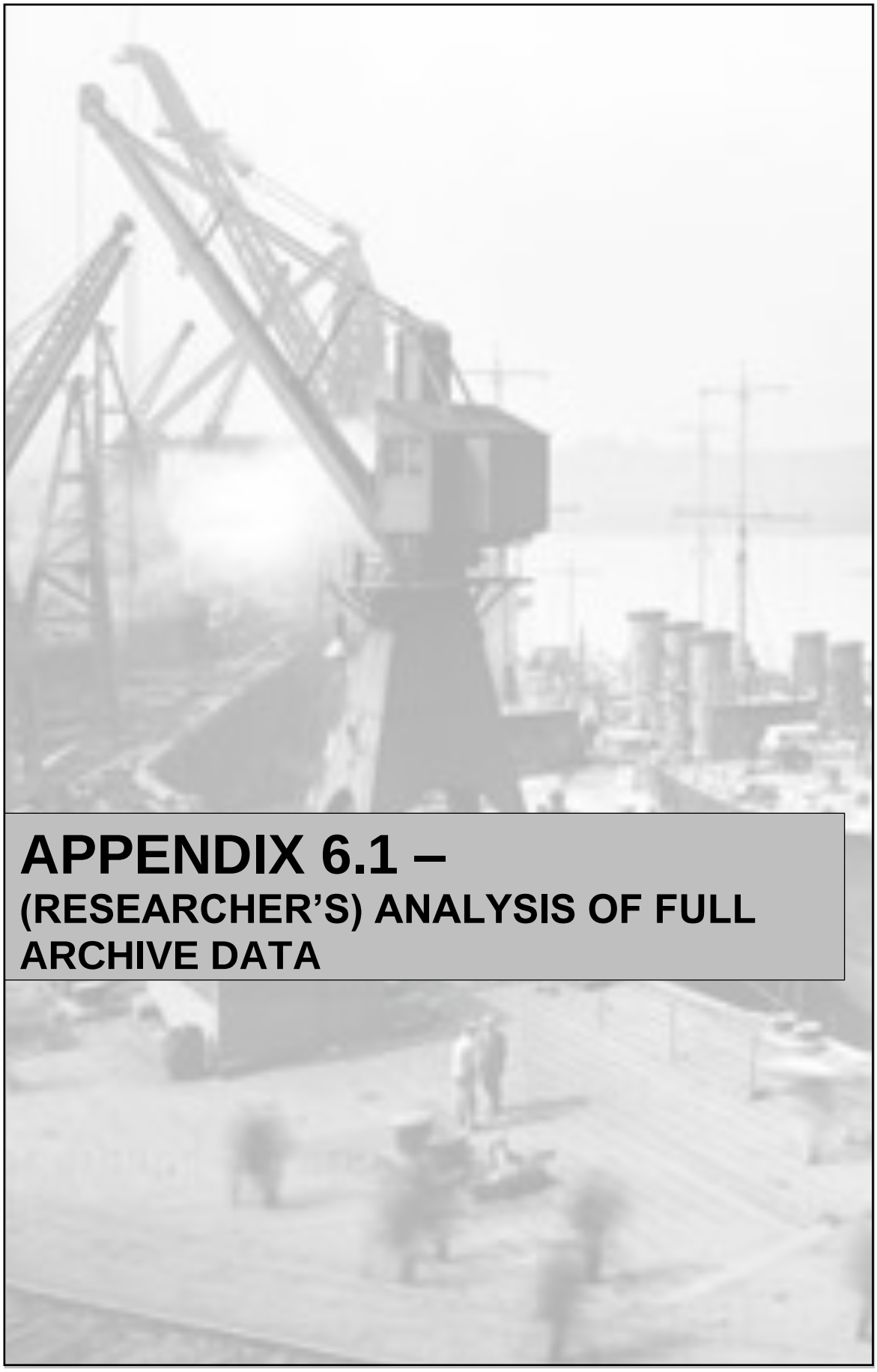
A substantial amendment should not be implemented until a favourable ethical opinion has been given by the Committee.

Researchers are reminded of the University's commitments as stated in the Concordat to Support Research Integrity viz:

- maintaining the highest standards of rigour and integrity in all aspects of research
- ensuring that research is conducted according to appropriate ethical, legal and professional frameworks, obligations and standards
- supporting a research environment that is underpinned by a culture of integrity and based on good governance, best practice and support for the development of researchers
- using transparent, robust and fair processes to deal with allegations of research misconduct should they arise
- working together to strengthen the integrity of research and to reviewing progress regularly and openly

In ensuring that it meets these commitments the University has adopted the UKRIO Code of Practice for Research. Any breach of this code may be considered as misconduct and may be investigated following the University Procedure for the Investigation of Allegations of Misconduct in Research.

Researchers are advised to use the UKRIO checklist as a simple guide to integrity.



APPENDIX 6.1 –
(RESEARCHER'S) ANALYSIS OF FULL ARCHIVE DATA

	SOURCE ARCHIVE	SOURCE FILE	DIRECT DARBAH REFERENCE	SOURCE SLIDE (if ... ..)	ALIGNED TO ELEMENT 'E' OF SYSTEMS MODEL (+ STRENGTH OF AGREEMENT 1-5)							ALIGNED TO ELEMENT 'E' OF ESSENCE OF PM (+ STRENGTH OF AGREEMENT 1-5)																		CONTENT - is file all 'consistent'?
					A	B	C	D	E	F	G	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	GLASGOW UNIVERSITY BUSINESS ARCHIVE - THREE STREET [GUA]	UCS 1-5-11	✓				C 5		F 4						4 3		6 3	7 5			10 1							17 3			STATETMENT SHOWING CAPACITY OF BUILDING &FINISHING BERTHS, VESSELS AT PRESENT UNDER CONSTRUCTION & PROGRESS OF WORK ON SAID VESSELS' - 22/2/1912-18/12/1912. (DSCF 2711-F2757) DSCF 2754 SHOWS BERTH BEING PREPED FOR BARHAM.
2	GUA	UCS 1-5-13			A 3			D 4							4 2	5 1	6 2										16 3				DETAILS OF TENDERS, SHOWING POSSIBLE DESIGN ALTERNATIVES. JAN 1914-SEPT 1914. (DSCF 2758-2766) DSCF2766 SHOWS DETAILS OF ADM CONTRACTS ACCEPTED AND DECLINED.
3	GUA	UCS 1-9-11					C 4								4 2		6 3							13 4							'ORGANISATION IN TIMES OF WAR' - LETTERS FROM 1904 FROM VICKERS MAXIM TO THE ADM. (DSCF 2767-2800) ALSO FROM VICKERS MAXIM TO JOHN BROWN SHOWING THAT THERE WAS CO-OPERATION BETWEEN BUILDERS AND GOVERNMENT DIRECTION TO THE INDUSTRY EVEN AS EARLY AS 1904. INCLs LIST OF 'INTERESTED' SHIPBUILDERS.
4	GUA	UCS 1-9-107						D 4	E 2			1 5			4 3		6 2			9 4	10 4								18 2		'STATISTICS' FROM CLYDE SHIPBUILDERS ASSOCISTION MEETINGS. MINUTES OF MEETINGS & DETAILS OF VARIOUS REPAIR RATES AT INCL JOHN BROWN YARD. (7/10/1911). (DSCF 2801-2807) ALSO DEMARCATION of jobs.
5	GUA	UCS 1-9-189				B 2	C 2								4 2		6 2			9 2							17 3	18 2		'MINUTES OF EVIDENCE ON SHIPPING AND SHIPBUILDERS - BOARD OF TRADE COMMITTEE EVIDENCE.15/12/16. EVIDENCE GIVEN BY Mr THOMAS BELL - MD OF JOHN BROWN & Co. dscf 2803 - 'YOUR WORKS ARE A VERY LARGE WORKS AND YOU DO HIGH CLASS WORK LARGELY GOVERNMENT WORK'. - A WIDE RANGING DOCUMENT THAT INVESTIGATES COSTS AND WORKINGS OF THE JOHN BROWN YARD. (DSCF 2808-2846). INCLUDES: ENG WRKS 8K MEN, SHIOPYARD 10 K MEN/ IMPORT TARRIFFS/ GERMAN STEEL PRICES/ QUALITY IOF BRITISH TOOLING/ LIMITING FACTORS OF PROD. - ENGINES OR RIVITERS/ TRAINING APPRENTICES FOREMANS' HOUSING/ SUPPORT FROM BANKS/ TRADE POST WWI/ RESEARCH/ POTENTIAL TO ACCELERATE PROD./ WORKING PRACTICES/ METRIC SYSTEM.
6	GUA	UCS 1-9-193	✓							F 3					4 1			7 2						13 3		15 2					(DSCF 2847-2864) ADM LETTER TO JOHN BROWN - 'SATISFACTORY PERFORMENCE IN BUILDING DESTROYERS.' 20/4/18. DETAILS SHIPS BUILT AND COMMENTS ON TIME PERFORMANCE . (JB = LARGEST ADM SUPPLIER OF DESTROYERS.) (SHOWS NOTE AT BOTTOM ADVISES COMPARISON WITH OTHER BUILDERS BEFORE THE LETTER IS SENT. (DSCF 2843). SUBSEQUENT TABLE SHOWS THAT JOHN BROWN HOLD THE RECORD FOR 'AV BUILD AND MIN BUILD ' TIMES. (DSCF 2852) DSCF 2856 BEGINS A HISTORY OF JOHN BROWN DURING THE WAR (WRITTEN BY JBs?) DSCF 2863 GIVES TABLE OF ALL VESSELS BUILT BY JOHN BROWN WEIGHTS, POWER& TYPE DURING WW1

	SOURCE ARCHIVE	SOURCE FILE	DIRECT DARBAH REFERENCE	SOURCE SLIDE (if ... ..)	ALIGNED TO ELEMENT 'E' OF SYSTEMS MODEL (+ STRENGTH OF AGREEMENT 1-5)							ALIGNED TO ELEMENT 'E' OF ESSENCE OF PM (+ STRENGTH OF AGREEMENT 1-5)																		CONTENT - is file all 'consistent'?
					A	B	C	D	E	F	G	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
7	GUA	UCS 1-10-2	✓							F 3		1 4						7 5	8 3											YARD DIARY 1907 - 1920. COVERS THE PERIOD Ono. & NAME) AND ALSO DETAILS OF YARD CLOSURES ETC.F BARHAM. INCLUDES MAJOR SHIP MOVEMENTS 9BY BUILD
8	GUA	UCS 1-13-1			A 3			D 4								5 3	6 5		8 3					13 5			16 4			DSCF 2865 REPLY TO TENDER INCL DISCUSSION OF DELIVERY DATES, DESIGN ALTERNATIVES, ARMAMENTS, LIST OF PLANS SUBMITTED, PROPOSED SCHEME OF INSTALMENTS , DSCF 2878 and 2888) ETC 4/4/11 - TENDERs FOR CHILLIE, ARGENTINA (TURNED DOWN BY jb QUOTING 'ARREARS IN YARD) AND HOLLAND (DSCF 2865-2894)
9	GUA	UCS 1-21-9	✓						E 4							5 3								13 4						DETAILS OF CONTRACTS AND COSTINGS / OUTSTANDING SUNDRIES. MOSTLY POST BARHAM, EXCPT CAMMELL LAIRD DOCKING CHARGE OF £650. - 1915 NET COSTS & % BASIS FOR CONTRACTS - ELECTRICAL WORK TO BE 'RENDERED SEPARATLY'. DSCF2904 DETAILS HOW COSTS (FROM ALL YARDS) SHOULD BE BROKEN DOWN. SPECIFIC REFEENCE TO 'EXTRAS' FOR BARHAM.
10	GUA	UCS 1-21-29	✓						E 4	F 4		1 5		3 5	4 5	6 5		7 5						13 5		15 4	16 5		18 4	31/3/15 EVIDENCE OF LACK OF WORKERS - PROGRSS CHASING, ACELERATION REQUESTS AND DRAFTING OF LABOUR ONTO CONSTRUCTION OF OTHER OTHER VESSELS (DSCF 2913- 2926) DSCF 2917 DISCUSSES SHORTAGES AND ADDITIONAL LABOUR REQUIRED/ REQUESTED FOR BARHAM (6/4/15). ALSO DETAILS OF SHIP TRIALS RUN FOR ADM.
11	GUA	UCS 1-21-33				B 2				F 3				3 3				7 3												HMS HOOD - CLARIFICATION OF PAYMENT TERMS (FIXED COST) 10/10/16 ALSO SIMILAR 20/8/15 (NET COST AND % BASIS) - FROM NAVAL CONTRACTS. ALSO LIST OF SHIPS FROM NO. 436-461. (DSCF 2927-2935)
12	GUA	UCS 1-21-34					C 2	D 3									6 4									15 2		18 1	(DSCF 2936-2950) 11-1-17 - LETTER RE ACCELERATION OF MERCHANT SHIPPING CONSTRUCTION. DSCF 2938 REFERENCE TO 'PROGRAMME OF SHIPBUILDING' (1918) DSCF 2943 EVIDENCE OF REALIGNMENT OF 'PROGRAMME' BETWEEN MERCHANT AND MILITARY NEEDS. OTHER RELATED CORESPONDENCE FROM JOHN BROWN & ADM.
13	GUA	UCS 1-21-50			A 3		C 2									5 4			8 2										(DSCF 2951-) ARGENTINE BATTLESHIP - SUMMARY OF COSTS & REPLY TO TENDER - FEB 1909. INCLs (DSCF 2973) SAME 'SCHEME OF INSTALMENTS' AS UCS 1-13-1. DIFFERENT FOR BATTLESHIP AS OPPOSED TO TORPEDO BOAT IN NEXT SLIDES. SEEMS TO BE A COLABORATION BETWEEN JOHN Br. FAIRFIELD & CAMMELL LAIRD. ESTABLISHMENT CHARGES.
14	GUA	UCS 1-21-118			• NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT							• NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT											• NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT						A STUDY OF SPANISH NAVAL CONSTRUCTION (DSCF2989- 3059)
15	GUA	UCS 1-22-3			• NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT							• NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT											• NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT						DSCF (2656-2697) COPIES OF MINUTES RELATING TO 1910 EXTENSIONS TO THE JOHN BROWN YARD. ALSO 1909 MACHINERY.

	SOURCE ARCHIVE	SOURCE FILE	DIRECT DARBAH REFERENCE	SOURCE SLIDE (if ...	ALIGNED TO ELEMENT 'X' OF SYSTEMS MODEL (+ STRENGTH OF AGREEMENT 1-5)							ALIGNED TO ELEMENT 'X' OF ESSENCE OF PM (+ STRENGTH OF AGREEMENT 1-5)																		CONTENT - is file all 'consistent'?
					A	B	C	D	E	F	G	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
16	GUA	UCS 1-23-3	✓							E 5					4 5		6 5				10 3					15 3	16 2		18 1	DSCF2698 -2707) CORRESPONDENCE RE BUILDING OF WORKER'S TENEMENTS. ALSO (DSCF 2707) LIST OF ESTIMATE OF IRONWORKERS EMPLOYED ON SHIPS UNDER CONSTRUCTION INCL BARHAM JUNE 1913 - JULY 1915.
17	GUA	UCS 1-25-81			•	NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT					G 5				•	NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT						•	NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT								- NOTHING RELEVANT
18	GUA	UCS1-34-12							E 4						4 2					9 2	10 2									SUNDRY SUMMARY ACCOUNTS
19	GUA	UCS 1-59-1, 2, 3 & 4	✓			B 4				F 3																				LIST OF ALL JOHN BROWN SHIPS - SHOWING BARHAM AS No. 424. (DSCF 3061). ALSO LEDGER GIVING WEEKLY RECORD OF WORKERS EMPLOYED ON CONTRACTS (DSCF 3062 - 3069). DETAIL FOR SHIPS 424-435 (PERIOD 4/11/14 - 8/9/15.)
20	GUA	UCS 1-59-1				B 4				F 3																				AS UCS 1-59-1 BUT FOR SHIPS 434 - 440 & 443 - 445 & 447 - 452 (DSCF 3070 - 3073) (DATE 22-23/9/15)
21	GUA	UCS 1-59-2				B 4				F 3					4 3					9 2	10 2									WEEKLY TOTAL FOR WORKERS ON A BOAT BY BOAT BASIS. - NO MENTION OF 424 BARHAM THOUGH.
22	GUA	UCS 1-59-3				B 4				F 3					4 3					9 2	10 2									AS UCS 1-59-1 BUT FOR SHIPS 425, 432,437-8, 443, 449-52, 455-60 (DSCF 3074 - 3079)
23	GUA	UCS 1-59-4				B 4				F 3					4 3					9 2	10 2									AS UCS 1-59-1 BUT FOR SHIPS 460, 470-1,477-80, 482-90 (DSCF 3080 - 3085) (Period 7/8/1918 - 28/1/20)
24	GUA	UCS 1-59-33				B 2				E 1					4 1						10 1								18 1	DOCUMENT SHOWING No. OF JOURNEYMEN AND APPRENTICES EMPLOYED IN THE YARD AS AT 3/11/13 & 3/11/20 AND WAGES FOR EACH AS AT 1300. (DSCF 3086 - 3093)
25	GUA	UCS 1-61-1								F 2					4 2			7 2						13 1						HMS SOUTHAMPTON RECORD OF ADMIRALTY STAGE PAYMENTSFROM 6/3/11-23/12/13 (DSCF 3094-3100)
26	GUA	UCS 1-61-2	✓	ANALYSE PAYMENTS OVER FULL LIFECYCLE		B 5	C 4								4 4		6 3	7 2								15 3				AS UCS 1-61-1 FOR HMS TIGER (DSCF 3101-3111) & HMS BARHAM (DSCF 3112-3129). ALSO - COPIES OF ESTIMATES - HMS TIGER (DSCF 3130-3135) & HMS BARHAM (3136-3140)
28	GUA	UCS 1-64-1	✓	COULD PLOT TIMINGS OF CHANGE ETC			C 5			F 3					4 3		6 4							13 3	14 5		16 2			LIST OF EXTRAS FOR HMS TIGER (DSCF 3148- 3153) SHOWING COST OF EXTRA AND DETAILS OF WHERE THE REQUEST CAME FROM (LETTER BOOK) / DATE APPROVED /DATE PAID/INVOICED ETC . SIMILAR INFO FOR 'REBATES'. HMS BARHAM - SAME DETAIL - (DSCF 3154 - 3159.)
29	GUA	UCS 1-64-1								F 1						5 1		7 1								15 1	16 1			STUCK IN THE BACK OF 1-64-1 - CUTTINGS FROM GLASGOW HERALD RE PROGRESS OF BUILD - 25/7/12 AND 31/10/12 RE DELAY IN CONSTRUCTION OF HMS TIGER. (DSCF 3163-70).

REF No.	SOURCE ARCHIVE	SOURCE FILE	DIRECT DARHAM REFERENCE	SOURCE SLIDE (if ... ..)	ALIGNED TO ELEMENT 'E' OF SYSTEMS MODEL (+ STRENGTH OF AGREEMENT 1-5)							ALIGNED TO ELEMENT 'E' OF ESSENCE OF PM (+ STRENGTH OF AGREEMENT 1-5)																		CONTENT - is file all 'consistent'?
					A	D	C	D	E	F	G	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
30	GUA	UCS 1-74-6	✓				C 4	D 3									6 4										16 3			REF No. 424 (BARHAM) 'PROPOSED' COST CALCS AND DELIVERY DATE SPECIFIED AS 30-1-15, ALTERNATIVE COSTINGS LISTED, DATED 22-10-12. (DSCF 3172-3) (SHOWS DELIVERY DATE PLANNED OF JAN 1915)
31	GUA	UCS 1-75-8	✓	ALL GOOD COPY FULL CYCLE - MUST PLOT - EVM?					E 4	F 4					4 4		6 3								14 4		16 1			CONTRACTS IN PROGRESS SHOWING: ESTIMATED COSTS/ CONTRACT PRICE/ COST/ CASH REC'D/ EXCESS CHARGES. HMS BARHAM APPEARS AT BOTTOM OF DSCF 3175 (19-2-13) AND WORKS UP TO THE TOP OF THE LIST BY: DSCF 3233 - 3/5/16.
32	GUA	UCS 1-77-147	✓						E 3						4 4			7 3												MANAGERS PROGRESIVE COSTS BOOK' FOR HMS BARHAM FROM DEC 1912 (DSCF 3295- 3307) ALSO DSCF 3308 - 3329 MORE DETAILED COSTINGS - AT A LOWER LEVEL.
33	GUA	UCS 1-82-11							E 3						4 4			7 3												(DSCF 3354-3367) WAGES BOOK BOAT 418 (TIGER) ALSO DEBIT AND CREDIT ACCOUNTING BOOK.
34	GUA	UCS 1-85-3		PROJECT BROKEN DOWN BY RESOURCES RATHER THAN BY TASK		B 4				F 3					4 3		6 5									16 3			COMPARISON OF COSTS BETWEEN HMS HOOD AND 'PROPOSAL'. LARGELY TYPES AND QUANTITIES OF WOOD, BUT ALSO GENERAL PARTICULARS (DSCF3341) AND HULL COMPARISONS. SOME FURTHER EXAMPLES OF 'ESTIMATES'. SUMMARY OF HOOD v PROPOSAL COSTS (DSCF 3348.) (DSCF 3334-3353) (DATED APPROX 1921)
35	GUA	UCS 1-86-9	✓	WORTH ANALYSING EST. AND COSTS OVER TIME		B 3				F 5					4 3		6 4	7 2							15 1	16 2			COMPARISSON OF COST & ESTIMATE BOOK FOR HMS BARHAM. (DSCF 3426-3267).
36	GUA	UCS 108-11		These reports generally discuss machinery and yard layout and ships being built. Interesting		B 1	C 1								4 1	5 1											17 1	18 1		REPORT ON DUTCH SHIP BUILDING - MARCH 1914. INCLs WAGE AND WORKER CONDITIONS/ OVERHEAD COST/ TIME/ REPAIR WORK COMPARISON. SOME WORDS ON FRENCH, GERMAN, ITALIAN, NORWAY, SPAIN SHIPBUILDING. (DSCF 3330-3333)
37	GUA	UCS 1-108-12				B 1	C 1								4 1	5 1											17 1	18 1		(DSCF 3268-3293) DESCRIPTION OF VISIT/FINDINGS OF TRIP TO US SHIPYARDS.
38	GUA	UCS 1-108-12			AS ABOVE																									CYDE SHIPBUILDERS YARDS REPORT ON VISIT TO US SHIPYARD AUG 1901 (DSCF 3268-3293)
39	GUA	UGD 1-1-1-1		FROM NEWSPAPER ARTICLE A FLOW DIAGRAM OF CONSTRUCTION CAN BE MADE.		B 1	C 2					1 4			4 3			7 3	8 3											DSCF 2499- 2520)BEARDMORE MINUTE BOOK PLUS PRESS CUTTINGS ON BEARDMORE NAVAL WORKS.

ref no.	SOURCE ARCHIVE	SOURCE FILE	DIRECT DARDAN REFERENCE	SOURCE SLIDE (if ... ..)	ALIGNED TO ELEMENT '2' OF SYSTEMS MODEL (+ STRENGTH OF AGREEMENT 1-5)							ALIGNED TO ELEMENT '2' OF ESSENCE OF PM (+ STRENGTH OF AGREEMENT 1-5)																		CONTENT - is file all 'consistent'?
					A	B	C	D	E	F	G	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
40	GUA	UGD 1-13-11		MAP & INFO COULD BE USED WITH RGD 1-1-1-1 ABOVE		B 1	C 2					1 4			4 3				8 3											(DSCF 2534-2543) THE BUILDING OF SHIPS - A BRITISH SURVEY - 1938
41	GUA	UGD 1-13-31			•						G 5			•									•							
42	GUA	UGD 100-7-1-25			•						G 5			•									•							BEARDMORE 'RECRUITMENT AND TRAINING OF YOUNG PEOPLE' (DSCF 2544 - 2550) - UNDATED BUT SUSPECTYED TO BE FROM A PERIOD POST THE PERIOD OF STUDY.
43	GUA	UGD 100-7-1-26		SOME PHOTOS	•						G 5			•									•							(DSCF 2551- 2569) GENERAL INFO ON BEARDSMORE
44	GUA	UGD 137-3-24		SOME PHOTOS	•						G 5			•									•							1919 JOURNAL ARTICLE DESCRIBING THE BEARDSMORE WORKS and achievements (DSCF2570-2588)
45	NATIONAL ARCHIVE	ADM 1-8435-...	✓	DSCF 4368-4419			C 4			F 3							6 5	7 2									16 2		18 5	(DSCF 4368-4419)PROGRAMME OF NEW CONSTRUCTION 1915 . DSCF 4403 18/3/15
46		ADM 95 Pt. 1		DSCF 4368-4382			C 4			F 2			2 5		4 5			7 5		9 5	10 5				14 2			17 5		DESCRIPTION OF DUTIES OF PROFESSIONMAL OFFICERS IN HM DOCKYARD
47		ADM 95 Pt. 2					C 4			F 2			2 5		4 5			7 5		9 5	10 5				14 2			17 5		DESCRIPTION OF DUTIES OF PROFESSIONMAL OFFICERS IN HM DOCKYARD
48		ADM 95 Pt. 3					C 4			F 2			2 5		4 5			7 5		9 5	10 5				14 2			17 5		DESCRIPTION OF DUTIES OF PROFESSIONMAL OFFICERS IN HM DOCKYARD
49		ADM 95 Pt. 4					C 4			F 2			2 5		4 5			7 5		9 5	10 5				14 2			17 5		DESCRIPTION OF DUTIES OF PROFESSIONMAL OFFICERS IN HM DOCKYARD
50		ADM 95 Pt. 5.1					C 4			F 2			2 5		4 5			7 5		9 5	10 5				14 2			17 5		DESCRIPTION OF DUTIES OF PROFESSIONMAL OFFICERS IN HM DOCKYARD
51		ADM 95 Pt. 5..2					C 4			F 2			2 5		4 5			7 5		9 5	10 5				14 2			17 5		DESCRIPTION OF DUTIES OF PROFESSIONMAL OFFICERS IN HM DOCKYARD
		ADM 95 107		DSCF 4383-4418			C 4			F 2			2 5		4 5			7 5		9 5	10 5				14 2			17 5		DESCRIPTION OF DUTIES OF PROFESSIONMAL OFFICERS IN HM DOCKYARD
52		ADM 268-3			•						G 5			•									•							RATES OF PAY ETC FROM 1952 - THEREFORE NOT RELEVANT.
53		ADM 281-4			•						G 5			•									•							REPORT ON VENTILATION AND HYGENE IN WARSHIPS DATED 1915, LAREGLY LOOKING AT SHIPS POST LAUNCH, AND PROVIDING RECOMMENDATIONS FOR FUTURE BUILDS THEREFORE NOT RELEVANT TO BARHAM.
54		ADM324-1			•						G 5			•									•							1936 PLANNING IN CASE FOR SHIP BUILDING IN CASE OF WWII.

	SOURCE ARCHIVE	SOURCE FILE	DIRECT BARHAM REFERENCE	SOURCE SLIDE (if	ALIGNED TO ELEMENT '1' OF SYSTEMS MODEL (+ STRENGTH OF AGREEMENT 1-5)							ALIGNED TO ELEMENT '1' OF ESSENCE OF PM (+ STRENGTH OF AGREEMENT 1-5)																	CONTENT - is file all 'consistent'?
					A	B	C	D	E	F	G	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
55		CAB 37-118			• NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT										• NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT							• NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT								INTERESTING PREP FOR WWII SHOWING WHAT COULD BE OMITTED TO SPEED SHIP DELIVERY. BUT ALL POST WWI SO NOT RELEVANT.
56		ADM 1-8491-148			A 1	B 3											6 2									15 1			18 4	1917 VIEW OF SHIPBUILDING SITUATION. REVIEW OF LOSSES. LABOUR AND STEEL IDENTIFIED AS RESOURCES IN SHORTEST SUPPLY. TOTALS FOR WORLDWIDE SHIPPING OUTPUT - 1913.
57		ADM 95-101	✓							F 3								7 3												STANDARD FORM FOR RECORDING SHIP DESCRIPTION ON COMPLETION. (barham ref 483 - NOT 61.)
58		ADM1-24200		DSCF 4185-423	A 4		C 3								4 3		6 4													DETAILS OF 'PROGAMME' OF SHIP CONSTRUCTION 1903-04 AND 1907 ALTERNATIVE DESIGNS REVIEWED. STD FORM FOR 'STATEMENT OF DIMENSIONS AND ESTIMATE OF WEIGHT etc
59		MT25 N456-1		DSCF 4238-424			C 1																	13 3						1917 'SUGGESTIONS FOR ALLEVIATING DIFFICULTIES UNDER WHICH WORK IS CURRENTLY BEING CARRIED OUT.' CONTAINS A FEW EXCHANGES OF LIMITED RELEVANCE TO THIS STUDY. requesting specific draughtsmen on accont of their experience.
60		MT25 N456-2		DSCF 4258-427	A 1		C 1																				16 2			1917 'OBSERVATIONS ON PAINTING SHIPS IN SUCH A WAY AS TO REDUCE THEIR VISABILITY.' DAZZLE PAINTING FOR MERCHANT SHIPS. ALSO LIGHT GREY (15-20PARTS WHITE TO 1 PART BLACK)
61		MT25 N456-3		DSCF 4275-4351							G 5				4 1															1917 CORRESPONDENCE WITH VICKERS Ltd RE ADDITIONAL MINE PROTECTION. 'otter instalation'. MULTIPLE LISTS OF VESSELS, LARGELY MERCHANT WITH STATUS OF OTTER FIXINGS.
62		MT25 N456-4		DSCF 4357-435	• NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT						G 3				• NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT							• NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT								TRANSLATIONS OF GERMAN RADIO BROADCASTS RE CONTINUATION OF THE WAR.
63		T1-11579				B 2											6 1				10 3								18 4	PAPERS RE A REQUEST FOR ADDITIONAL DRAUGHTSMEN
64	BRASS FOUNDRY	BFR0100			A 2		C 1					1 1			4 1															DISCUSSION AROUND NEW BUILDS NOT HAVING TORPEDO NETS ATTACHED.
65	BRASS FOUNDRY	BFR0101			A 5		C 4										6 3							13 5						LIST OF DRAWINGS REC'D BY J BROWN FROM THE CONSTRUCTOR - MR WORTHINGTON (RN?) FOR BARHAM - REC'D AT CLYDEBANK 20th JUNE 1913. PROBABLY A PROCESS AS ALSO RECEIPT OF VALIANT DRAWINGS ALSO RECIORDED AS REC'D BY FAIRFIELDS.
66	BRASS FOUNDRY	BFR0102			A 5		C 4										6 3							13 5						DETAILS RE SENDING OF DRAWING DOCS TO YARDS RE 1912-13 BATTLESHPS.

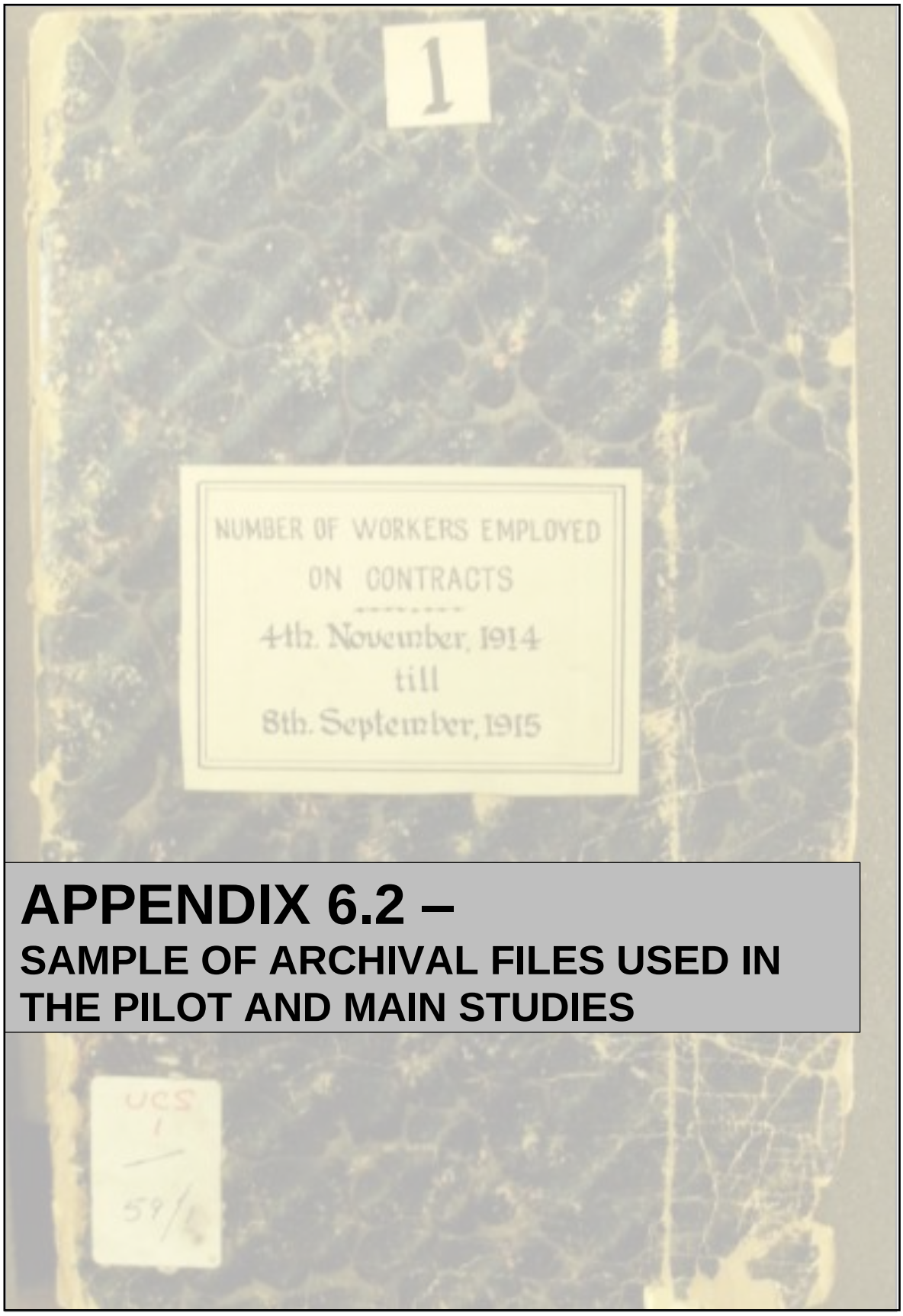
ref no.	SOURCE ARCHIVE	SOURCE FILE	DIRECT DARBAN REFERENCE	SOURCE SLIDE (if ... ..)	ALIGNED TO ELEMENT 'X' OF SYSTEMS MODEL (+ STRENGTH OF AGREEMENT 1-5)								ALIGNED TO ELEMENT 'X' OF ESSENCE OF PM (+ STRENGTH OF AGREEMENT 1-5)																		CONTENT - is file all 'consistent'?
					A	B	C	D	E	F	G		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
67	BRASS FOUNDRY	BFR0103	✓		A 5	B 4		D 4								4 5		6 5			9 3	10 5			13 5					18 3	ADM BOARD MINUTE RE DISTRIBUTION OF SHIP WEIGHT 18-3-13 - QE CLASS. ALSO REQUESTING SPECIFIC ADDITIONAL DRAUGHTSMEN ON ACCOUNT OF THEIR EXPERIENCE. ALSO 'OFFICIAL SECRETS ACT' FORERUNNER! SIGNED BY NUMEROUS BETWEEN 4/5 AND 8/7 1912. RELATES TO 1912-13 PROGRAMME. BOARD MEMO CONFIRMING SELECTION OF RIII DESIGN OPTION. COMPARATIVE DESCRIBTION V. IRON DUKE GIVEN. DETAILS RE ARMOUR PROTECTION REQUIRED IS GIVEN. DETAILS OF DIMENSION AND WEIGHTS GIVEN. LETTER FROM P WATTS SHOWING DESIGN DEVELOPMENT. LETTER DATED 18/5/12 ASKING WHEN LAGER DOCK WILL BE COMPLETED AT PORTSMOUTH. DIVISION OF DRAWINGS BETWEEN YARDS.
68	BRASS FOUNDRY	BFR0104					C 3						1 5		3 5	4 4	5 5	6 5			9 5				13 4					18 3	CONTRACT AWARDED FOR STEERING GEAR AND DATE FOR INSTALLATION GIVEN - 15/11/13 (LETTER DATED 3/1/13) APPT OF OVERSEER. CONTRACT AWARDED ALSO FOR RIVETS. AND STEEL PLATES - SELECTED SUPPLIES FOR 'SPECIAL STEEL PLATES'. PRE-PRINTED STEEL PLATE TENDER FORM. CONTRACT FOR 'HULL AND MACHINERY' - SHOWS PROJECT BROKEN DOWN INTO SPECIFIC AREAS WITH COSTS ATTRIBUTED - SO SHOWS THE OVERALL TASK BROKEN DOWN INTO SUB AREAS. FULL CONTRACT TERMS (STD FORM) . PROVISION FOR OVERSEER. ALLOCATION OF RESPONSIBILITIES (RISK). INSURANCE. DETAILS OF TRIALS.
69	BRASS FOUNDRY	BFR0105	✓		A 4		C 4	D 4								4 4	5 2	6 4			9 3					14 5	15 3	16 5			PROVISIONAL ARMAMENT STATEMENT (STD FORM) CHANGES PUT FORWARD AND THE AFFECT ON POWER AND COST DISCUSSED - CHANGE CONTROL. (DSCF 3471) DISTRIBUTION OF DRAWINGS BETWEEN YARDS. REQUEST RE ARMOUR PRICING. LETTER DETAILING ACTION RE PLANS FOR 1912-13 PROGRAMME WRITTEN 7/12 - IN ADVANCE. COPY OF A PLAN.
70	BRASS FOUNDRY	BFR0106	✓		A 3		C 4	D 3									5 3	6 5			9 5	10 4			13 3		15 3			18 5	DSCF 3439 - REQUIRES DELIVERY TO SET DATE. STRICT SPECIFICATION GIVEN FOR ARMOUR BELTS. 13-6-13 LETTER GIVING REQUIRED DELIVERY OF BELTS TO BARHAM BY 30-6-14
71	BRASS FOUNDRY	BFR0107						D 3										6 3											17 2		METHOD OF RISK REDUCTION RE OIL ONLY VESSELS. DATED 29-10-15. RISK REDUCTION FROM HOOD EXPERIENCE TO QE CLASS - 'THESE SHIPS NOT HAVING BEEN COMPLETED WHEN THE ORDER WAS ISSUED'. DSCF 3819.
72	BRASS FOUNDRY	BFR0108		DSCF 3583			C 4	D 3					1 3			4 3					9 2					14 5		16 3			16-1-14 - PRINCIPLE ALTERATIONS MADE SINCE TENDERS WERE ACCEPTED (FOR Q.E. CLASS) (DSCF 3583-90) WITH REFERENCE TO COSTS ASSOCIATED. CONSIDERATION OF ALTERNATIVE OPTIONS. NOTES OF DELAYS IN GUN TESTING. SOME DETAIL DECIDED ON DURING LIFE - DETAILED PLACEMENT OF WASHBASINS - 11/5/14 - ADD WEIGHT = 114 TONS TO BE ADJUSTED BY CARRYING LESS FUEL! DSCF 3676 SHOWS CHANGE/TIME/COST/PERFORMANCE CONSIDERED TOGETHER. SEE ALSO DSCF 3678.

	SOURCE ARCHIVE	SOURCE FILE	DIRECT BARHAM REFERENCE	SOURCE SLIDE (if ... ..)	ALIGNED TO ELEMENT 'A' OF SYSTEMS MODEL (+ STRENGTH OF AGREEMENT 1-5)							ALIGNED TO ELEMENT 'A' OF ESSENCE OF PM (+ STRENGTH OF AGREEMENT 1-5)																		CONTENT - is file all 'consistent'?
					A	D	C	D	E	F	G	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
73	BRASS FOUNDRY	BFR0109	✓					D 4				1 2			4 3	5 2				9 3					14 1		16 2				DIFFERENCE BETWEEN ESTIMATING PLANS AND BUILDING DRAWINGS (FOR BARHAM). MODIFICATIONS TO BUILDING DRAWINGS. MODIFICATIONS TO TENDER PRINTS FWDED TO CONTRACTORS ON 23-3-12.
74	BRASS FOUNDRY	BFR0110	✓					D 4		F 2							6 3	7 5		9 3									18 2		DETAIL RE SUPPLY OF BOATS TO HMS BARHAM. DATED 18-8-15 SHOWING A REQUEST FOR DISPATCH AND REPORT WHEN DONE.
75	BRASS FOUNDRY	BFR0111	✓	DSCF 3510	A 4					F 3		1 3		3 4	4 4		6 3	7 5						13 4	14 1	15 3					HMS BARHAM 'STATEMENT OF EXTRAS INVOLVED THROUGH ALTERATION TO DESIGN' 5-2-1913 (DSCF 3510-3512) 15-2-13 NOTE RE DELAY IN PATTERNS FOR QE + NOTE TO ORDER EVERYTHING 3 MTHS IN ADVANCE OF LAYING DOWN SHIPS.(DSCF 3509) EVIDENCE IN MINUTES OF 2 WAY CIONVERSATION. MALAYA - WORK ON HULL NOT MADE REQ'D PROGRESS DUE TO LABOUR SHORTAGES + OTHER DELAYS - DELIVERY DATE FOR MALAYA PUT BACK UNTIL 31-12-15. MILESTONE DATES GIVEN FOR GUNS BEING PLACED ON BOARD. DSCF 3839 - DELAYS RE VALIANT.
76	BRASS FOUNDRY	BFR0112				B 3	C 3			F 4							6 5			9 2				13 2					18 1		ESTIMATES FOR QE COMPARED TO VALIANT (APPROX 23/6/13) - ALSO SHOWING AVERAGE OF 6 UNACCEPTED QUOTES - SHOWING THAT ONE OF THE CHEAPER OPTIONS WAS SELECTED. 7/12/12 - CALCULATIONS FOR QE CLASS APPROVED. (DSCF 3489). PRINCIPLE DIMENSIONS OF BARHAM - LAUNCHED 31-12-14.
77	BRASS FOUNDRY	BFR0113		DSCF 3535					E 4	F 3					4 3															PRINCIPLE SALIENT FEATURES OF IRON DUKE & QUEEN ELIZABETH WHICH CAUSE EXTRA COST FOR LATER SHIP.' 2-9-14 FOR INFORMATION OF FINANCE COMMITTEE.
78	BRASS FOUNDRY	BFR0114	✓				C 2		E 2								6 2			9 2											FLAGSHIP DECISIONS: HMS QE AS AT 28-8-14, MALAYA AS AT 19-9-14, BARHAM AS AT 15-10-14, BARHAM AS AT 9-6-15, HMS QE FLEET FLAGSHIP AS AT 24-12-16. BEATTY'S REQUIREMENTS OF A FLAGSHIP.
79	BRASS FOUNDRY	BFR0115	✓		•		NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT				G 5			•	NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT							•	NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT							1931 - PROBABLE ORDER OF REPLACEMENT OF CAPITAL SHIPS. ALL POST PROJECT
80	BRASS FOUNDRY	BFR0116	✓	DSCF 3575			C 3			F 4				3 3	4 3	5 3	6 5									15 5					HMS BARHAM 'AN ACCOUNT SHEWING THE PRINCIPAL DIMENSIONS OF THIS SHIP LAUNCHED 31/12/1914 (DSCF 3575-6) AND FOR MALAYA (18-5-15) , QUEEN ELIZABETH(16-10-13) , WARSPITE (26-11-13) , Valliant (4-11-14) BARHAM - PERMISSION TO LAUNCH BARHAM ON 31-12-14 GIVEN ON 15-11-14. PERMISSION GIVEN FOR FOR QE: 22-8-13
81	BRASS FOUNDRY	BFR0117	✓		•		NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT				G 5			•	NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT							•	NO ALIGNMENT TO SYSTEM MODEL OR ESSENCE OF PROJECT MANAGEMENT							WARSPITE - SCHEME OF COMPLIMENT. BARHAM - SCHEME OF COMPLIMENT
82	BRASS FOUNDRY	BFR0118				B 2											6 1	7 1													DETAILS OF PAYMENT RE CONNING TOWER OF HMS MALAYA

	SOURCE ARCHIVE	SOURCE FILE	DIRECT DARHAM REFERENCE	SOURCE SLIDE (if ... ..)	ALIGNED TO ELEMENT 'A' OF SYSTEMS MODEL (+ STRENGTH OF AGREEMENT 1-5)								ALIGNED TO ELEMENT 'A' OF ESSENCE OF PM (+ STRENGTH OF AGREEMENT 1-5)																		CONTENT - is file all 'consistent'?
					A	B	C	D	E	F	G		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
13	BRASS FOUNDRY	BFR0119	✓					D 4	E 3				1 3		3 5			6 4	7 4							14 2	15 1					VALLIANT - ACCELERATION OF WORK, 25-11-14. REQUEST FOR CONTRACTORS TO REPORT IF THIS SITUATION CHANGES. ESTIMATE DATES FOR DELIVERY OF TURRETS GIVEN FOR BARHAM (JAN/FEB 1915) AND GUN TRIALS (APR 1915) DAY AND NIGHT SHIFTS REQUIRED FOR WARSPITE AIMING TO ENSURE DELIVERY APR 1915. EXTRA LABOUR REQ'D BUT NOT TO APPROACH WORKERS IN HM DOCKYARDS. SLIDE DSCF3672 PARA 3 SUGGESTS REDUCING TRIALS TO GET LAUNCH BACK ON TRACK!!
14	BRASS FOUNDRY	BFR0120					C 2			F 5					3 5	4 2		6 4	7 5		9 2				13 3	14 2	15 1			18 4	EVIDENCE OF SYSTEM - 'SIGNING BUILDING DRAWINGS AS USUAL' 20-10-1914 OVERSEER SAYS THEY WILL FWD WEEKLY REPORT TO ADM DETAILING NO. OF WORKERS ON HULL SHEWING AV NOS FOR DAY SHIFT/NIGHT SHIFT & O/T. 12-10-15 - REPORT OF MTHLY 'CONFERENCE' - RE PROGRESS OF WORK ON VALLIANT DSCF 3825/6. EVIDENCE OF A QRTLY RETURN DSCF 3892. DESIGN OF CLASS BEGUN 13-6-12. QE RUSHED FOR GALLIPOLI HENCE LOWER LEVEL OF FINISH DSCF3900 - MAY 1918 REVIEW OF CLASS.
15	BRASS FOUNDRY	BFR0121	✓	DSCF 3626		B 4	C 5						1 5		3 5	4 5	5 5	6 5			9 3				13 5		15 4	16 5		18 5	Aug 17-1914 HMS QE SETTING OF DATES, CONSIDERATION OF PRECEDING TASKS, LINKED ASSUMPTIONS. EVIDENCE OF PRE PLANNING VISIT TO PORTSMOUTH BY REP. changes req'd linked to costs payable. DSCF 3626 REQUESTS 'A PRE ARRANGED PLAN' BE DRAWN UP FOR ACCELERATING QE WORK INCL DESCOPING. [SEE ALSO BFR0113] 26-3-14 REQUEST FOR ARMOUR DELIVERY DATES FROM CONTRACTOR. (TIES UP T/C & Q. - DSCF3654 AND 3655.) 3-4-15 MEMO ESTABLISHING EARLIEST/LATEST DEL DATE FOR BARHAM (WITH COMPLETION OF GUN MOUNTS) SAYS A+B TURRETS SHIP TO YARD END OD MAY 1915. - PROGRAMME FOR COMPLETION AND TRIALS OF HMS BARHAM = SCHEDULING DSCF3683 - CLEAREST SCHEDULE TO DATE.
16	BRASS FOUNDRY	BFR0122					C 3											6 2							13 2						LETTER TO CONTRACTORS (1911) DETAILING CARE REQUIRED OVER PLANS SENT TO THEM AND INCL SUBLETS.
17	BRASS FOUNDRY	BFR0123	✓				C 3	D 3										6 2			9 2					14 1				18 4	DETAIL OF BARHAM PAINT REQ'D. DOC TITLED 'STATEMENT OF REQUIREMENT' RE THICKENING OF DECKS OVER MAGAZINES.
18	BRASS FOUNDRY	BFR0124	✓				C 3	D 4					1 2		3 2		5 3	6 3							13 2						TENDER DOCUMENT FOR STEEL PLATES (STD FORM - UNDATED) TENDER EVALUATION DOC. TENDER ACCEPTANCE.= INCL DSCF 3538 REQUIREMENT AND COMMITMENT TO A DELIVERY DATE 27 MTHS FROM RECEIPT OF DRAWINGS. (15-5-15). INVITATION TO TENDER FOR FIRING GEAR 24-3-14. (INCL BARHAM.)

	SOURCE ARCHIVE	SOURCE FILE	DIRECT DARBAH REFERENCE	SOURCE SLIDE (if ..)	ALIGNED TO ELEMENT 'X' OF SYSTEMS MODEL (+ STRENGTH OF AGREEMENT 1-5)							ALIGNED TO ELEMENT 'X' OF ESSENCE OF PM (+ STRENGTH OF AGREEMENT 1-5)																	CONTENT - is file all 'consistent'?
					A	B	C	D	E	F	G	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
83	BRASS FOUNDRY	BFR0125		DSCF3528					E	3	F	4		1	4		3	3			6	4	7	4				13	2			15	2				TRIAL OF TRANSPORT ARRANGEMENTS FOR CORDITE. CIRCA 1912-13. (DSCF 3520- 3523) GUN TRIALS. DSCF 3572 - SCIENTIFIC ANALYSIS OF STEEL PLATE CONTENT - QUALITY CNTRL. SOME DETAIL ON HMS QE TRIALS. RPT DETAILING ACTIONS SINCE GUN TRIALS. WARSPITE TORPEDO TRIALS. DETAILED AND TIMED PROGRAMME OF TRIALS FOR VALLIANT GUNS.
84	BRASS FOUNDRY	BFR0126	✓					D	3	E	3	F	4				4	3			6	3	7	3						14	1			17	3	DCSF3733 - REVISED PROGRAMME OF TRIALS FOR BARHAM. 10&11 AUGUST 1915 BARHAM TESTING OF X AND Y TURRETS . PROGRESS REPORT DSCF 3738 ON X&Y TURRETS + RESPONSE NOTES. BARHAM X&Y TURRET TEST REPORTS. (SEE BFR0116 FOR ;'LAUNCH' DATE.) HMS QE GUN TESTS 30-1-15. DSCF3574 SHOWS SOME FRICTION BETWEEN PARTIES RE HOW SERIOUSLY THEY TOOK 2ND TESTS. (DETAILED GUN TEST RPT.) BARHAM X&Y TURRET EQPT TEST DSCF 3803 SHOWING RESULTING ACTIONS. DSCF 3816 COMPLAINT RE SAFETY OF GUN TESTS WHEN EQPT NOT FULLY INSTALLED - BARHAM. MALAYA TURRET TESTS. DSCF 3851 - COMPLETED SCHEDULE FOR PROGRAMME OF BARHAM TESTS - 3-7-15. CERTIFICATE FOR CAPSTAN AND ANCHOR TRIALS - MALAYA [STD FORM] BARHAM FULL POWER TRIALS - 6-7-16 DSCF3864. DSCF 3874 - DISAPPOINTING RESULT OF BARHAM TRIALS. DSCF 3876 DISCUSSION RE ADJUSTMENTS POST FP TESTING.
91	BRASS FOUNDRY	BFR0127	✓				C	4											6	3														27-11-12 NAME AND YARD ALLOCATION FOR BARHAM + 3 OTHER QEs
92	CAMBRIDGE UNIVERSITY LIBRARY (CUL)	DOC748																																
93	CUL	DOC757																																
94	CUL	DOC813																																
95	CUL	DOC836																																
96	CUL	DOC1115																																
97	CUL	DOC1115 b																																
98	CUL	DOC1129																																
99	CUL	DOC1155																																
100	CUL	DOC1158																																
101	CUL	DOC2336																																

CAMBRIDGE LIBRARY CONTAINS RECORDS FROM VICKERS Ltd. THERE ARE NO RECORDS FROM JOHN BROWN Ltd AND NO RECORDS PERTAINING TO HMS BARHAM. THESE RECORDS ARE ONLY OF USE FOR COMPARISON PURPOSES AND HAVE NOT THEREFORE BEEN ANALYSED AS ABOVE.



APPENDIX 6.2 –
SAMPLE OF ARCHIVAL FILES USED IN THE PILOT AND MAIN STUDIES

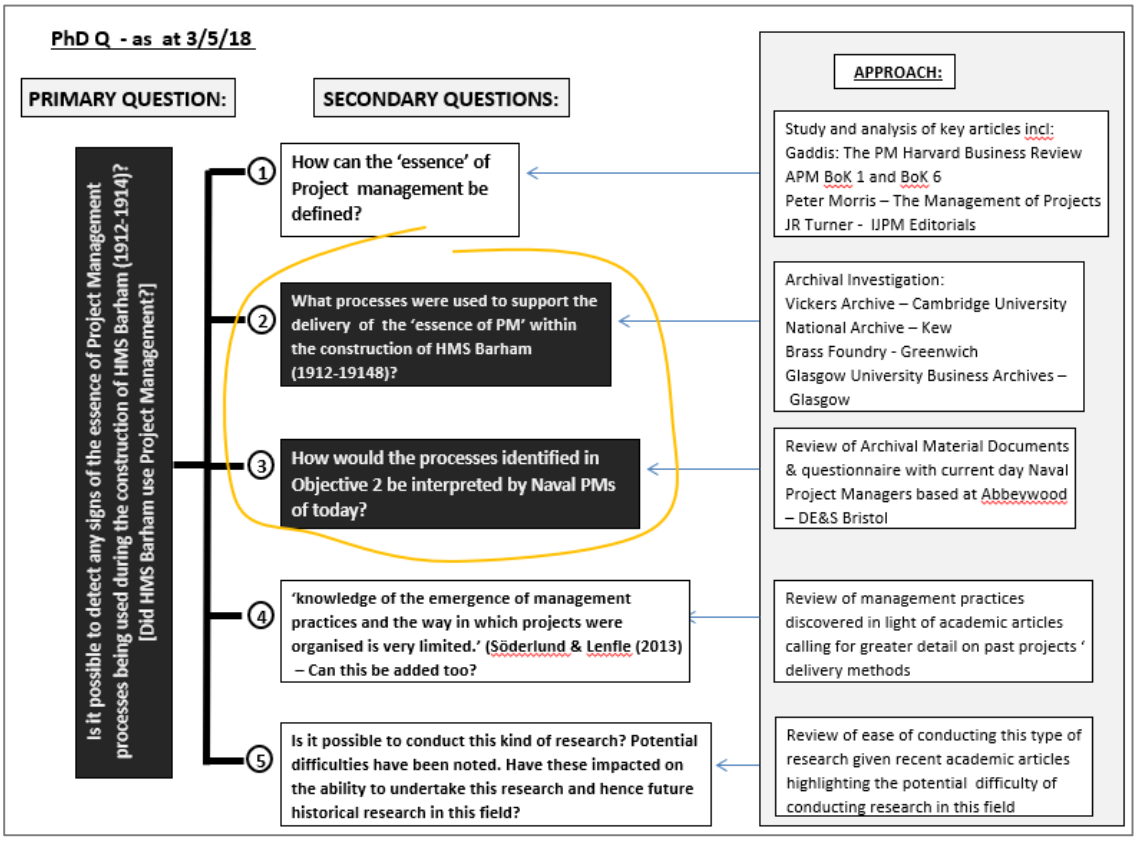
	SOURCE ARCHIVE	SOURCE FILE	PRESENTATION QUESTION NUMBER
1	GLASGOW	UCS 1-74-6	**Q1**
2	GLASGOW	UCS 1-13-1	**Q2**
3	GLASGOW	UCS 1-5-13	**Q3**
4	BRASS FOUNDRY	DSCF 3510	**Q4**
5	GLASGOW	UCS 1-61-2	**Q5**
6	GLASGOW	UCS 1-5-11	**Q6**
7	GLASGOW	UCS 1-59-1	**Q7**
8	GLASGOW	UCS 1-85-3	**Q8**
9	NATIONAL ARCHIVE	ADM 1-8435-297	**Q9**
10	GLASGOW	UCS 1-86-9	**Q10**
11	GLASGOW	UCS 1-64-1	**Q11a**
12	BRASS FOUNDRY	DSCF 3626 / BFR0121	**Q12**
13	BRASS FOUNDRY	DSCF 3595 / BFR0113	**Q13**
	GLASGOW	UCS 1-64-1	**Q11b**
14	BRASS FOUNDRY	DSCF 3575 / BFR0116	**Q15**
15	BRASS FOUNDRY	DSCF 3589 / BFR0108	**Q16**

APPENDIX 6.3 –
PILOT STUDY POWER-POINT SLIDES

Research into 'Manufacturing Management' Processes

CONSTRUCTION OF DREADNOUGHTS WITHIN THE GRAND FLEET OF WW1

An outline of the study

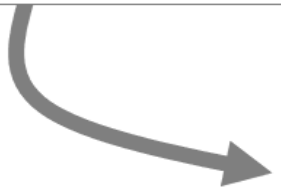


Questions....

What is (M)Project Management?

How do you look for it before it was established?

What exactly is being 'looked for'?



Search for the 'essence' of MPM

PM and Systems Theory

- **Fortune, J., & White, D. (2006). Framing of project critical success factors by a systems model. *International journal of project management*, *24*(1), 53-65.**

  - shows how a systems model, the Formal Systems Model, can be used as a framing device to deliver the benefits of taking account of 'critical success factors'

- **White, D., & Fortune, J. (2009). The project-specific formal system model. *International Journal of Managing Projects in Business*, *2*(1), 36-52.**

  - the purpose of this paper is to introduce a project-specific version of the Formal Systems Model that can be used by project managers and other professionals to identify actual or potential weaknesses in a project's structure or processes and to look for difficulties in the relationships between the project and the context in which it is or will be taking place.

The Formal Systems Model:

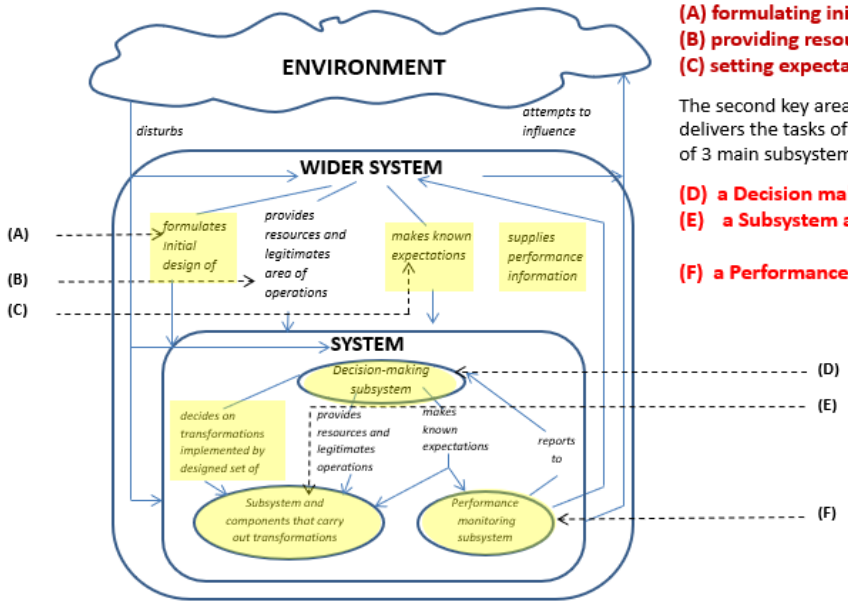


Figure 1 The Formal Systems Model (Fortune, J., & White, D (2006))

Figure 1 above shows that there are two key areas – the 'Wider System' delivers the functions of systems analysis and includes:

(A) formulating initial design
(B) providing resources
(C) setting expectations

The second key area is the 'System' itself which delivers the tasks of systems engineering consisting of 3 main subsystems:

(D) a Decision making subsystem
(E) a Subsystem and components that carry out transformations, and
(F) a Performance Monitoring subsystem.

What is the 'essence' of PM?

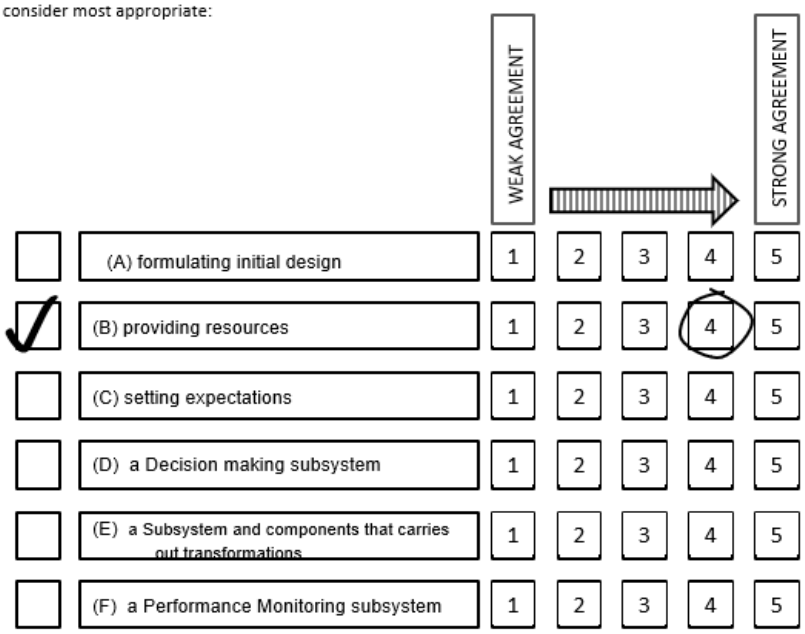
TOPICS HIGHLIGHTED IN P GADDIS ARTICLE 'THE PROJECT MANAGER' HARVARD BUSINESS REVIEW 1959	ARE 'GADDIS TOPICS' INCLUDED IN APM BoK1 &/OR IJPM PAPERS? P. Gaddis - The Project Manager 1959 A	APM - BoK 1 1992 B	Articles in IJPM - R. Turner 2006 C	TOTAL OCCURRNCES OF TOPIC = (A+B+C)
Projects are usually structured and organised by task.	✓	✓	✓	3
The PM manages other workers	✓	✓	✓	3
Delegation	✓	✓	×	2
The PM's task is finite in duration	✓	✓	✓	3
Team tailored specifically to the project	✓	✓	×	2
Lack of feedback information particularly in the early stages	✓	×	×	1
Structure – clear definition of authority and ownership	✓	✓	✓	3
Delivery within Time Cost and Specification is required	✓	✓	✓	3
Organisation Planning – 'shaping a team that can "play over its head" (Gaddis 1959 p 93)	✓	✓	×	2
Soft Skills – an understanding of the personalities/characteristic and attitudes of the team members	✓	✓	×	2
Advance planning – avoid crises	✓	✓	✓	3
Good two way communication within the team	✓	✓	×	2
Goal driven	✓	×	×	1
Progress Reporting	✓	✓	✓	3
The design, manufacturing and check-out stages	✓	✓	✓	3

TOPICS ADDRESSED IN THE APM BoK BUT NOT INCLUDING IN GADDIS D	Are Topics included in the IJPM papers by R. Turner, but not in Gaddis? E	TOTAL OCCURRNCES OF TOPIC = (D+E)
MANAGEMENT DEVELOPMENT	×	1
PROJECT ENVIRONMENT	×	1
PROJECT APPRAISAL	×	1
INTEGRATION	×	1
SAFETY	×	1
DESIGN MANAGEMENT	×	1
VALUE ENGINEERING	×	1
CHANGE CONTROL	✓	2
PROCUREMENT	✓	2
MOBILISATION	×	1
MARKETING AND SALES	×	1
OPERATIONS/TECHNICAL M'MENT	×	1
INFORMATION TECHNOLOGY	×	1
LAW	×	1
INDUSTRIAL RELATIONS	×	1

The analysis process

Q1

Noting that HMS Barham is ship 424, does Slide Set 1 show any of the following Systems theory processes (shown in figure 1 above) - please tick the option you consider most appropriate:



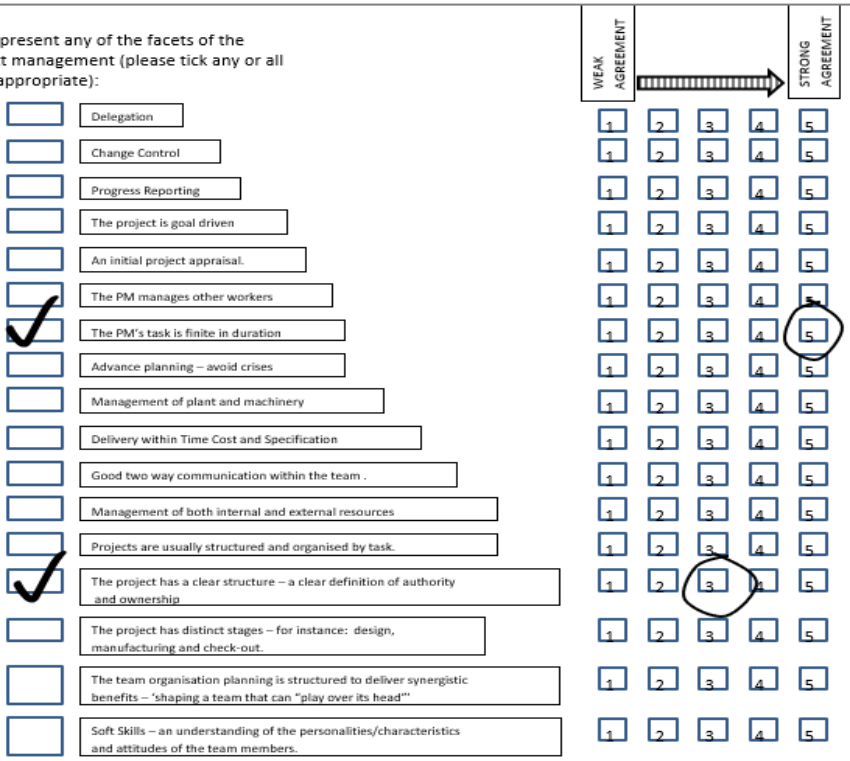
Q2

Please briefly explain what you have considered relevant when ticking the categories in Q1.

SF GYNIOGYDD UCHAFRIC'#

Q3

Does Slide Set 1 represent any of the facets of the 'essence' of project management (please tick any or all that you consider appropriate):



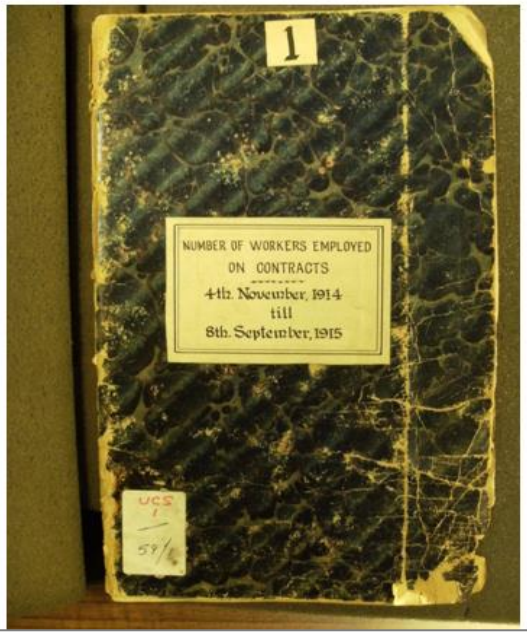
Q4
Please explain your thoughts and reasoning in arriving at your answer to Q3.

Your comments, reflections views and thoughts

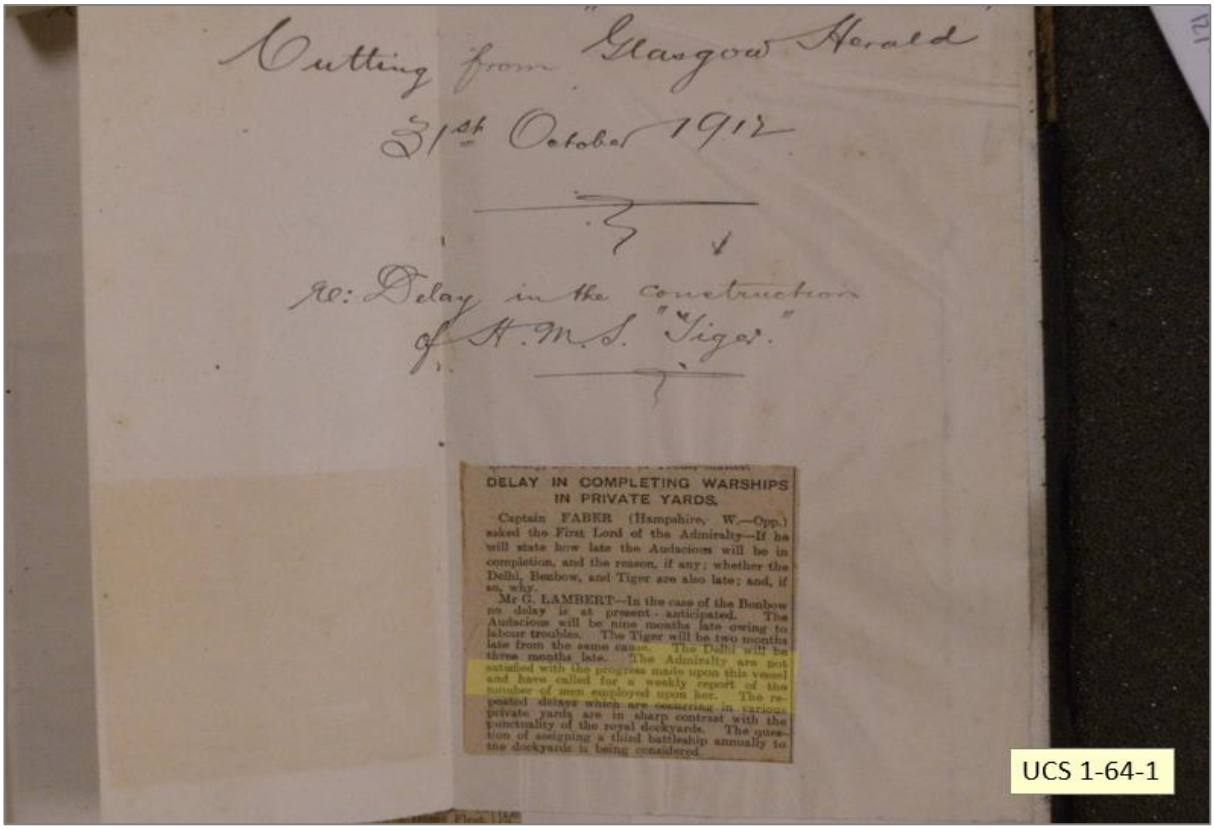
Q5
Do you think that the slide could be indicative of or be used to facilitate any other PM process?
Does itsuggest the use or existence of any project process not outlined in Q3 above?

For example, a timeline showing the periodic spend on an item could be used to construct the project lifecycle used.

Evidence of these functions?



UCS 1-59-1



Cutting from "Glasgow Herald"
31st October 1912

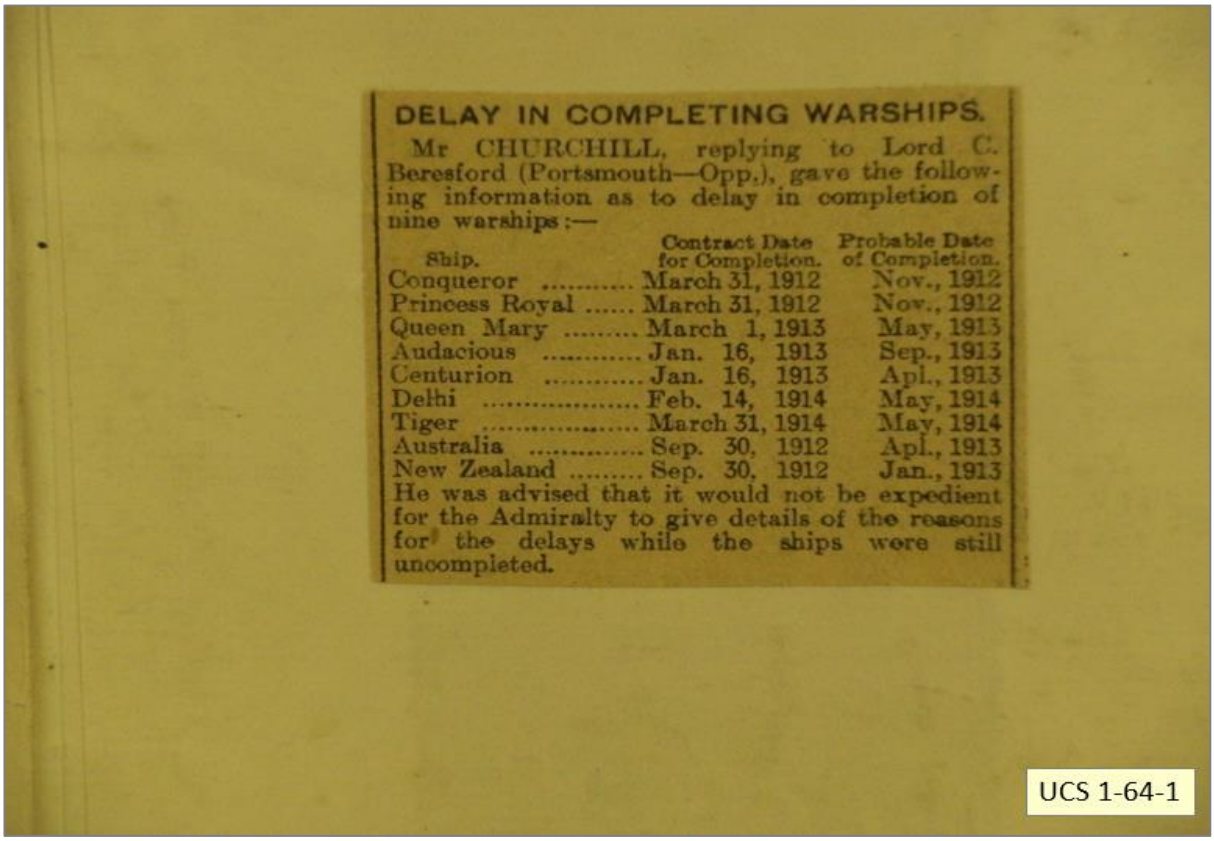
Re: Delay in the construction of H.M.S. "Tiger."

DELAY IN COMPLETING WARSHIPS IN PRIVATE YARDS.

Captain FABER (Hampshire, W.—Opp.) asked the First Lord of the Admiralty—If he will state how late the Audacious will be in completion, and the reason, if any; whether the Delhi, Bembow, and Tiger are also late; and, if so, why.

Mr G. LAMBERT—In the case of the Bembow no delay is at present anticipated. The Audacious will be nine months late owing to labour troubles. The Tiger will be two months late from the same cause. The Delhi will be three months late. The Admiralty are not satisfied with the progress made upon this vessel and have called for a weekly report of the number of men employed upon her. The repeated delays which are occurring in various private yards are in sharp contrast with the punctuality of the royal dockyards. The question of assigning a third battleship annually to the dockyards is being considered.

UCS 1-64-1



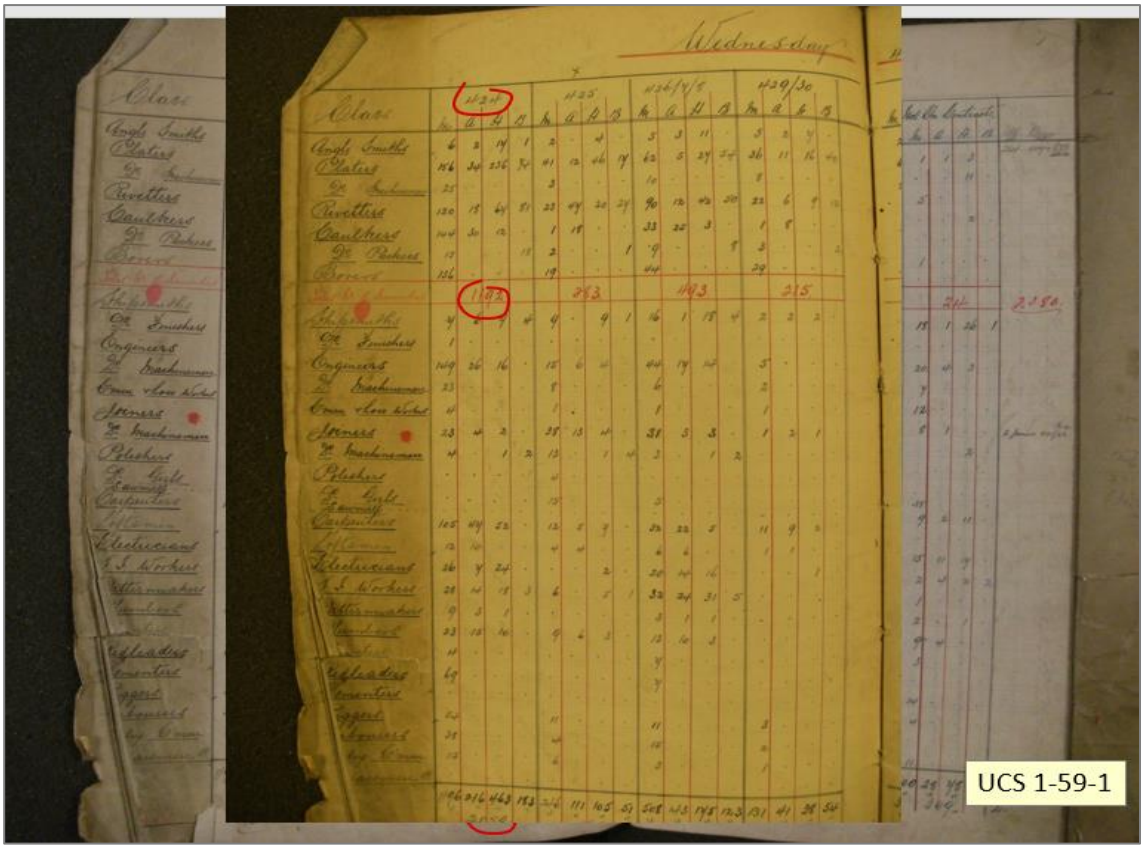
DELAY IN COMPLETING WARSHIPS.

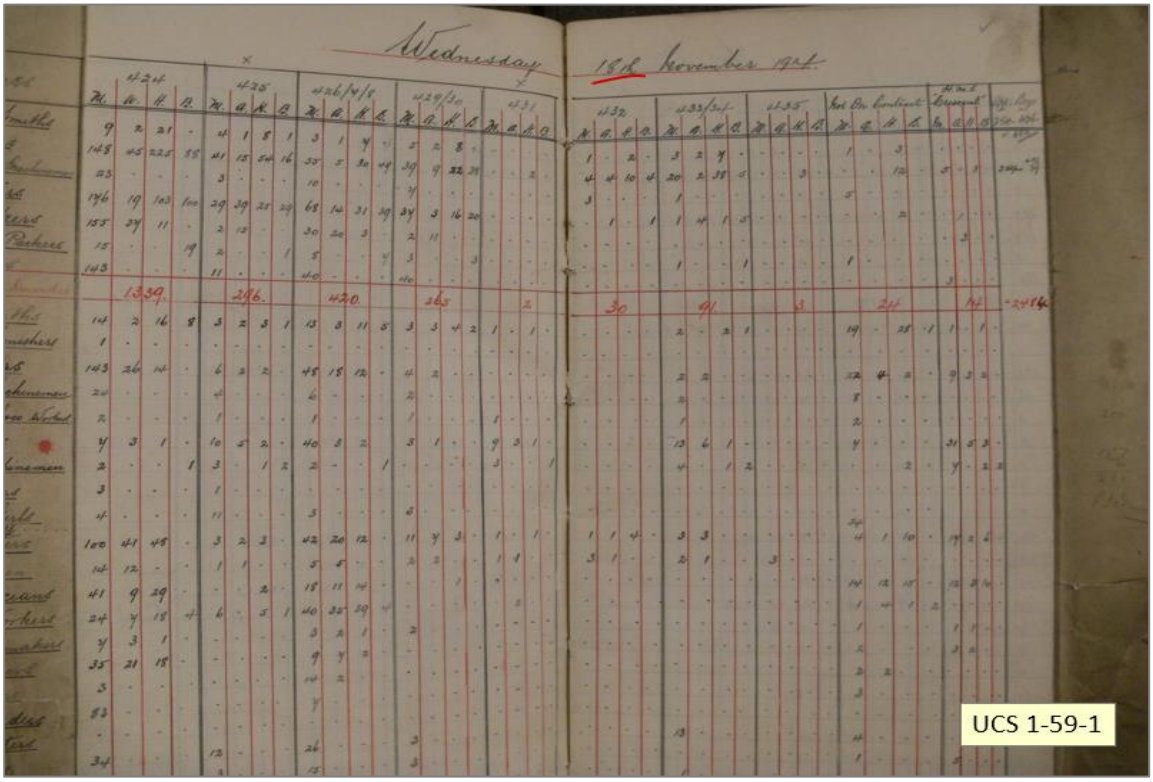
Mr CHURCHILL, replying to Lord C. Beresford (Portsmouth—Opp.), gave the following information as to delay in completion of nine warships:—

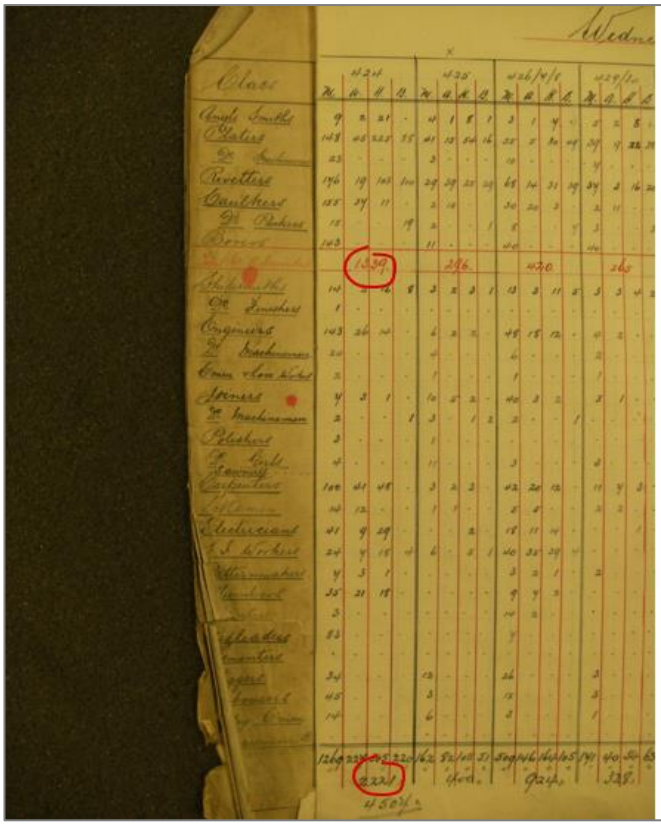
Ship.	Contract Date for Completion.	Probable Date of Completion.
Conqueror	March 31, 1912	Nov., 1912
Princess Royal	March 31, 1912	Nov., 1912
Queen Mary	March 1, 1913	May, 1913
Audacious	Jan. 16, 1913	Sep., 1913
Centurion	Jan. 16, 1913	Apl., 1913
Delhi	Feb. 14, 1914	May, 1914
Tiger	March 31, 1914	May, 1914
Australia	Sep. 30, 1912	Apl., 1913
New Zealand	Sep. 30, 1912	Jan., 1913

He was advised that it would not be expedient for the Admiralty to give details of the reasons for the delays while the ships were still uncompleted.

UCS 1-64-1

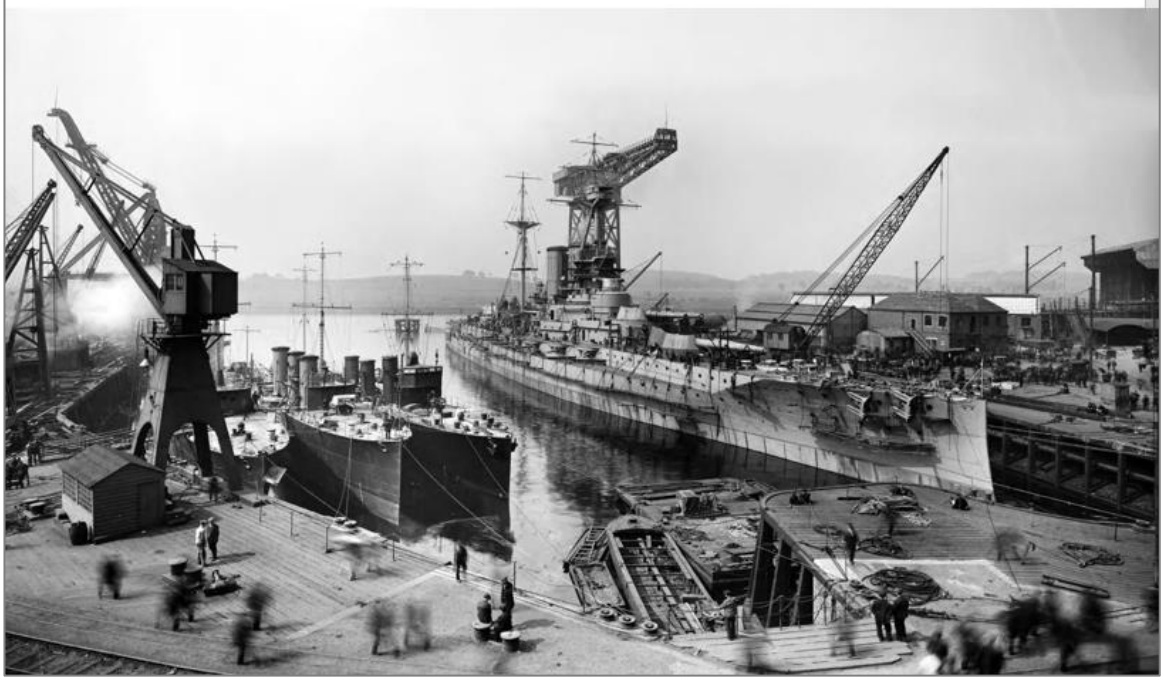

Wednesday
UCS 1-59-1

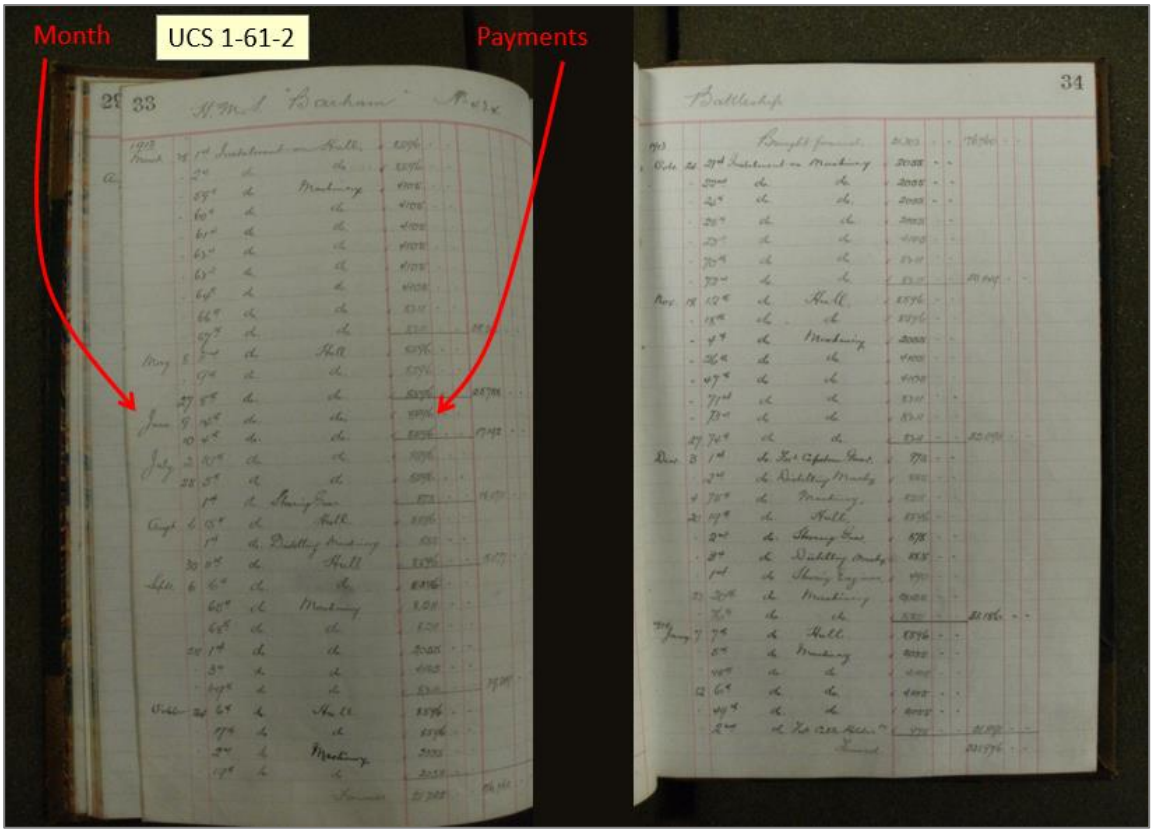

Wednesday
18th November 1914
UCS 1-59-1

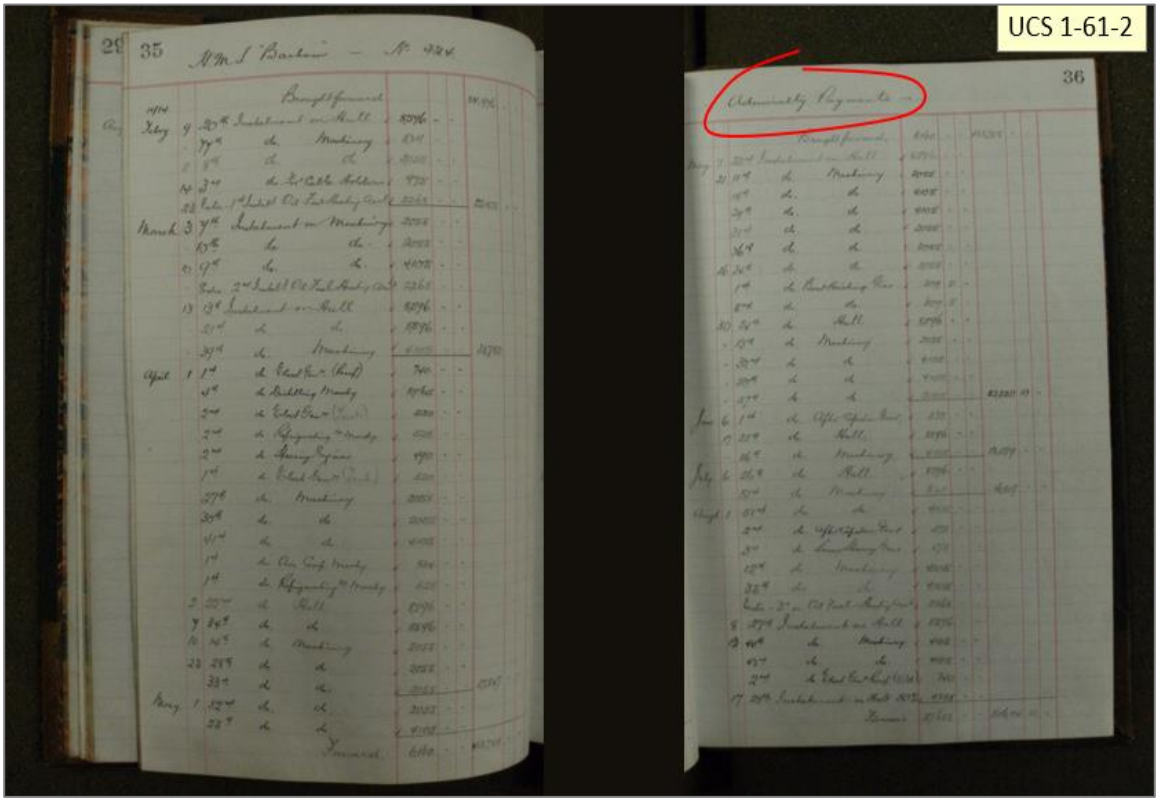


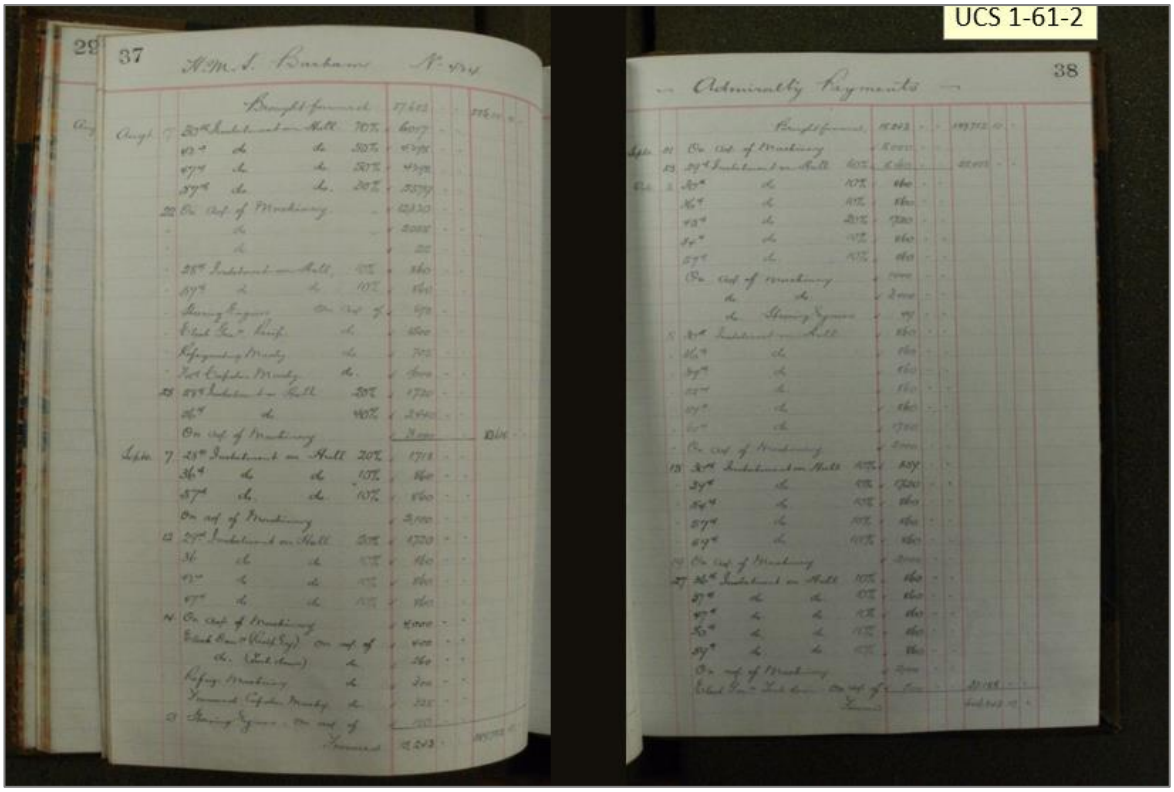
UCS 1-59-1

" HMS Barham and the destroyers Mons and Medusa, being fitted out at Clydebank, July "
https://www.pinterest.com.au/pin/485544403568438101/

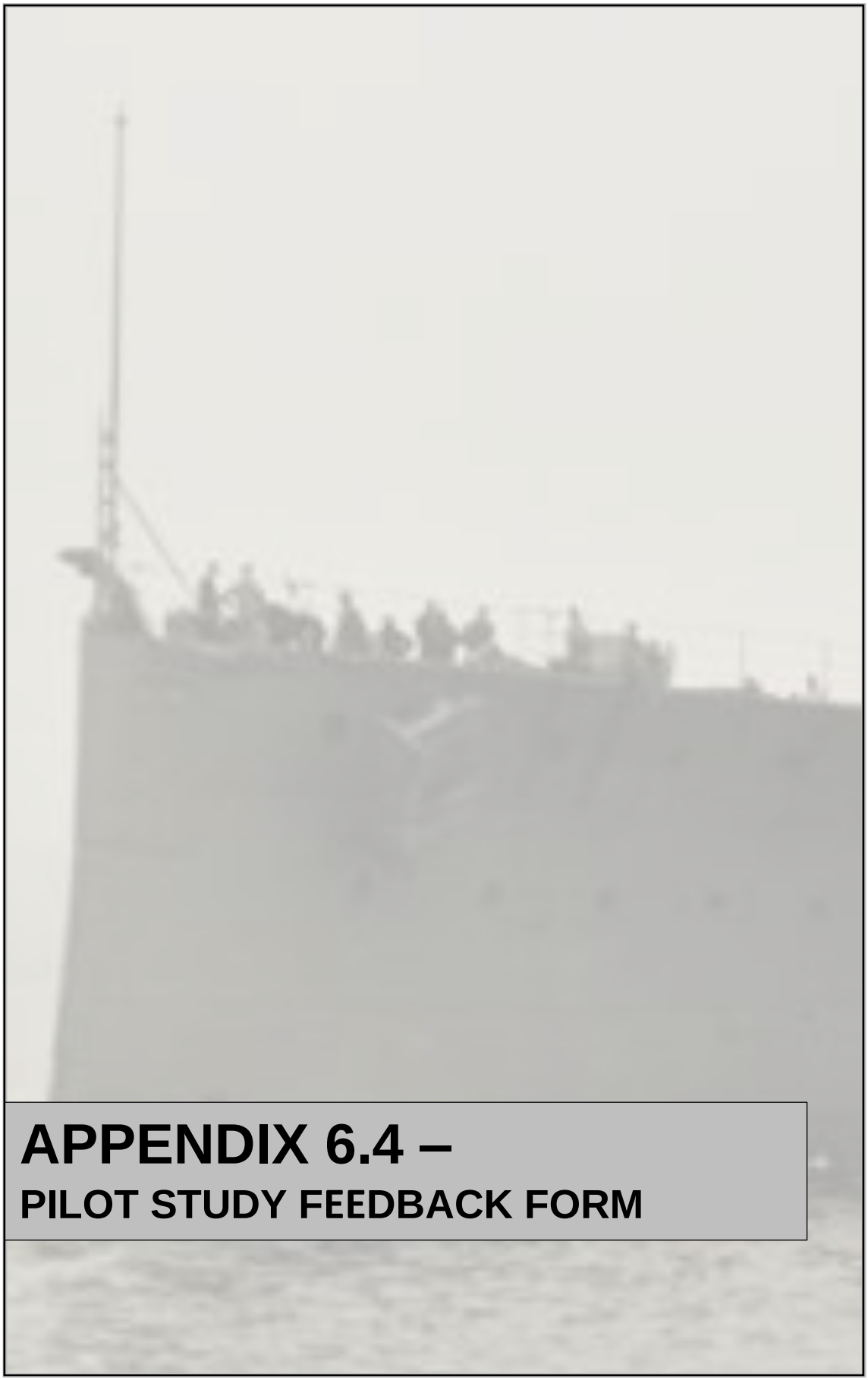



Month
UCS 1-61-2
Payments
33
34
Battleship


UCS 1-61-2
35
36



UCS 1-61-2



APPENDIX 6.4 –
PILOT STUDY FEEDBACK FORM

FILE: UCS 1-5-11

Q1

Noting that HMS Barham is ship 424, does Slide Set 1 show any of the following Systems theory processes (shown in Figure 1 above) - please tick the option you consider most appropriate:

		WEAK AGREEMENT				STRONG AGREEMENT
☐	(A) formulating initial design	1	2	3	4	5
☐	(B) providing resources	1	2	3	4	5
☐	(C) setting expectations	1	2	3	4	5
☐	(D) a Decision making subsystem	1	2	3	4	5
☐	(E) a Subsystem and components that carries out transformations	1	2	3	4	5
☐	(F) a Performance Monitoring subsystem	1	2	3	4	5

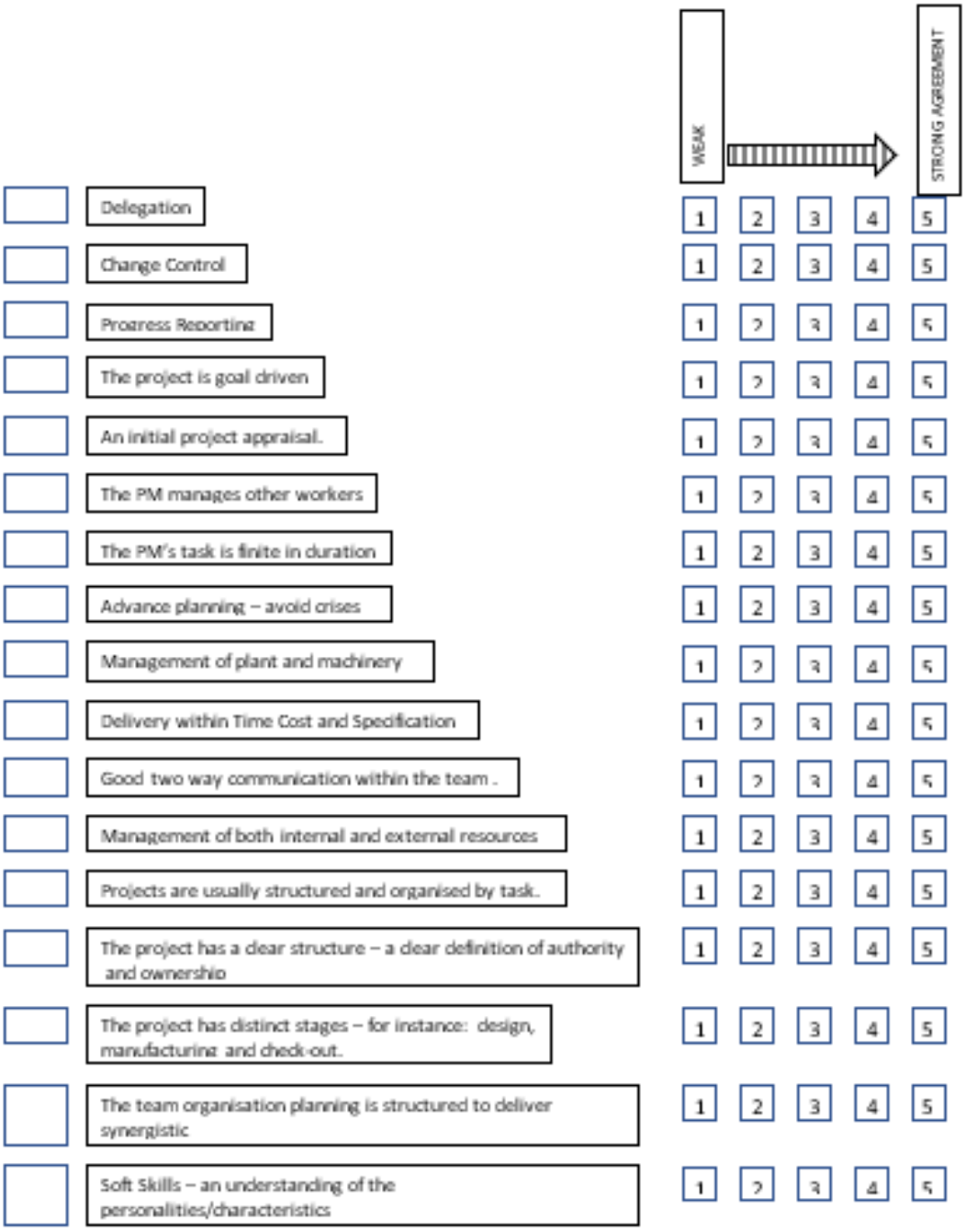
Q2

Please briefly explain what you have considered relevant when ticking the categories in Q1.

FILE: UCS 1-5-11

Q3

Does Slide Set 1 represent any of the facets of the 'essence' of project management (please tick any or all that you consider appropriate):



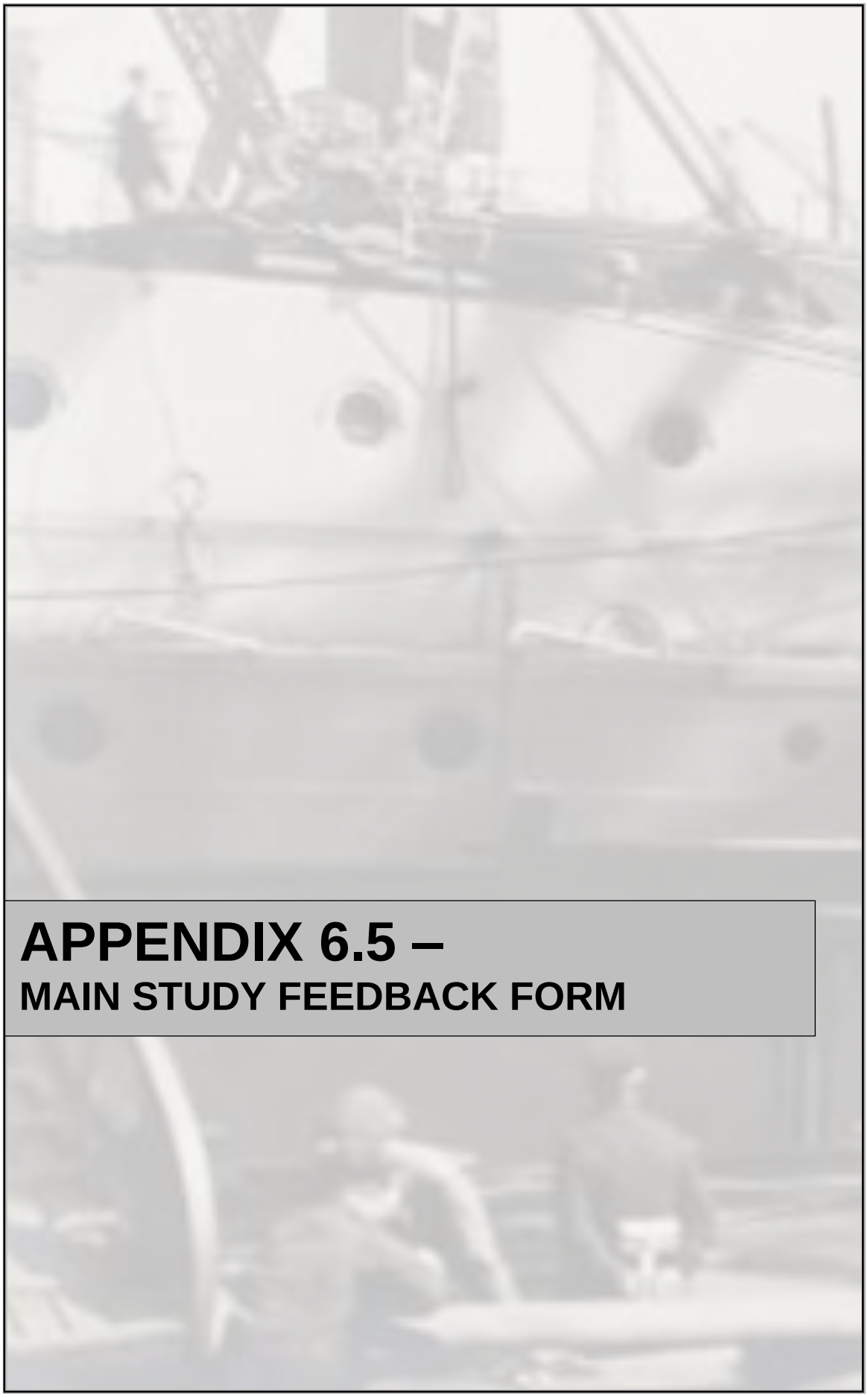
FILE: UCS 1-5-11

Q4

Please explain your thoughts and reasoning in arriving at your answer to Q3.

Q5

Do you think that the slide suggests the use or existence of any project process not outlined in Q3 above? What does this show or how could it be used in linking to other PM processes?



APPENDIX 6.5 –
MAIN STUDY FEEDBACK FORM

FILE: UCS 1-5-11

Q1

Do the slides being reviewed show any of the following Systems theory processes?

How strong do you consider the correlation to be?

Please indicate if you consider that the slide you are reviewing contributes to any of the following parts of the Systems Model.
Please mark a maximum of 2 areas and mark those which you consider to have the strongest correlation.

		VERY WEAK				VERY STRONG
☐	(G) formulating initial design	1	2	3	4	5
☐	(H) Providing resources	1	2	3	4	5
☐	(I) Setting Expectations	1	2	3	4	5
☐	(J) Decision making sub-system	1	2	3	4	5
☐	(K) Subsystem & components that carry out transformations	1	2	3	4	5
☐	(L) Performance monitoring subsystem	1	2	3	4	5
☐	None of the above					

Q2

Please explain your thinking behind your answer(s) to Q1.

FILE: UCS 1-5-11

Q3

Does Slide Set 1 represent any of the facets of the 'essence' of project management (please tick any or all that you consider appropriate):

Please indicate if you consider the slide you are reviewing to exhibit any of the traits listed below:
Please mark any that you consider applicable.

		VERY WEAK				VERY STRONG
☐		1	2	3	4	5
☐	THE OVERALL ACTIVITY IS BROKEN DOWN INTO TASKS	1	2	3	4	5
☐	THERE IS MANAGEMENT OF OTHERS BY 'PM'	1	2	3	4	5
☐	INDIVIDUAL TASKS HAVE A FINITE DURATION (ESTIMATED IN ADVANCE)	1	2	3	4	5
☐	THE OVERALL ACTIVITY HAS STRUCTURE AND ORGANISATION	1	2	3	4	5
☐	DELIVERY WITHIN TIME, COST AND TO SPECIFICATION IS REQUIRED	1	2	3	4	5
☐	ADVANCE PLANNING IS EVIDENCED	1	2	3	4	5
☐	PROGRESS REPORTING IS EVIDENCED	1	2	3	4	5
☐	THE DELIVERY HAS DISTINCT STAGES e.g. DESIGN/ MANUFACTURE/ CLOSE OUT	1	2	3	4	5
☐	TASKS ARE DELEGATED	1	2	3	4	5
☐	THE WORKERS ARE TAILORED TO THE ACTIVITY ACCORDING TO SPECIFIC SKILLS	1	2	3	4	5
☐	THE TEAM IS STRUCTURED TO DELIVER SYNERGISTIC BENEFITS	1	2	3	4	5
☐	SOFT SKILLS – AN UNDERSTANDING OF PERSONALITIES, CHARACTERISTIC & ATTITUDES IS REQUIRED	1	2	3	4	5
☐	TWO WAY COMMUNICATION IS EVIDENCED	1	2	3	4	5
☐	CHANGE CONTROL IS EVIDENCED	1	2	3	4	5
☐	ACTIVITY IS DRIVEN BY PRE PLANNED GOALS	1	2	3	4	5
☐	AN INITIAL APPRAISAL/ PLAN OF THE ACTIVITY IS PRODUCED	1	2	3	4	5
☐	MANAGEMENT OF PLANT AND MACHINERY IS NECESSARY	1	2	3	4	5
☐	MANAGEMENT OF INTERNAL AND EXTERNAL RESOURCE IS REQUIRED					

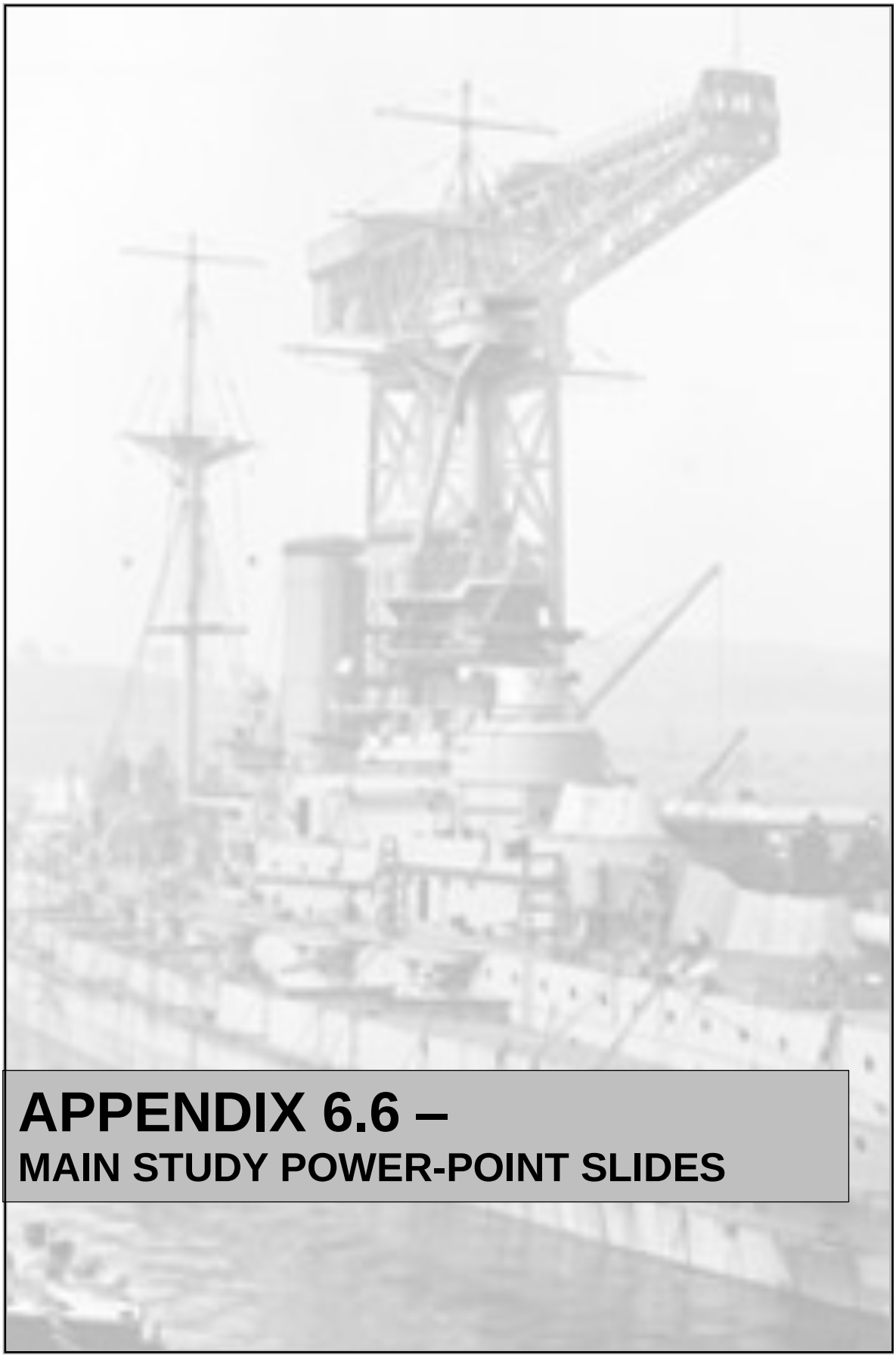
FILE: UCS 1-5-11

Q4

Please explain your thoughts and reasoning in arriving at your answer(s) to Q3.

Q5

Do you think that the slide suggests the use or existence of any project process not outlined in Q3 above, What does this show or how could it be used to demonstrate a link to other PM processes?

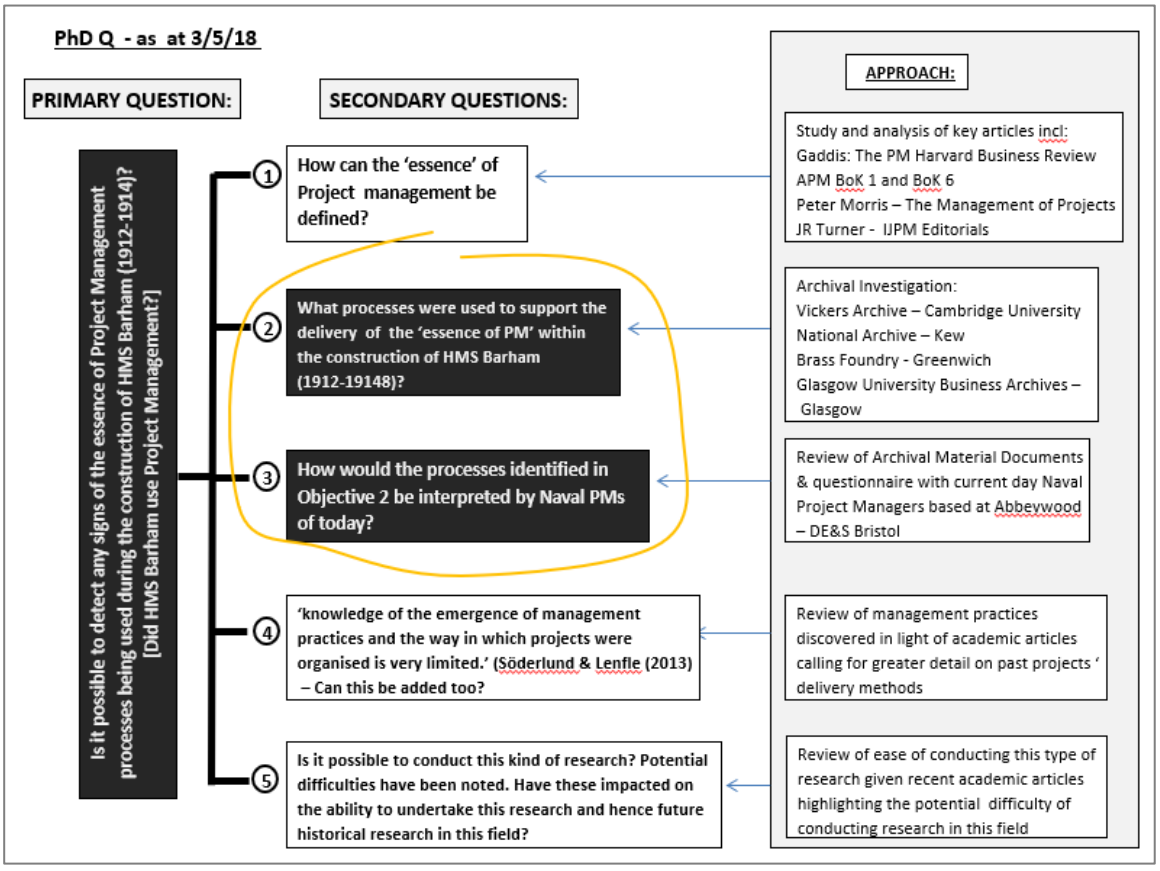


APPENDIX 6.6 –
MAIN STUDY POWER-POINT SLIDES

Research into 'Manufacturing Management' Processes

CONSTRUCTION OF DREADNOUGHTS WITHIN THE GRAND FLEET OF WW1

An outline of the study

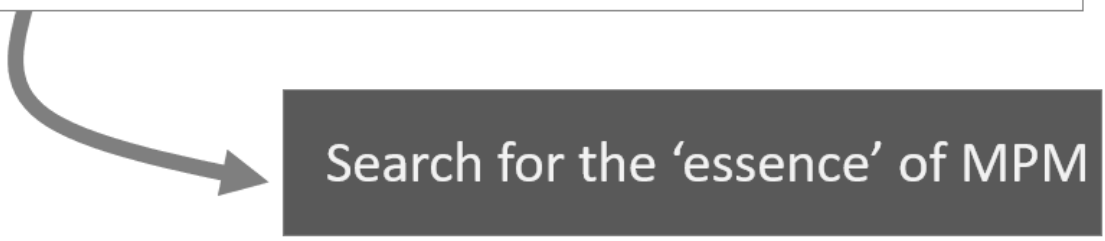


Questions....

What is (M)Project Management?

How do you look for it before it was established?

What exactly is being 'looked for'?



PM and Systems Theory

- **Fortune, J., & White, D. (2006). Framing of project critical success factors by a systems model. *International journal of project management*, *24*(1), 53-65.**

  - shows how a systems model, the Formal Systems Model, can be used as a framing device to deliver the benefits of taking account of 'critical success factors'

- **White, D., & Fortune, J. (2009). The project-specific formal system model. *International Journal of Managing Projects in Business*, *2*(1), 36-52.**

  - the purpose of this paper is to introduce a project-specific version of the Formal Systems Model that can be used by project managers and other professionals to identify actual or potential weaknesses in a project's structure or processes and to look for difficulties in the relationships between the project and the context in which it is or will be taking place.

The Formal Systems Model:

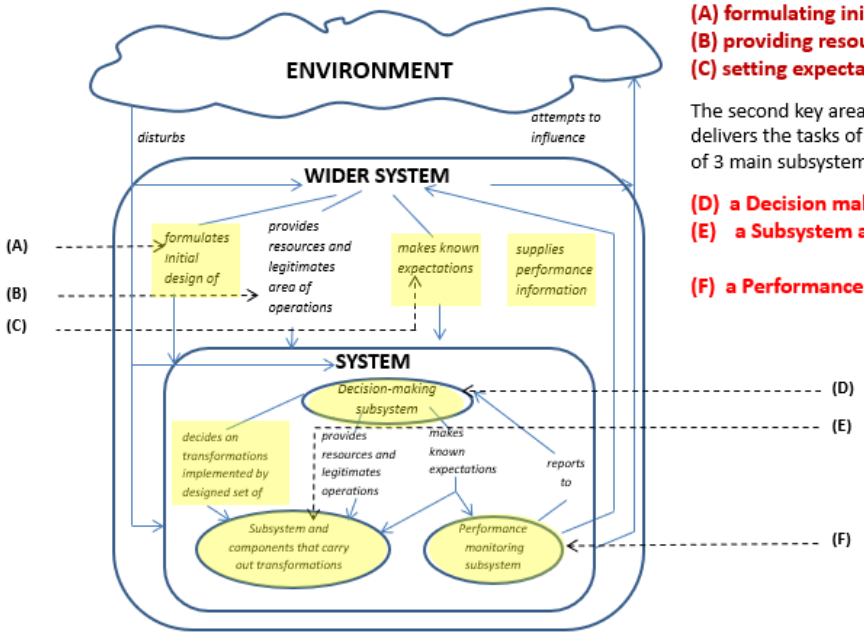


Figure 1 above shows that there are two key areas – the 'Wider System' delivers the functions of systems analysis and includes:

(A) formulating initial design
(B) providing resources
(C) setting expectations

The second key area is the 'System' itself which delivers the tasks of systems engineering consisting of 3 main subsystems:

(D) a Decision making subsystem
(E) a Subsystem and components that carry out transformations, and
(F) a Performance Monitoring subsystem.

Figure 1 The Formal Systems Model (Fortune, J., & White, D (2006))

What is the 'essence' of PM?

TOPICS HIGHLIGHTED IN P GADDIS ARTICLE 'THE PROJECT MANAGER' HARVARD BUSINESS REVIEW 1959	ARE 'GADDIS TOPICS' INCLUDED IN APM BoK1 &/OR IJPM PAPERS? P. Gaddis - The Project Manager 1959 A	APM - BoK 1 1992 B	Articles in IJPM - R. Turner 2006 C	TOTAL OCCURANCES OF TOPIC = (A+B+C)
Projects are usually structured and organised by task.	✓	✓	✓	3
The PM manages other workers	✓	✓	✓	3
Delegation	✓	✓	×	2
The PM's task is finite in duration	✓	✓	✓	3
Team tailored specifically to the project	✓	✓	×	2
Lack of feedback information particularly in the early stages	✓	×	×	1
Structure – clear definition of authority and ownership	✓	✓	✓	3
Delivery within Time Cost and Specification is required	✓	✓	✓	3
Organisation Planning – 'shaping a team that can "play over its head" (Gaddis 1959 p 93)	✓	✓	×	2
Soft Skills – an understanding of the personalities/characteristic and attitudes of the team members	✓	✓	×	2
Advance planning – avoid crises	✓	✓	✓	3
Good two way communication within the team	✓	✓	×	2
Goal driven	✓	×	×	1
Progress Reporting	✓	✓	✓	3
The design, manufacturing and check-out stages	✓	✓	✓	3

TOPICS ADDRESSED IN THE APM BoK BUT NOT INCLUDING IN GADDIS D	Are Topics included in the IJPM papers by R. Turner, but not in Gaddis? E	TOTAL OCCURANCES OF TOPIC= (D+E)
MANAGEMENT DEVELOPMENT	×	1
PROJECT ENVIRONMENT	×	1
PROJECT APPRAISAL	×	1
INTEGRATION	×	1
SAFETY	×	1
DESIGN MANAGEMENT	×	1
VALUE ENGINEERING	×	1
CHANGE CONTROL	✓	2
PROCUREMENT	✓	2
MOBILISATION	×	1
MARKETING AND SALES	×	1
OPERATIONS/TECHNICAL M'MENT	×	1
INFORMATION TECHNOLOGY	×	1
LAW	×	1
INDUSTRIAL RELATIONS	×	1

The analysis process

Q1

Noting that HMS Barham is ship 424, does Slide Set 1 show any of the following Systems theory processes (shown in figure 1 above) - please tick the option you consider most appropriate:

		WEAK AGREEMENT				STRONG AGREEMENT
☐	(A) formulating initial design	1	2	3	4	5
✓	(B) providing resources	1	2	3	4	5
☐	(C) setting expectations	1	2	3	4	5
☐	(D) a Decision making subsystem	1	2	3	4	5
☐	(E) a Subsystem and components that carries out transformations	1	2	3	4	5
☐	(F) a Performance Monitoring subsystem	1	2	3	4	5

Q2

Please briefly explain what you have considered relevant when ticking the categories in Q1.

SF GYUIOGYDJ UIGYURTC'#

Q3

Does Slide Set 1 represent any of the facets of the 'essence' of project management (please tick any or all that you consider appropriate):

		WEAK AGREEMENT				STRONG AGREEMENT
☐	Delegation	1	2	3	4	5
☐	Change Control	1	2	3	4	5
☐	Progress Reporting	1	2	3	4	5
☐	The project is goal driven	1	2	3	4	5
☐	An initial project appraisal.	1	2	3	4	5
☐	The PM manages other workers	1	2	3	4	5
✓	The PM's task is finite in duration	1	2	3	4	5
☐	Advance planning – avoid crises	1	2	3	4	5
☐	Management of plant and machinery	1	2	3	4	5
☐	Delivery within Time Cost and Specification	1	2	3	4	5
☐	Good two way communication within the team .	1	2	3	4	5
☐	Management of both internal and external resources	1	2	3	4	5
☐	Projects are usually structured and organised by task.	1	2	3	4	5
✓	The project has a clear structure – a clear definition of authority and ownership	1	2	3	4	5
☐	The project has distinct stages – for instance: design, manufacturing and check-out.	1	2	3	4	5
☐	The team organisation planning is structured to deliver synergistic benefits – 'shaping a team that can "play over its head"'	1	2	3	4	5
☐	Soft Skills – an understanding of the personalities/characteristics and attitudes of the team members.	1	2	3	4	5

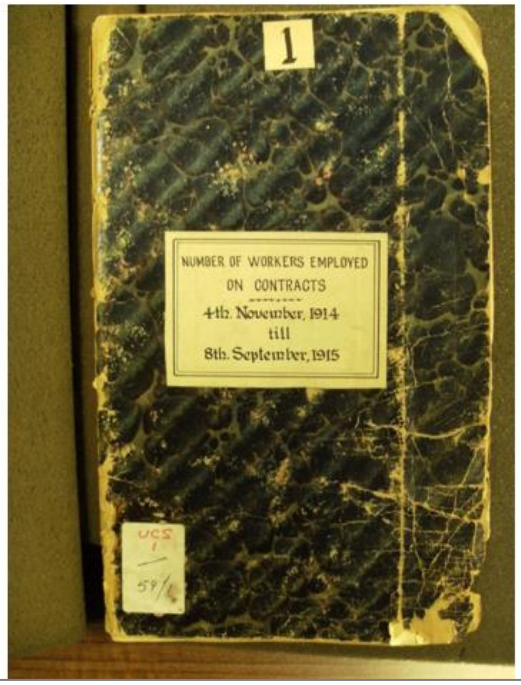
Q4
Please explain your thoughts and reasoning in arriving at your answer to Q3.

Your comments, reflections views and thoughts

Q5
Do you think that the slide could be indicative of or be used to facilitate any other PM process?
Does itsuggest the use or existence of any project process not outlined in Q3 above?

For example, a timeline showing the periodic spend on an item could be used to construct the project lifecycle used.

Evidence of these functions?



UCS 1-59-1

Cutting from "Glasgow Herald"

31st October 1912

Re: Delay in the construction of H.M.S. "Tiger".

DELAY IN COMPLETING WARSHIPS IN PRIVATE YARDS.

Captain FABER (Hampshire, W.—Opp.) asked the First Lord of the Admiralty—If he will state how late the Audacious will be in completion, and the reason, if any; whether the Delhi, Benbow, and Tiger are also late; and, if so, why.

Mr G. LAMBERT—In the case of the Benbow no delay is at present anticipated. The Audacious will be nine months late owing to labour troubles. The Tiger will be two months late from the same cause. The Delhi will be three months late. The Admiralty are not satisfied with the progress made upon this vessel and have called for a weekly report of the number of men employed upon her. The repeated delays which are occurring in various private yards are in sharp contrast with the punctuality of the royal dockyards. The question of assigning a third battleship annually to the dockyards is being considered.

UCS 1-64-1

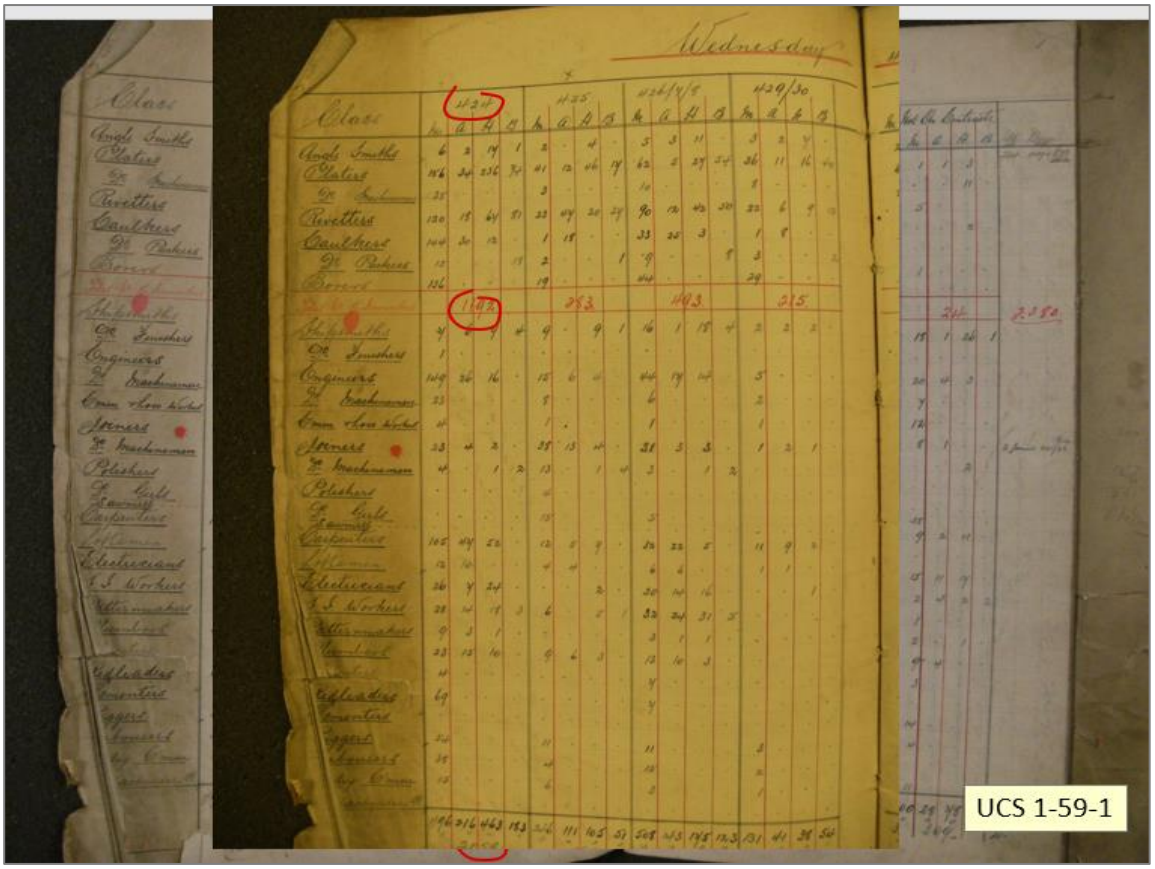
DELAY IN COMPLETING WARSHIPS.

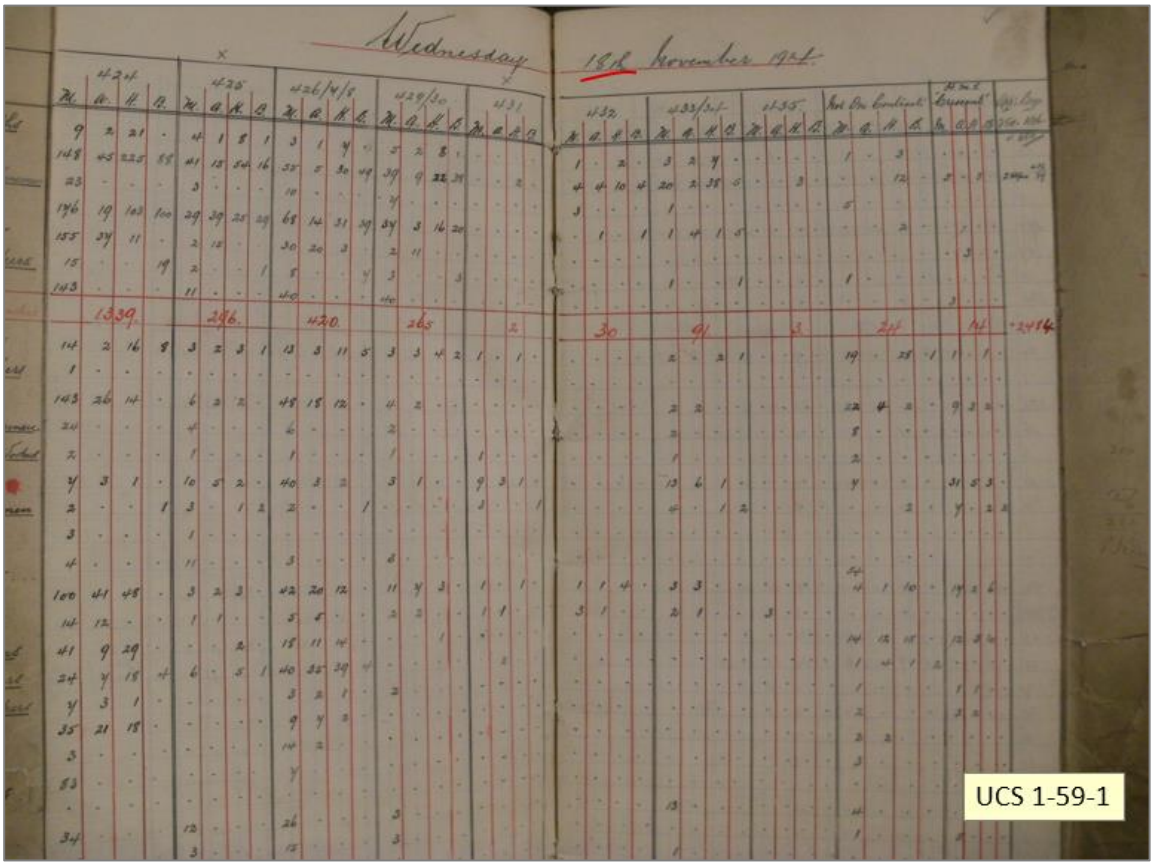
Mr CHURCHILL, replying to Lord C. Beresford (Portsmouth—Opp.), gave the following information as to delay in completion of nine warships:—

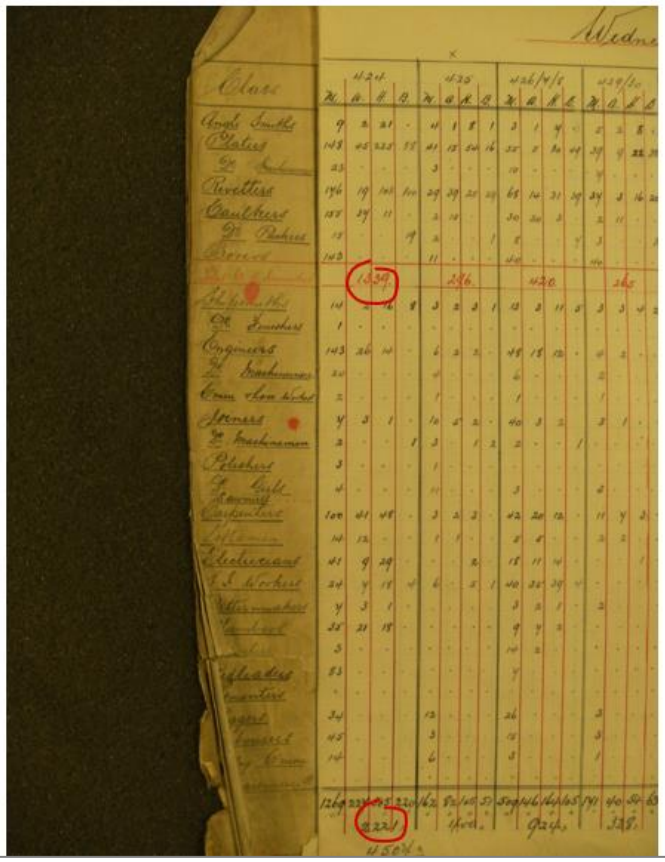
Ship.	Contract Date for Completion.	Probable Date of Completion.
Conqueror	March 31, 1912	Nov., 1912
Princess Royal	March 31, 1912	Nov., 1912
Queen Mary	March 1, 1913	May, 1913
Audacious	Jan. 16, 1913	Sep., 1913
Centurion	Jan. 16, 1913	Apl., 1913
Delhi	Feb. 14, 1914	May, 1914
Tiger	March 31, 1914	May, 1914
Australia	Sep. 30, 1912	Apl., 1913
New Zealand	Sep. 30, 1912	Jan., 1913

He was advised that it would not be expedient for the Admiralty to give details of the reasons for the delays while the ships were still uncompleted.

UCS 1-64-1

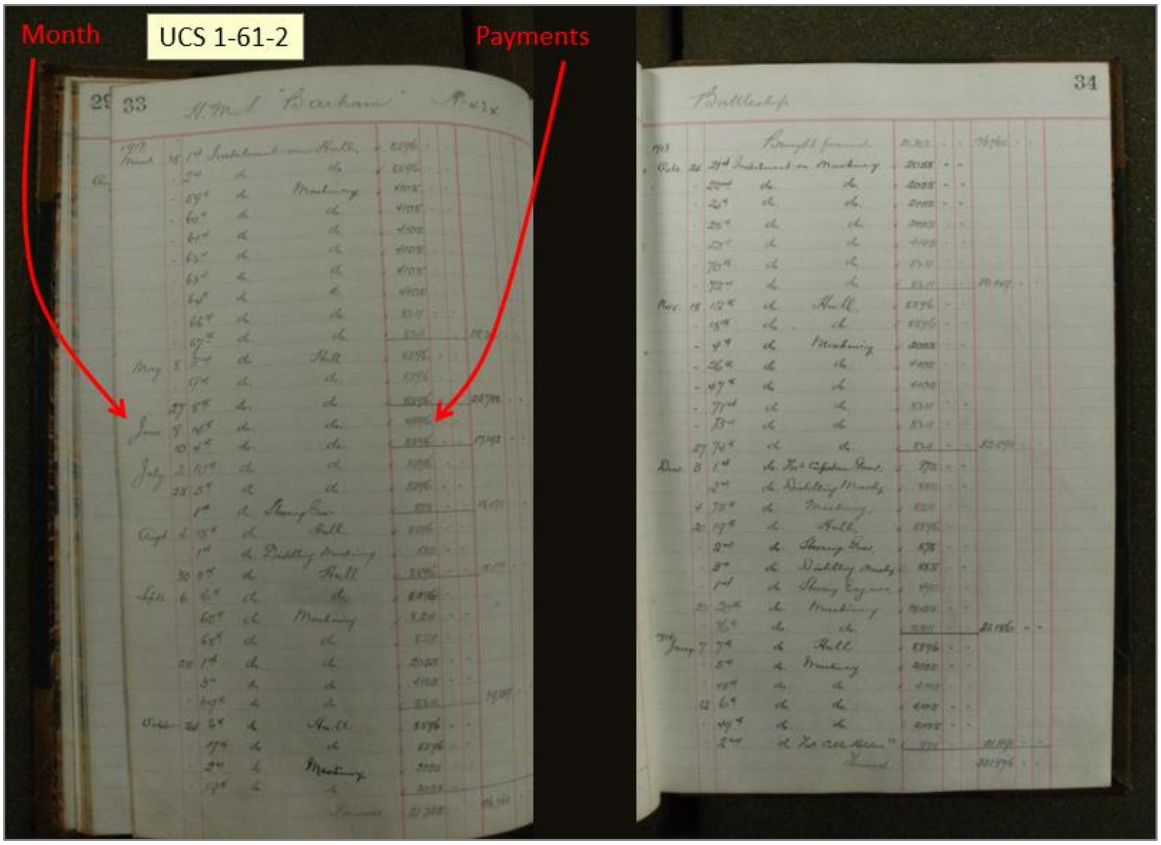

Wednesday
UCS 1-59-1

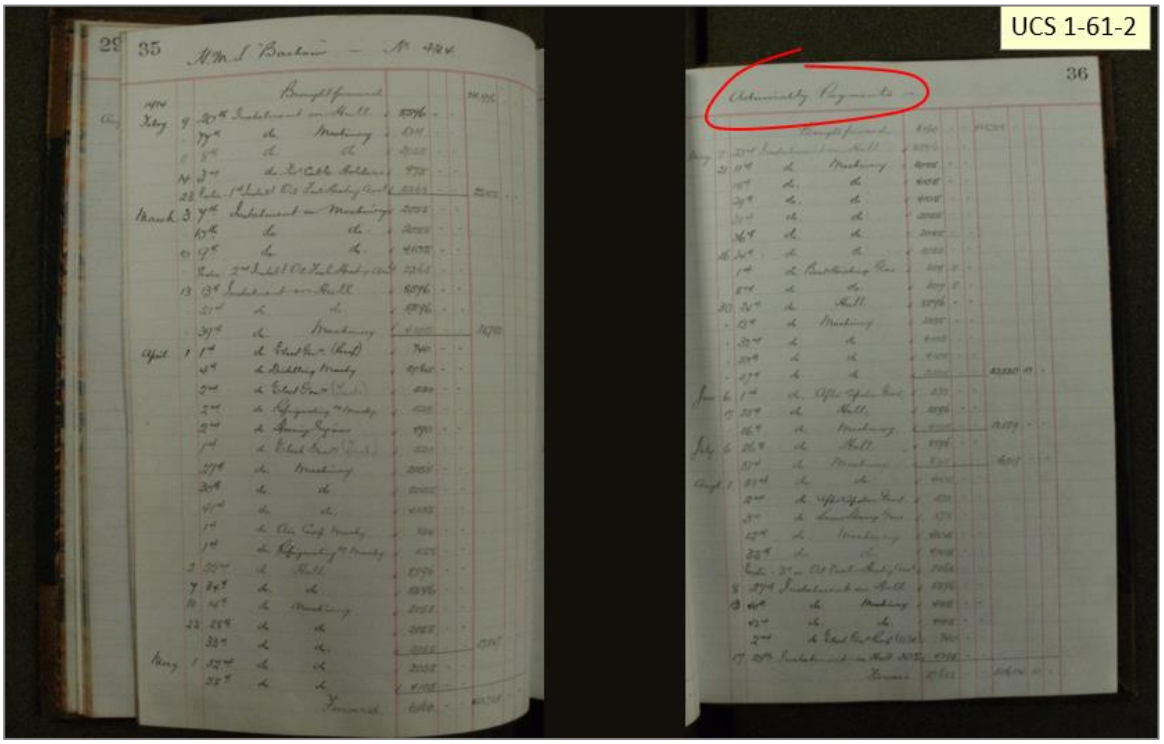

Wednesday
UCS 1-59-1

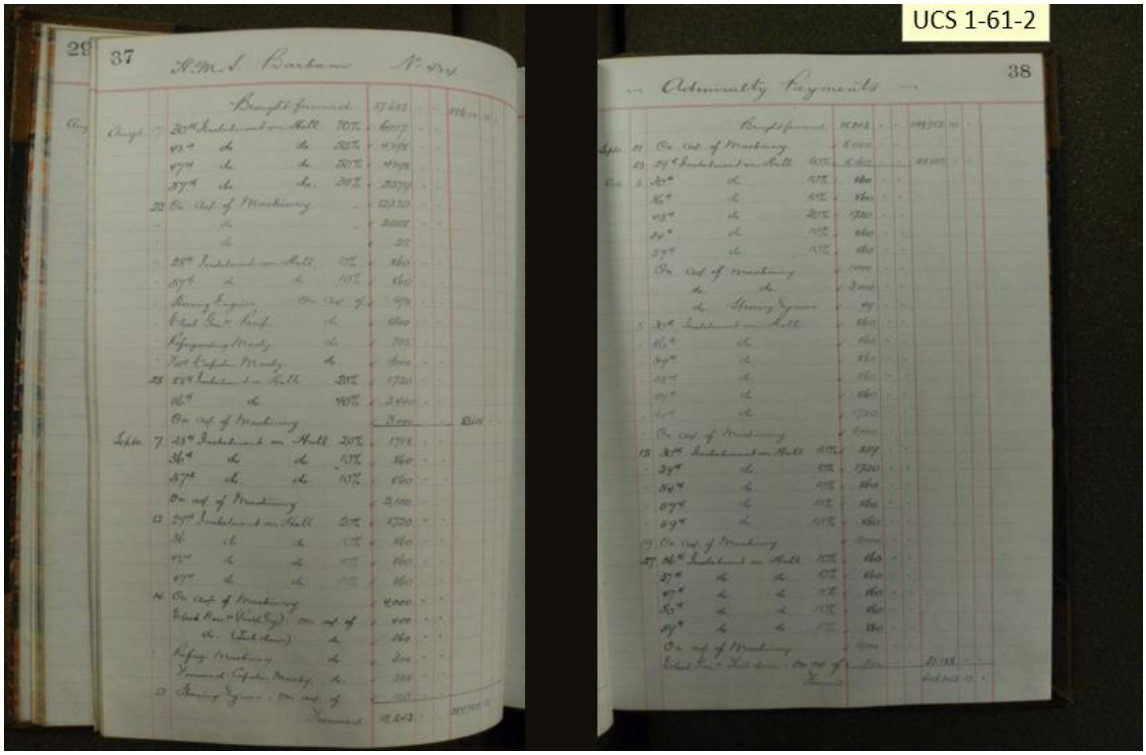


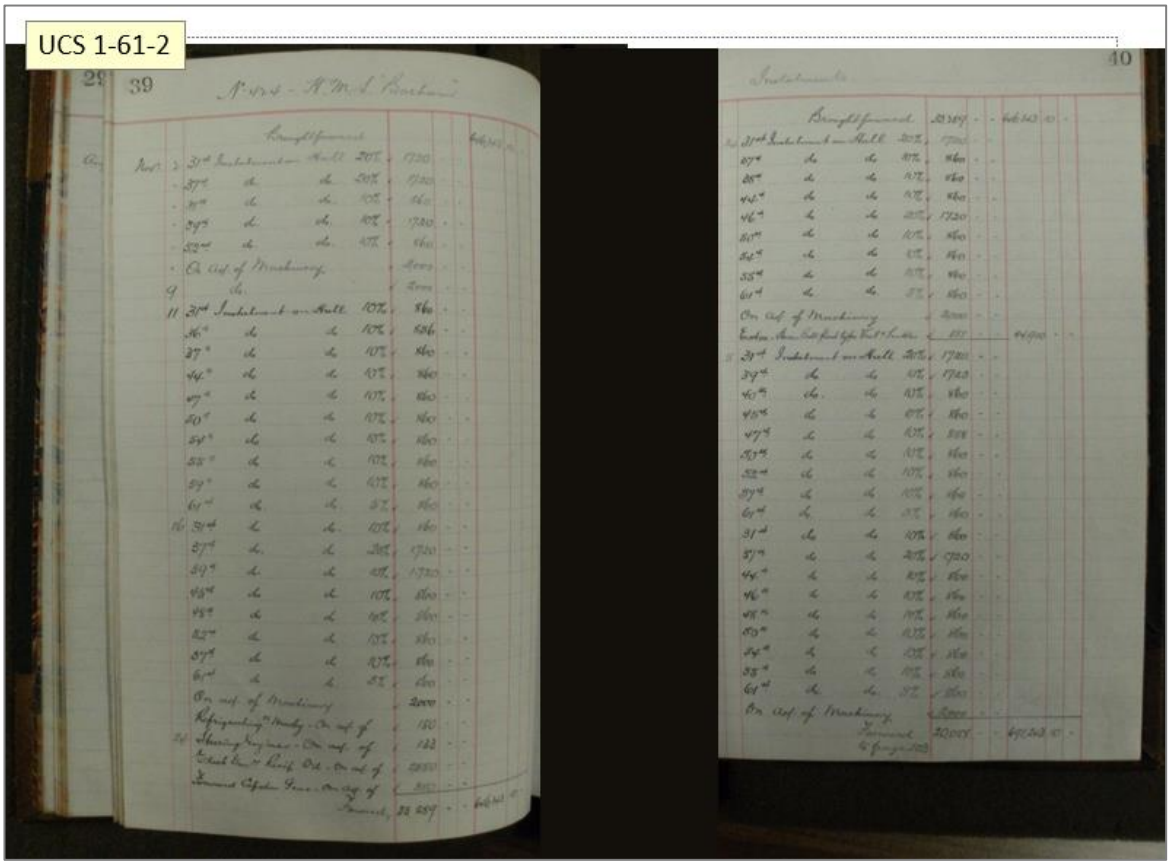
UCS 1-59-1

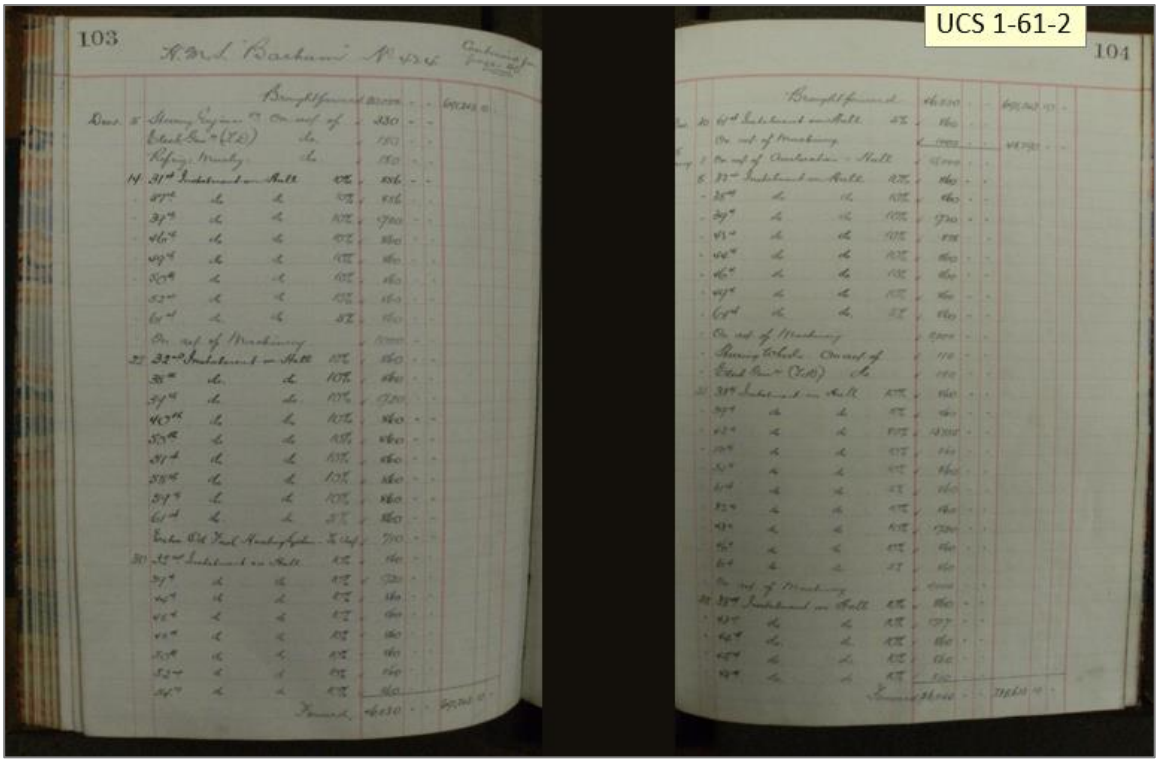
" HMS Barham and the destroyers Mons and Medusa, being fitted out at Clydebank, July "
https://www.pinterest.com.au/pin/485544403568438101/

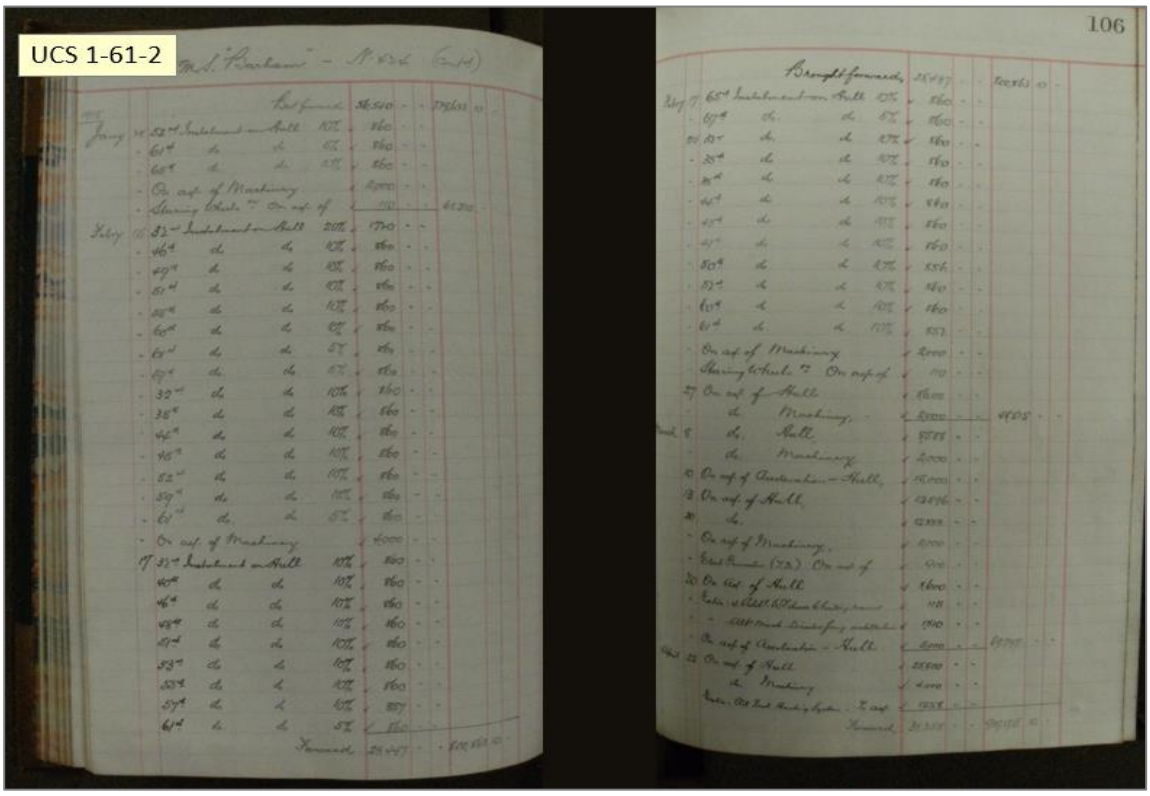

Month
UCS 1-61-2
Payments

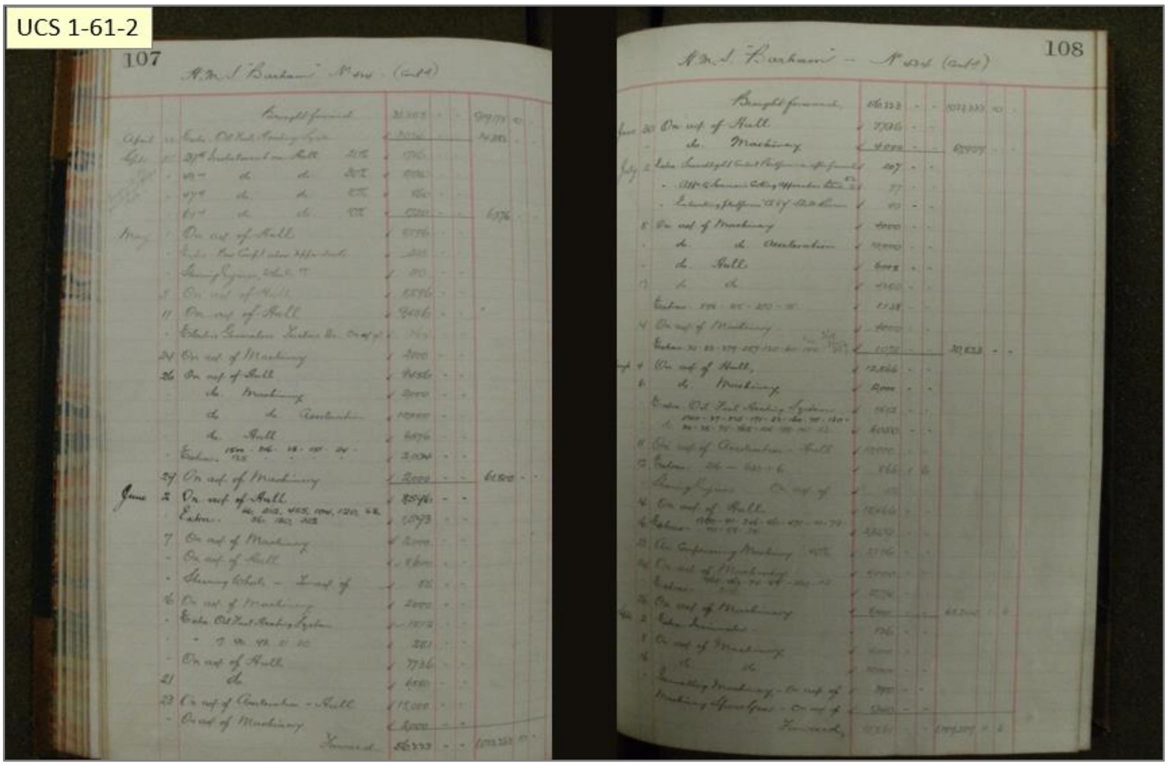

UCS 1-61-2


UCS 1-61-2


UCS 1-61-2


UCS 1-61-2


UCS 1-61-2

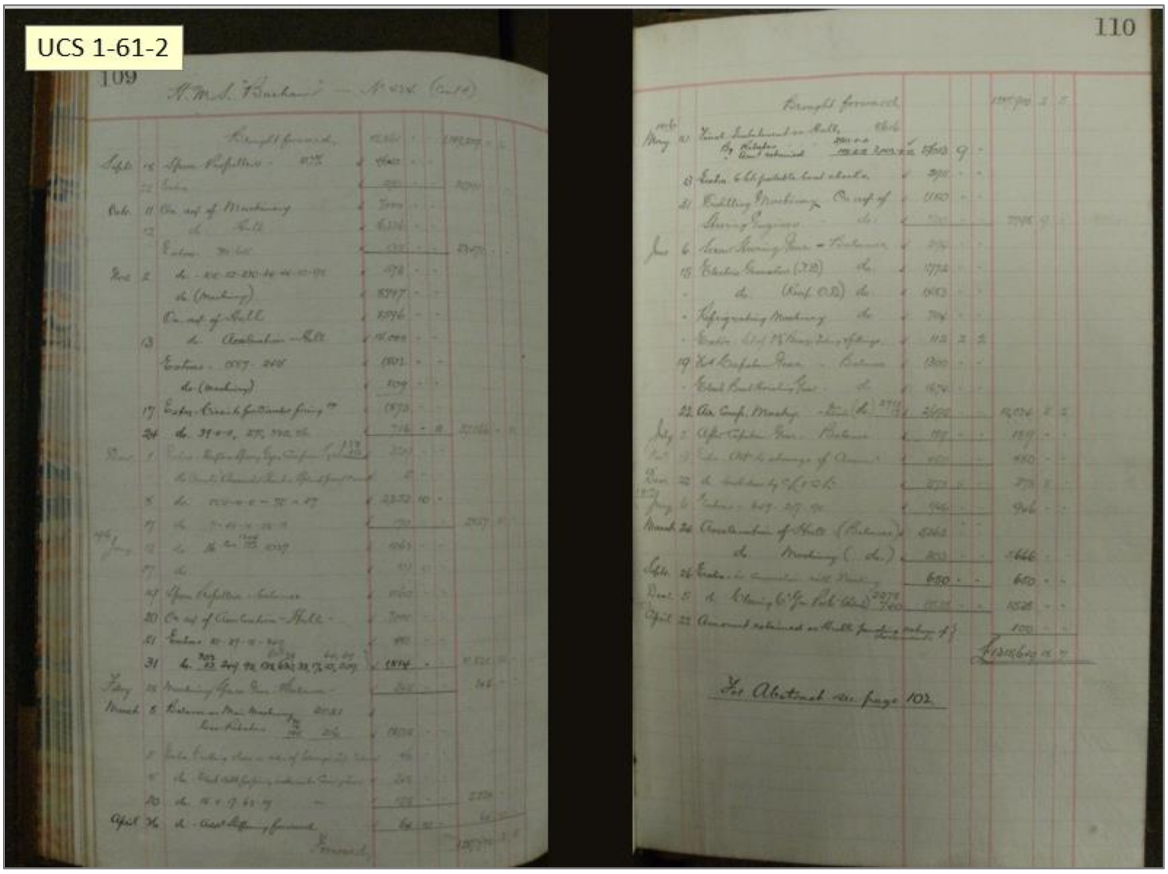

UCS 1-61-2

107 H.M.S. "Barham" No. 424 (Cont.)

Brought forward

108 H.M.S. "Barham" – No. 424 (Cont.)

Brought forward


UCS 1-61-2

109 H.M.S. "Barham" – No. 424 (Cont.)

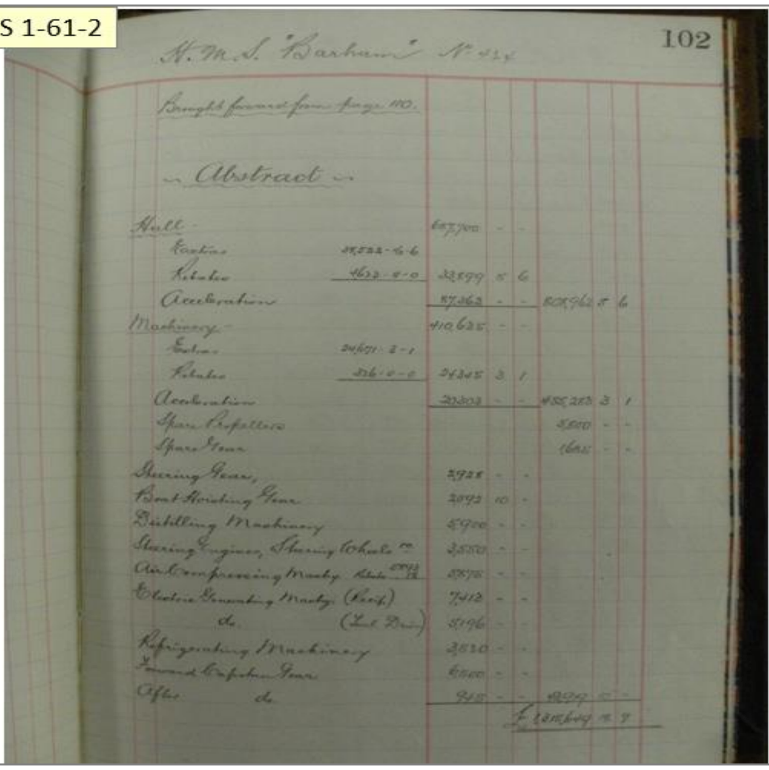
Brought forward

110

Brought forward

For Abstract see page 102.

UCS 1-61-2

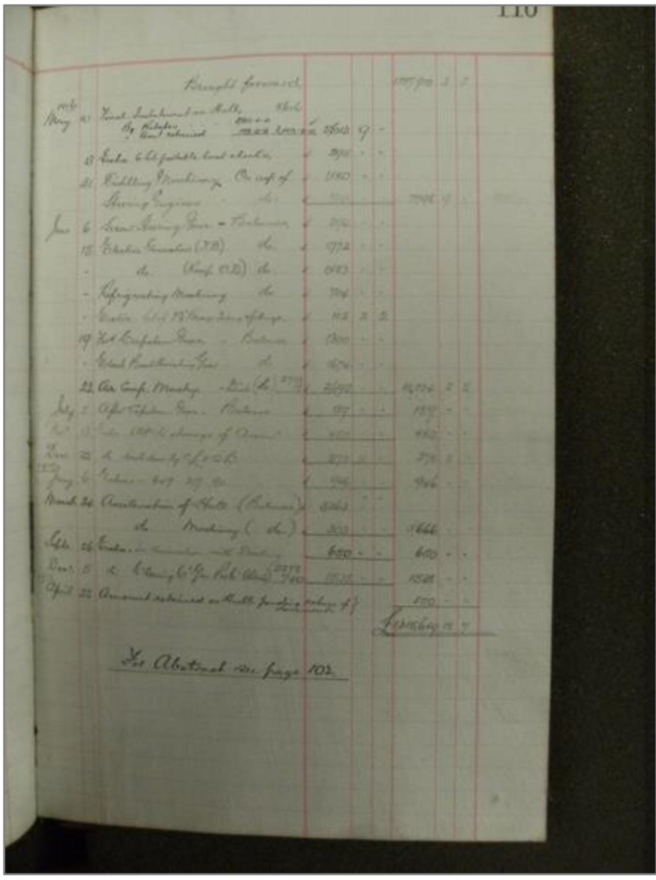


H.M.S. "Barham" No. 424 — 102

Brought forward from page 110.

~ Abstract ~

		£ s d	£ s d
Hull		687,700 - -	
Extras	28,532-6-6		
Rebates	4633-0-0	23,899 6 6	
Acceleration		87,363 - -	808,962 6 6
Machinery		410,625 - -	
Extras	24,671-3-1		
Rebates	326-0-0	24,345 3 1	
Acceleration		20,303 - -	455,273 3 1
Spare Propellers			5,800 - -
Spare Gear			1685 - -
Steering Gear		2925 - -	
Boat Hoisting Gear		2092 10 -	
Distilling Machinery		5900 - -	
Steering Engines, Steering Wheels &c		3,550 - -	
Air Compressing Machy.		5875 - -	
Electric Generating Machy. (Recip.)		7412 - -	
do. (Turb. Driven)		5196 - -	
Refrigerating Machinery		3520 - -	
Forward Capstan Gear		6500 - -	
After do.		915 - -	48,299 - -
			£1,318,669 9 7



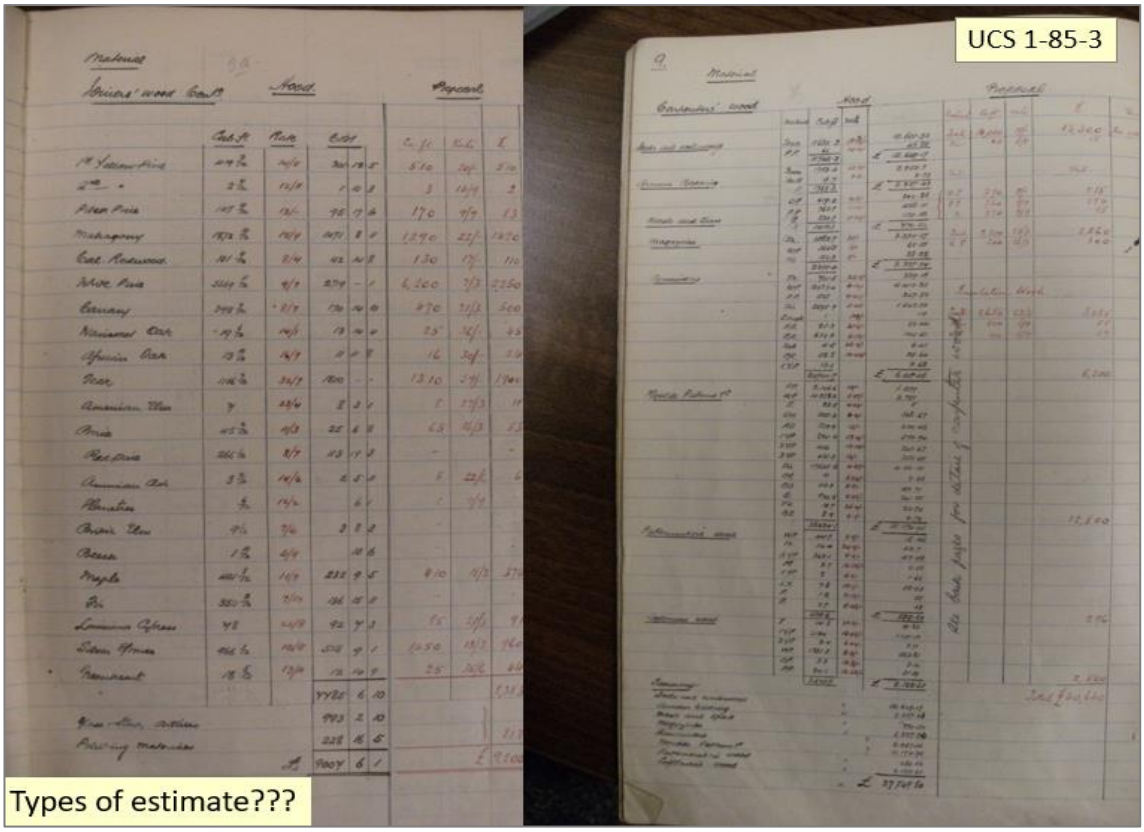
110

Brought forward

See Abstract on page 102.

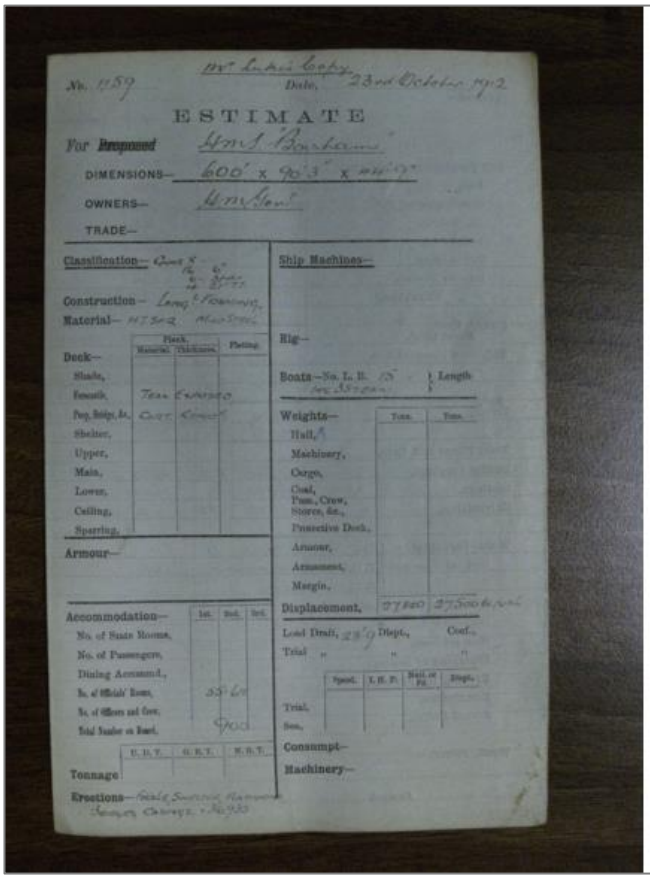
Payments from Admiralty on instalments

UCS 1-61-2



Types of estimate???

UCS 1-85-3



No. 1159

1st Latest Copy

Date, 23rd October 1912

ESTIMATE

For Proposed H.M.S. Barham

DIMENSIONS— 600' x 90'3" x 44'0"

OWNERS— H.M. Govt

TRADE—

Classification— Cruiser

Construction— Long. Framing

Material— Mild Steel

Ship Machines—

Rig—

Boats—No. L. B. 15' Length

Deck—

Shade,

Forecastle,

Pop. Bridge, &c.,

Shelter,

Upper,

Main,

Lower,

Ceiling,

Sparring,

Armour—

Weights—

Hull,

Machinery,

Cargo,

Coal,

Pass., Crew, Stores, &c.,

Protective Deck,

Armour,

Armament,

Margin,

Displacement, 27800 27500 tons

Accommodation—

No. of State Rooms,

No. of Passengers,

Dining Accomd.,

No. of Officers' Rooms,

No. of Officers and Crew,

Total Number on Board, 900

Load Draft, 23'0 Displt., Coef.

Trial " " "

Trial,

Sea,

Consumpt—

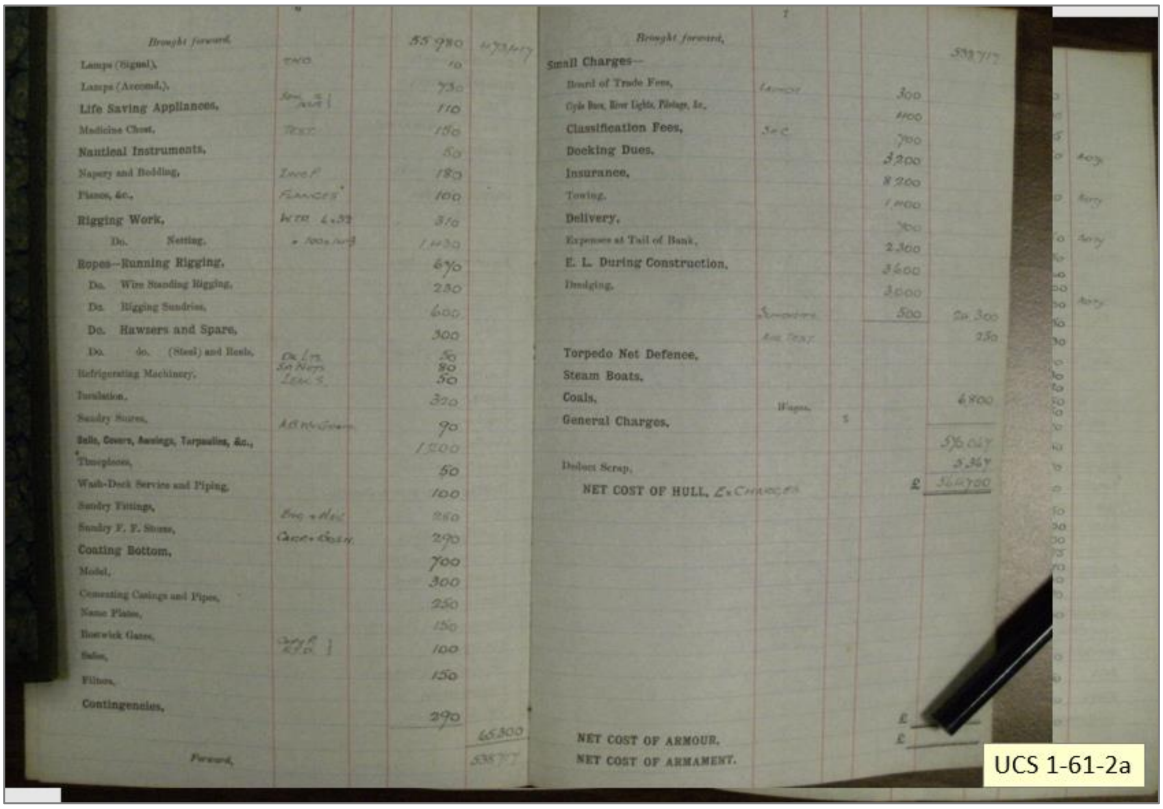
Machinery—

Tonnage

Erections—

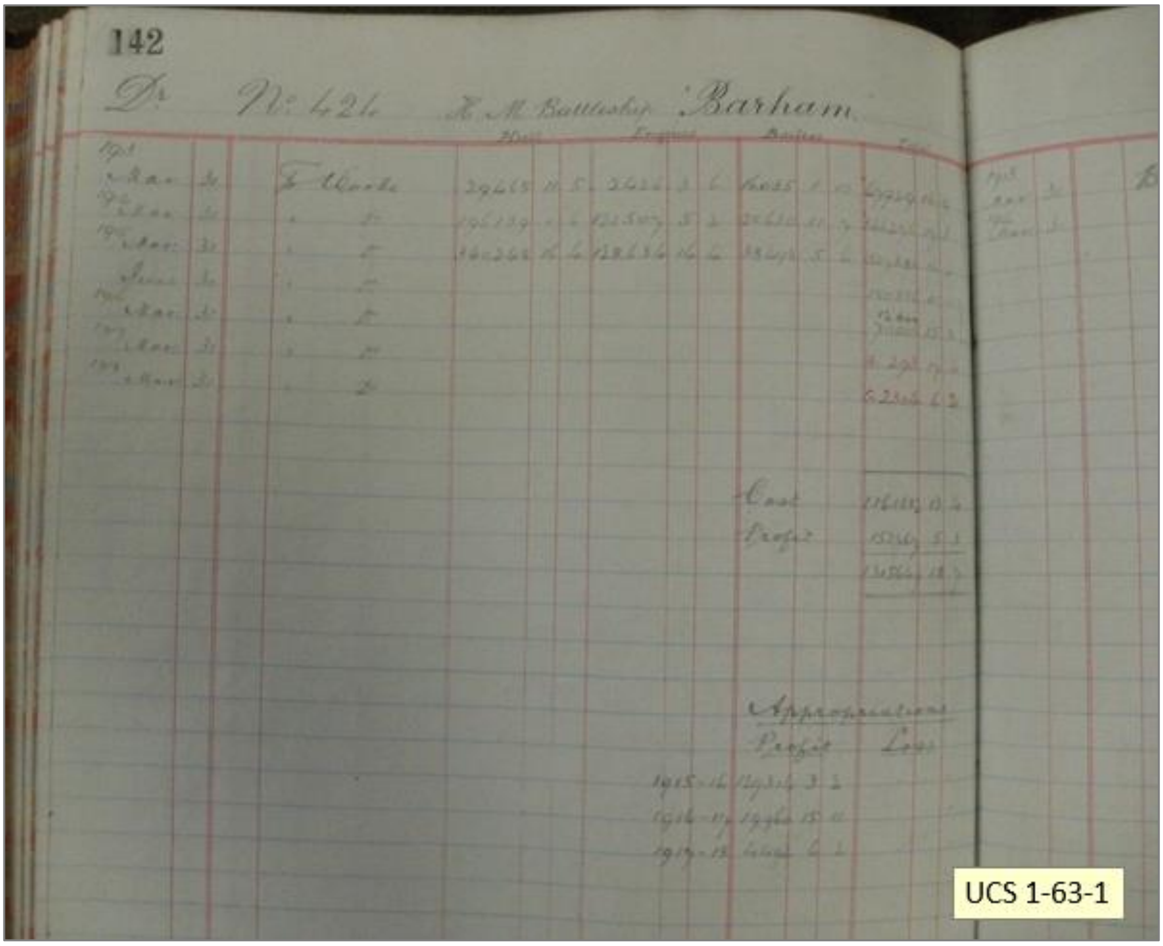
Estimates:

UCS 1-61-2a

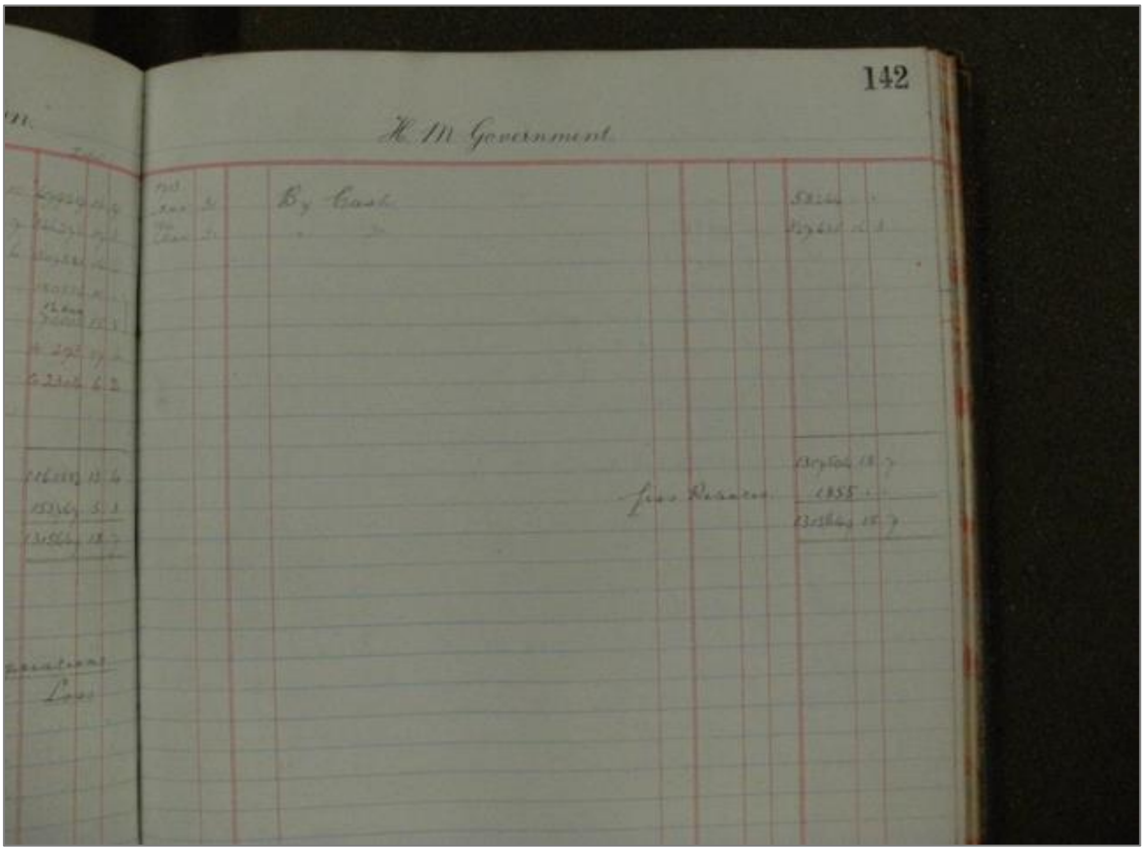

Brought forward,	55 980	473417
Lamps (Signal),	10	
Lamps (Accomd.),	730	
Life Saving Appliances,	110	
Medicine Chest,	150	
Nautical Instruments,	50	
Napery and Bedding,	180	
Pianos, &c.,	100	
Rigging Work,	310	
Do. Netting,	1,420	
Ropes—Running Rigging,	670	
Do. Wire Standing Rigging,	230	
Do. Rigging Sundries,	600	
Do. Hawsers and Spare,	300	
Do. do. (Steel) and Reels,	50 80 50	
Refrigerating Machinery,		
Insulation,	320	
Sundry Stores,	90	
Sails, Covers, Awnings, Tarpaulins, &c.,	1,500	
Timepieces,	50	
Wash-Deck Service and Piping,	100	
Sundry Fittings,	260	
Sundry F. F. Stores,	290	
Coating Bottom,	700	
Model,	300	
Cementing Casings and Pipes,	250	
Name Plates,	150	
Bostwick Gates,	100	
Sales,		
Filters,	150	
Contingencies,	290	
		65300
Forward,		538717

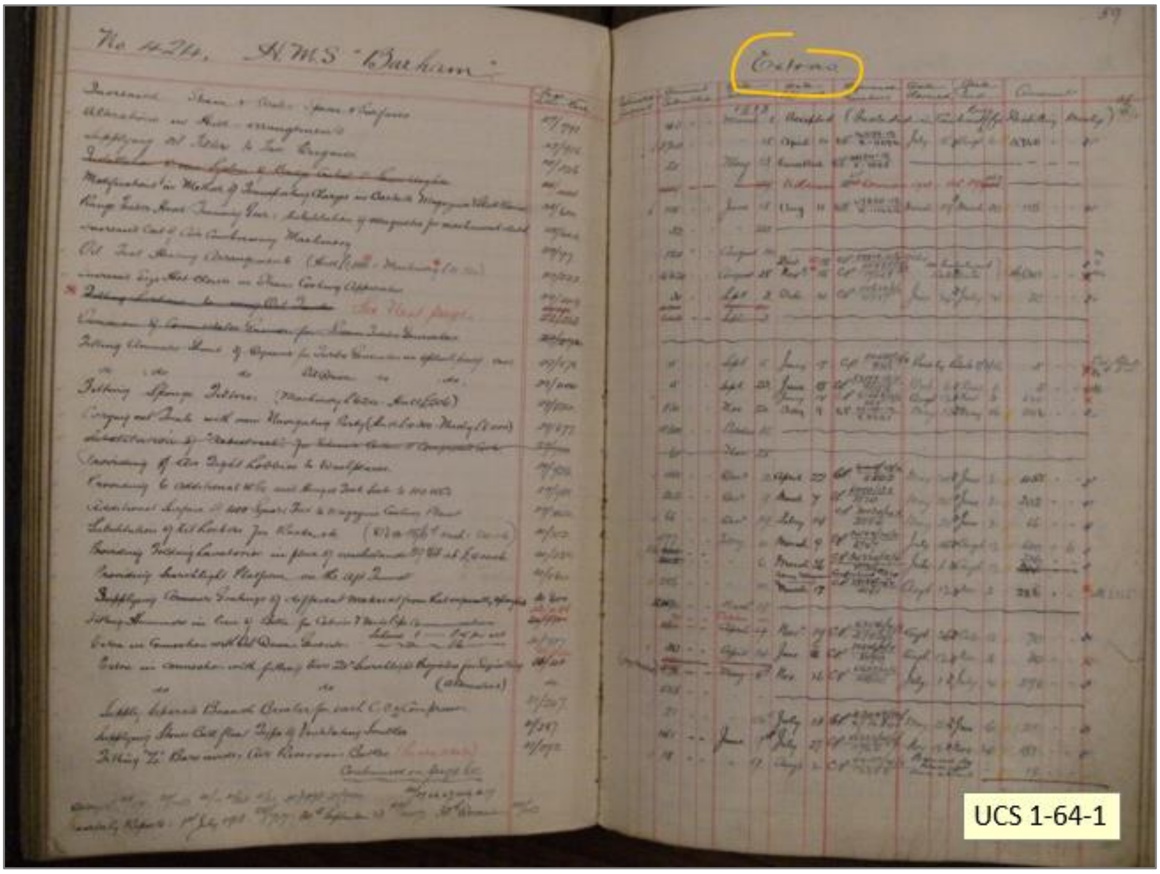
Brought forward,		538717
Small Charges—		
Board of Trade Fees,	300	
Clyde Dues, River Lights, Pilotage, &c.,	1100	
Classification Fees,	700	
Docking Dues,	3200	
Insurance,	8200	
Towing,	1,100	
Delivery,	700	
Expenses at Tail of Bank,	2,300	
E. L. During Construction,	3600	
Dredging,	3000	
	500	24,300
		250
Torpedo Net Defence,		
Steam Boats,		
Coals,		6800
General Charges,		
		570,067
Deduct Scrap,		5,367
NET COST OF HULL, Ex Charges		£ 564700
NET COST OF ARMOUR,		£
NET COST OF ARMAMENT,		£

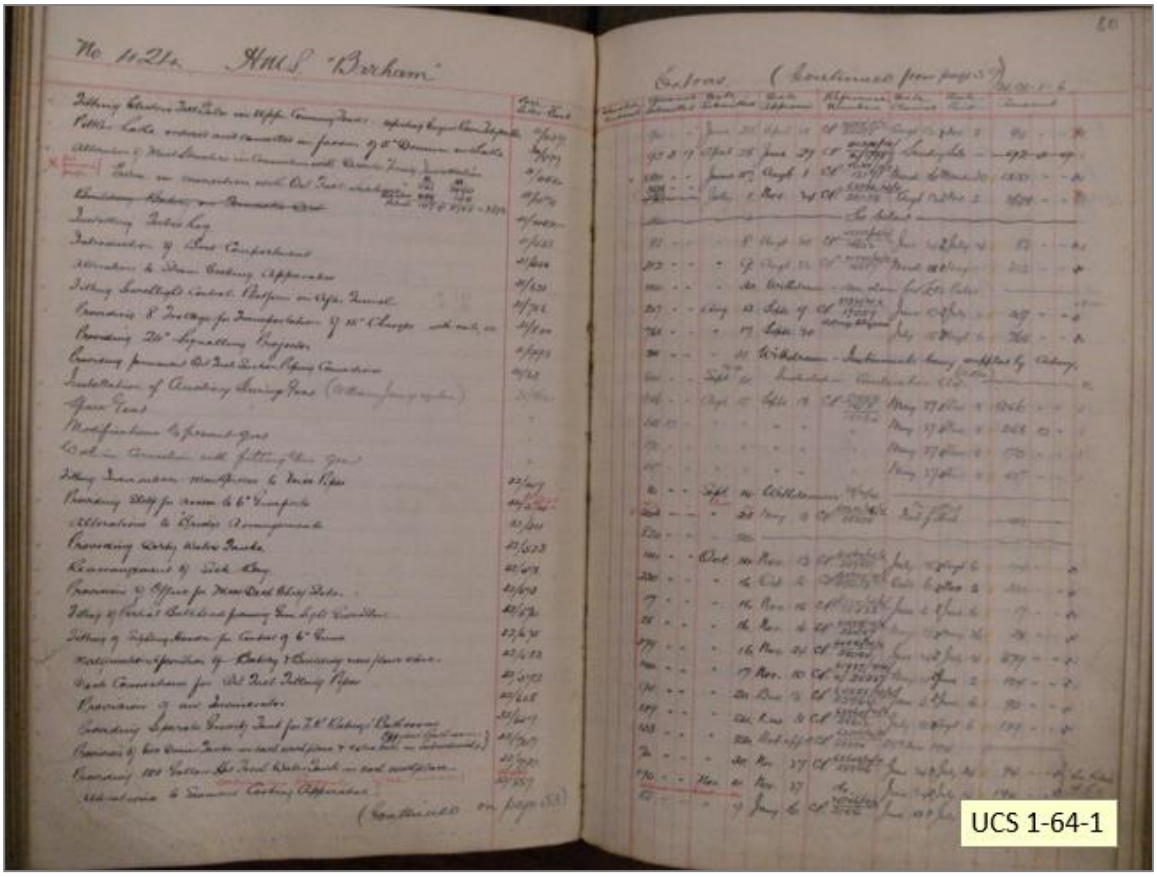
UCS 1-61-2a

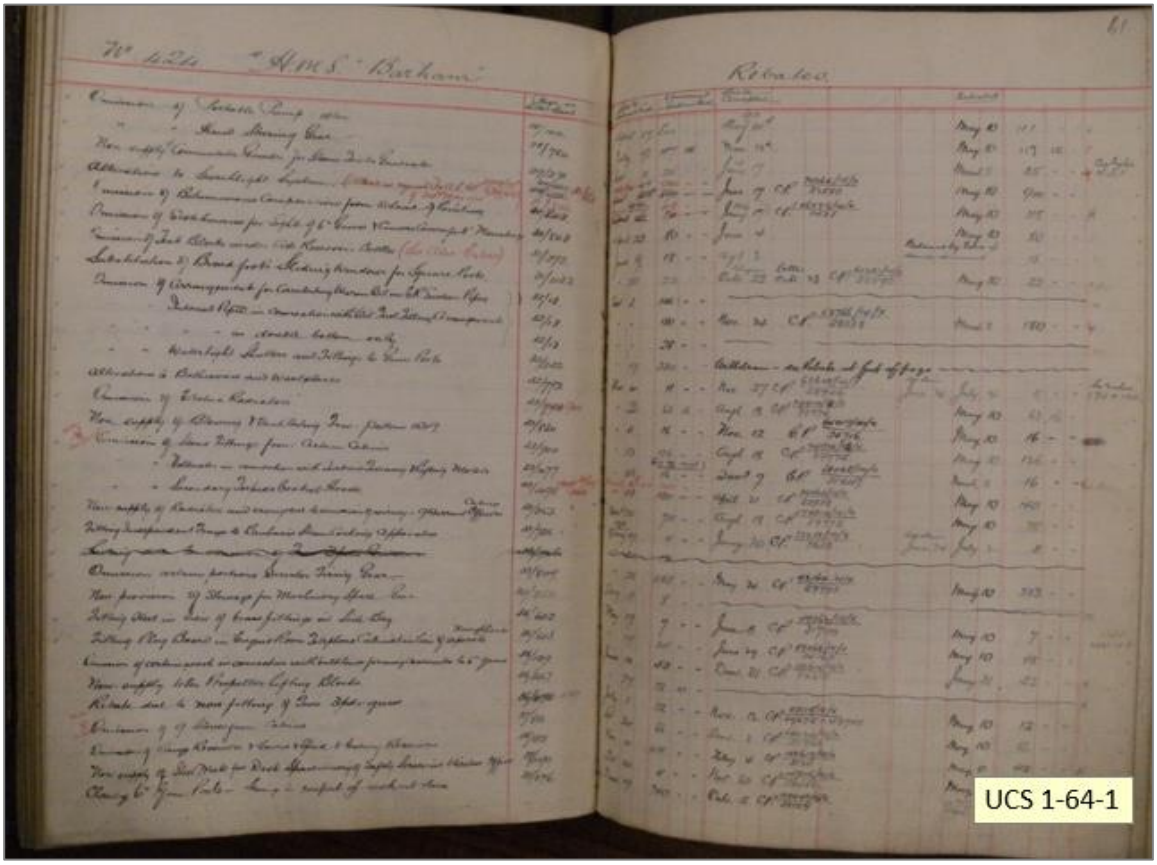


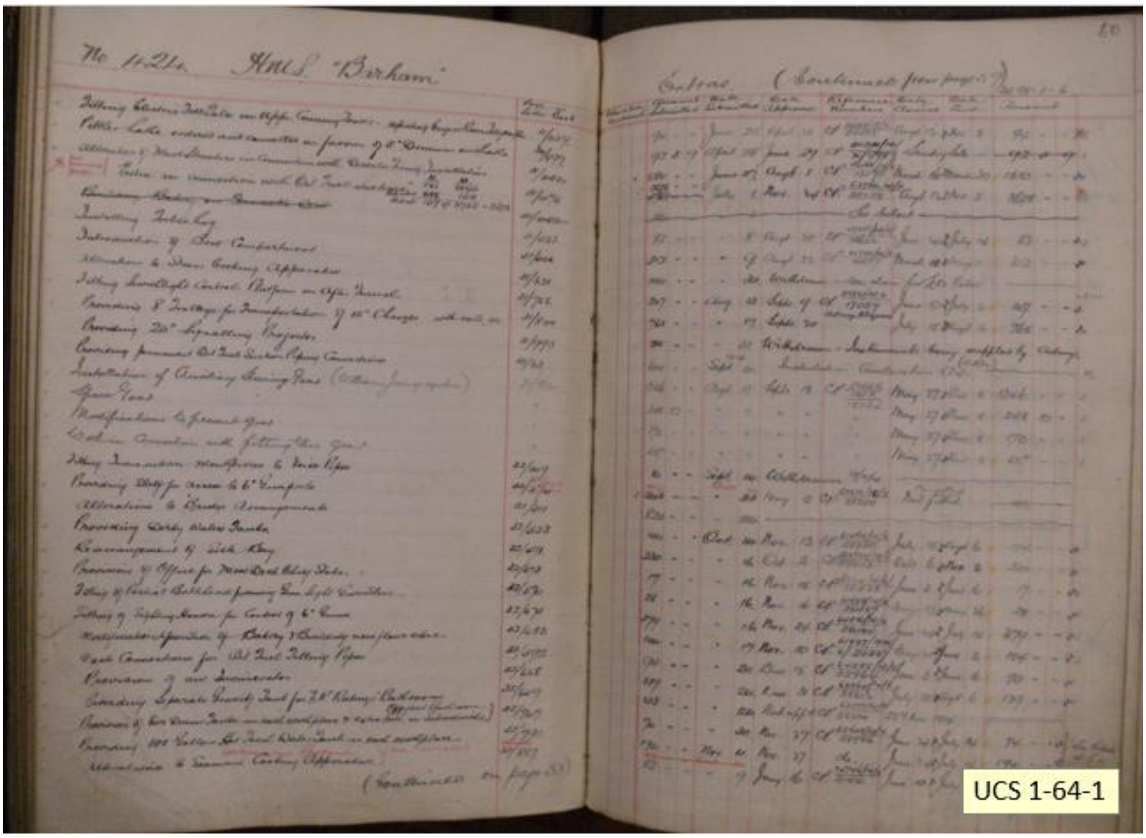
UCS 1-63-1

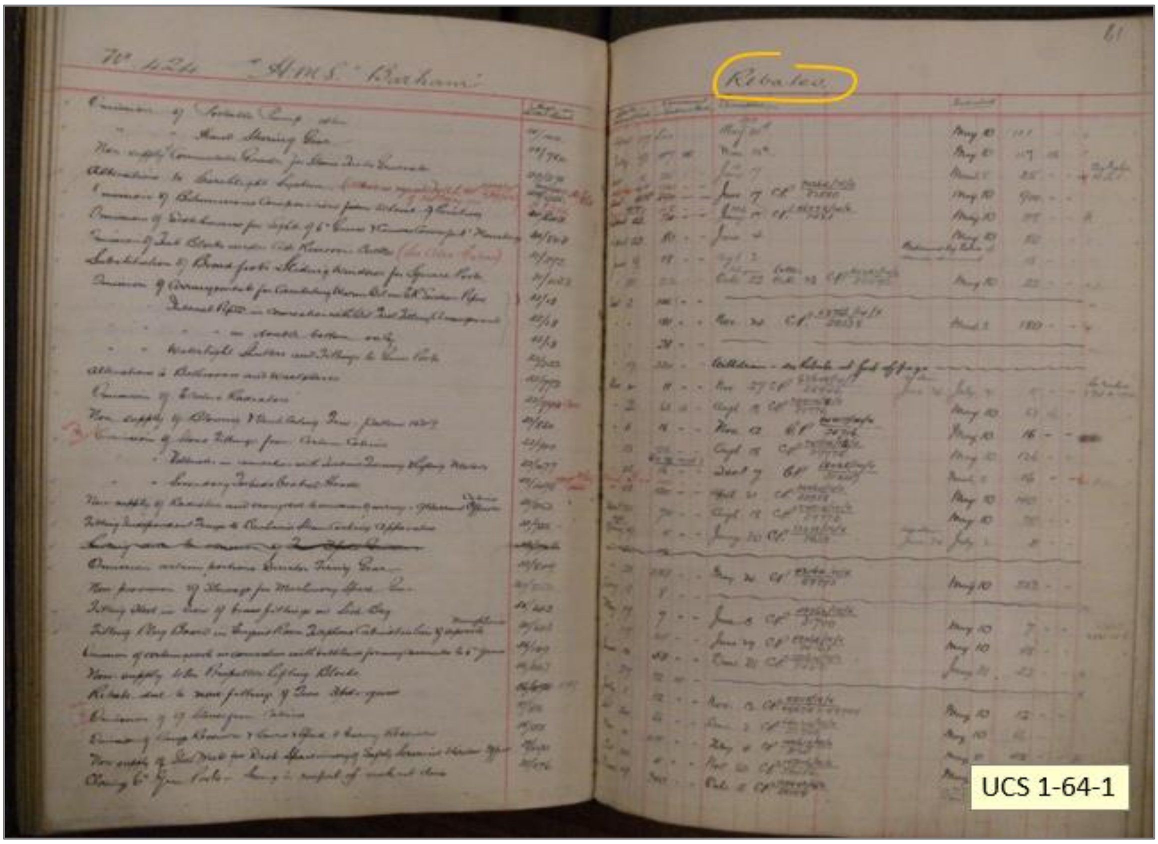

142
H. M. Government
By Cash


UCS 1-64-1

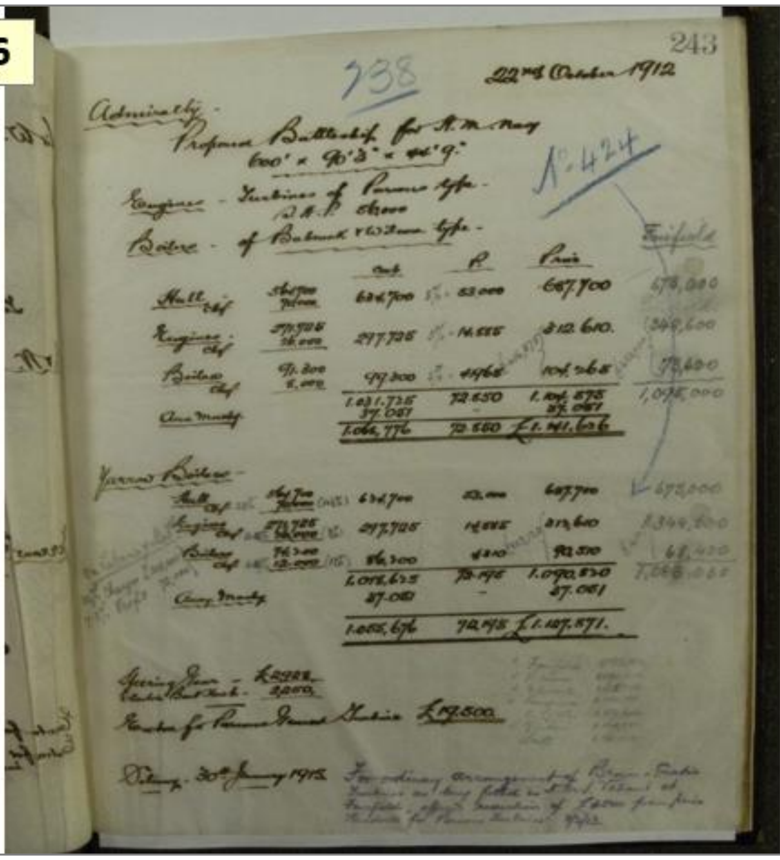

UCS 1-64-1


UCS 1-64-1


No 1424 HMS "Barham"
Extras (Continued from page
UCS 1-64-1


No 1424 "HMS" Barham
Rebates
UCS 1-64-1

UCS 1-74-6


243

22nd October 1912

Admiralty -

Proposed Battleship for H.M. Navy

600' x 90'3" x 44'9"

Engines - Turbines of Parsons type -

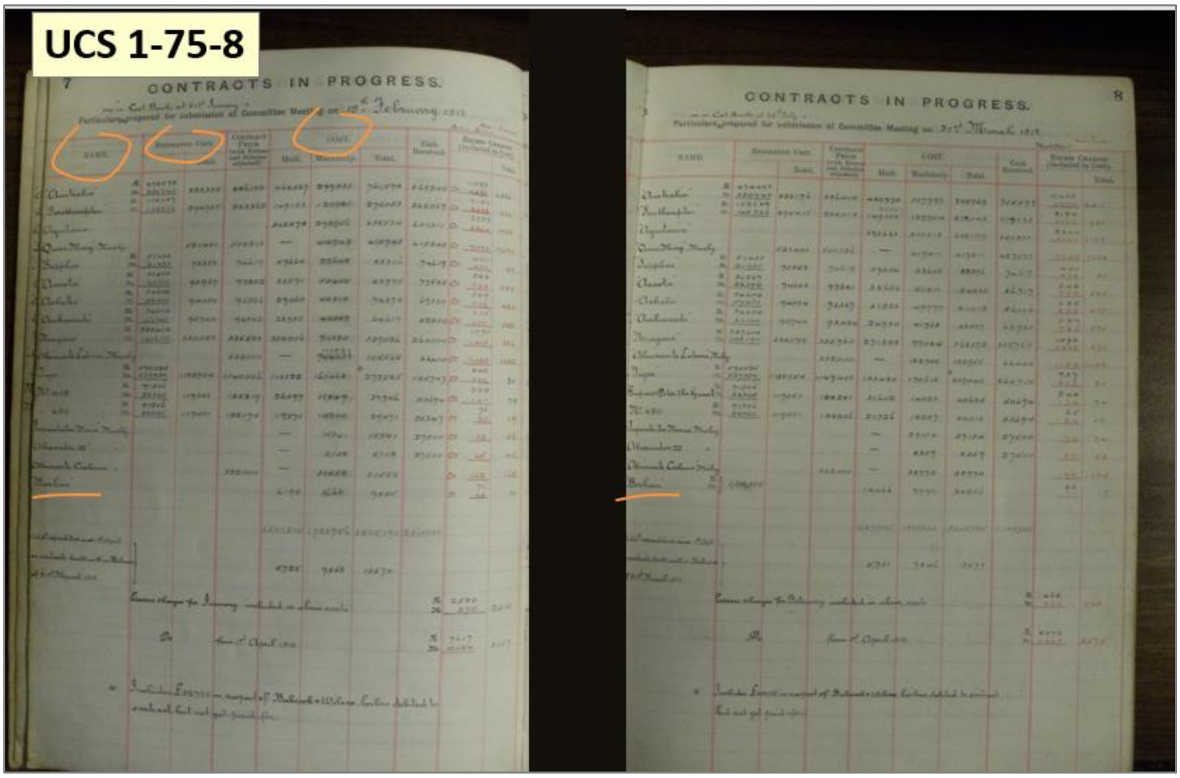
Boilers - of Babcock & Wilcox type -

	Cost		Price
Hull	636,700	51,000	687,700
Engines	297,725	14,885	312,610
Boilers	97,300	6,965	104,265
	1,031,725	72,550	1,104,575
	37,051		37,051
	1,068,776	72,550	£1,141,626

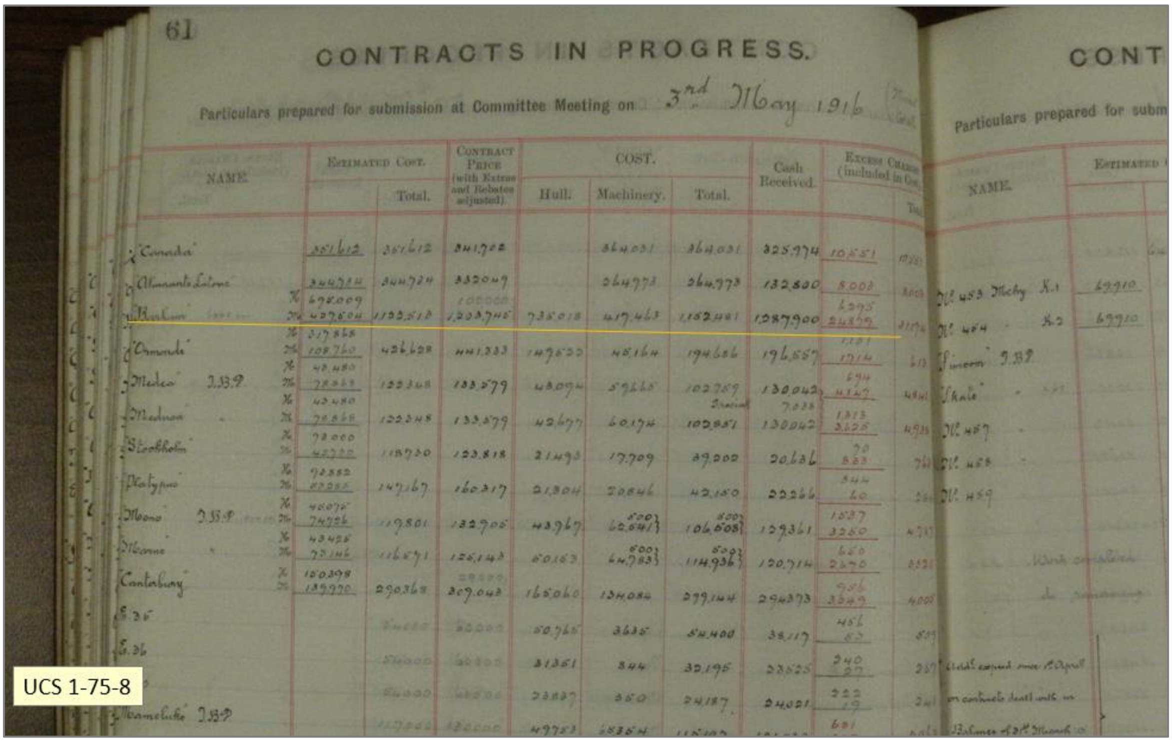
Yarrow Boilers -

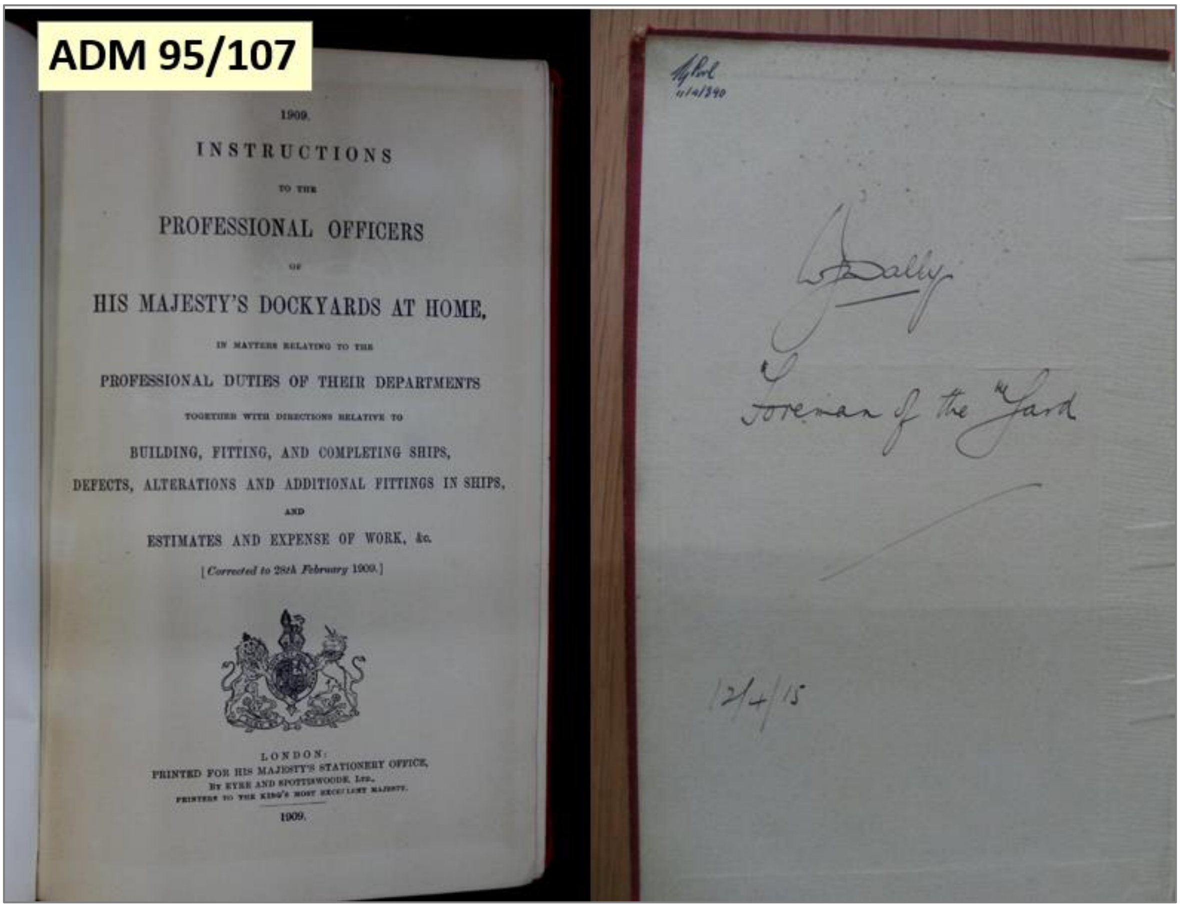
	Cost		Price
Hull	636,700	51,000	687,700
Engines	297,725	14,885	312,610
Boilers	86,200	4,310	90,510
	1,018,625	72,195	1,090,820
	37,051		37,051
	1,055,676	72,195	£1,127,871

UCS 1-75-8


CONTRACTS IN PROGRESS.

CONTRACTS IN PROGRESS.


61
CONTRACTS IN PROGRESS.
Particulars prepared for submission at Committee Meeting on 3rd May 1916
NAME.
Estimated Cost.
Total.
Contract Price (with Extras and Rebates adjusted).
COST.
Hull.
Machinery.
Total.
Cash Received.
Excess Charges (included in Cost)
UCS 1-75-8


ADM 95/107
1909.
INSTRUCTIONS
TO THE
PROFESSIONAL OFFICERS
OF
HIS MAJESTY'S DOCKYARDS AT HOME,
IN MATTERS RELATING TO THE
PROFESSIONAL DUTIES OF THEIR DEPARTMENTS
TOGETHER WITH DIRECTIONS RELATIVE TO
BUILDING, FITTING, AND COMPLETING SHIPS,
DEFECTS, ALTERATIONS AND ADDITIONAL FITTINGS IN SHIPS,
AND
ESTIMATES AND EXPENSE OF WORK, &c.
[Corrected to 28th February 1909.]
LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
BY EYRE AND SPOTTISWOODE, LTD.,
PRINTERS TO THE KING'S MOST EXCELLENT MAJESTY.
1909.
Foreman of the Yard
12/4/15

ADM 95/107

CONTENTS.

ADM 95/107

CHAPTER VII.

BUILDING, FITTING AND COMPLETING SHIPS FOR COMMISSION, &c.

375.

All vessels are to be built in strict accordance with the drawings and specifications approved and transmitted for the guidance of the Superintendent and Officers of the Yard by the Admiralty, and during the building or repair of any vessel no deviation from them, or from the standing orders and regulations for building and fitting ships, is to be made without written sanction from the Admiralty. Accordance with drawings and orders.

2. A copy of the original approved specification of each ship or vessel ordered to be built at a Dockyard is to be interleaved with blank sheets, upon which the particulars, dates, and numbers of all authorised deviations are to be noted in red ink at the time the orders are received. This copy is to be transmitted to the Admiralty when the ship is completed. Report of alterations.

3. When an alteration or addition is proposed by the Dockyard Officers, or ordered by the Admiralty, during the construction of a ship or vessel, an estimate of the additional expense is to be submitted to the Admiralty, so that the probable effect on her cost and date of completion may be fully appreciated. Alterations while building.

4. A careful record of all alterations and additions authorised during construction, and their estimated cost, is to be kept at each Yard so as to be easily accessible for reference. Record of alterations and additions.

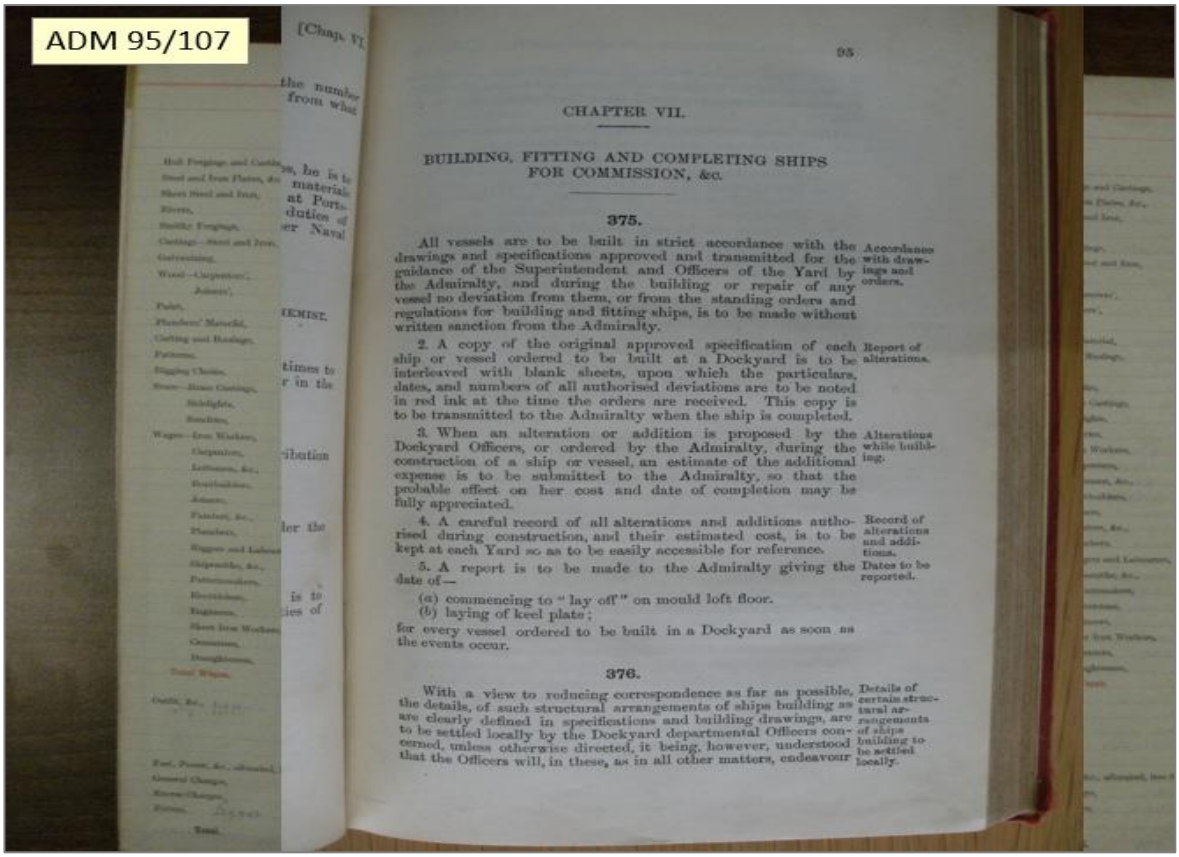
5. A report is to be made to the Admiralty giving the date of— Dates to be reported.

(a) commencing to "lay off" on mould loft floor.
(b) laying of keel plate;

for every vessel ordered to be built in a Dockyard as soon as the events occur.

376.

With a view to reducing correspondence as far as possible, the details, of such structural arrangements of ships building as are clearly defined in specifications and building drawings, are to be settled locally by the Dockyard departmental Officers concerned, unless otherwise directed, it being, however, understood that the Officers will, in these, as in all other matters, endeavour Details of certain structural arrangements of ships building to be settled locally.



CHAPTER VII.

BUILDING, FITTING AND COMPLETING SHIPS FOR COMMISSION, &c.

375.

All vessels are to be built in strict accordance with the drawings and specifications approved and transmitted for the guidance of the Superintendent and Officers of the Yard by the Admiralty, and during the building or repair of any vessel no deviation from them, or from the standing orders and regulations for building and fitting ships, is to be made without written sanction from the Admiralty. Accordance with drawings and orders.

2. A copy of the original approved specification of each ship or vessel ordered to be built at a Dockyard is to be interleaved with blank sheets, upon which the particulars, dates, and numbers of all authorised deviations are to be noted in red ink at the time the orders are received. This copy is to be transmitted to the Admiralty when the ship is completed. Report of alterations.

3. When an alteration or addition is proposed by the Dockyard Officers, or ordered by the Admiralty, during the construction of a ship or vessel, an estimate of the additional expense is to be submitted to the Admiralty, so that the probable effect on her cost and date of completion may be fully appreciated. Alterations while building.

4. A careful record of all alterations and additions authorised during construction, and their estimated cost, is to be kept at each Yard so as to be easily accessible for reference. Record of alterations and additions.

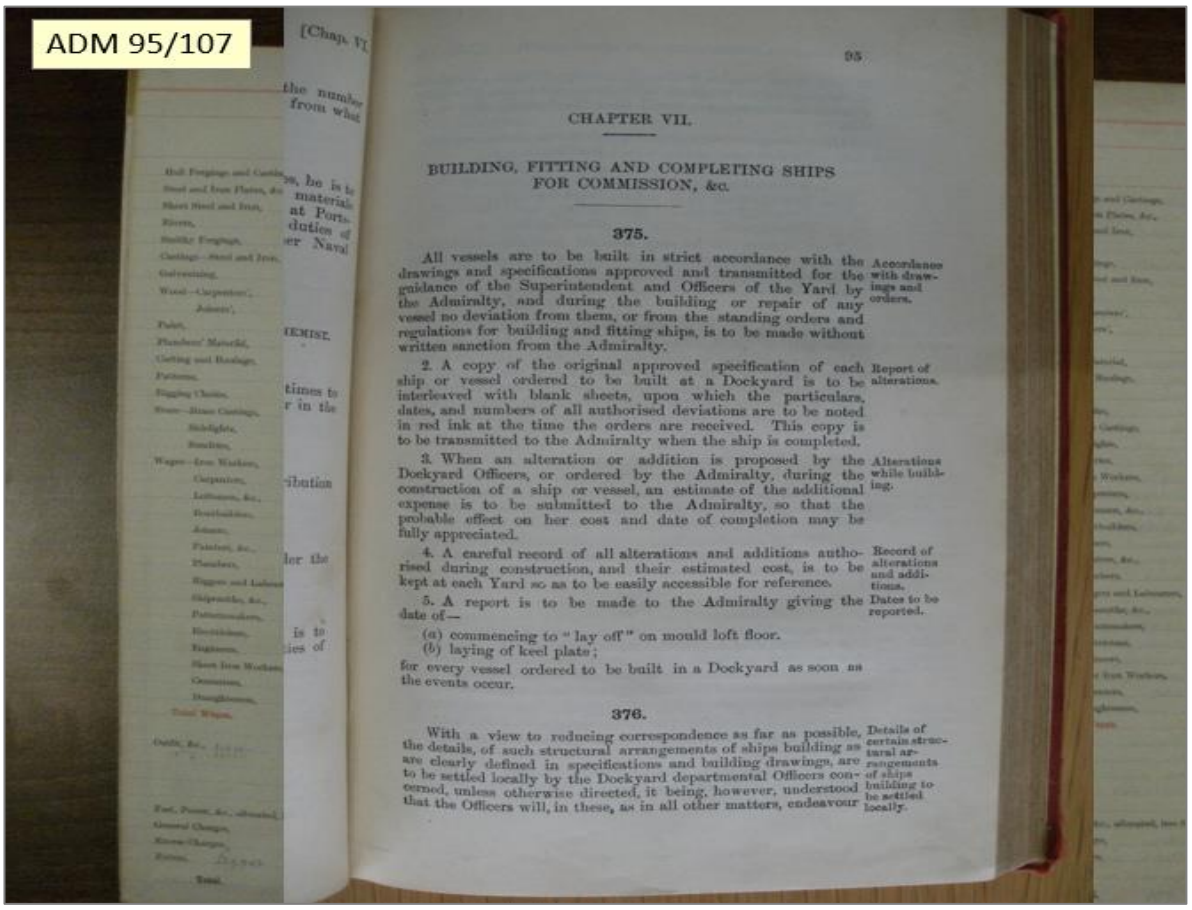
5. A report is to be made to the Admiralty giving the date of— Dates to be reported.

(a) commencing to "lay off" on mould loft floor.
(b) laying of keel plate;

for every vessel ordered to be built in a Dockyard as soon as the events occur.

376.

With a view to reducing correspondence as far as possible, the details, of such structural arrangements of ships building as are clearly defined in specifications and building drawings, are to be settled locally by the Dockyard departmental Officers concerned, unless otherwise directed, it being, however, understood that the Officers will, in these, as in all other matters, endeavour Details of certain structural arrangements of ships building to be settled locally.



95

CHAPTER VII.

BUILDING, FITTING AND COMPLETING SHIPS FOR COMMISSION, &c.

375.

All vessels are to be built in strict accordance with the drawings and specifications approved and transmitted for the guidance of the Superintendent and Officers of the Yard by the Admiralty, and during the building or repair of any vessel no deviation from them, or from the standing orders and regulations for building and fitting ships, is to be made without written sanction from the Admiralty. Accordance with drawings and orders.

2. A copy of the original approved specification of each ship or vessel ordered to be built at a Dockyard is to be interleaved with blank sheets, upon which the particulars, dates, and numbers of all authorised deviations are to be noted in red ink at the time the orders are received. This copy is to be transmitted to the Admiralty when the ship is completed. Report of alterations.

3. When an alteration or addition is proposed by the Dockyard Officers, or ordered by the Admiralty, during the construction of a ship or vessel, an estimate of the additional expense is to be submitted to the Admiralty, so that the probable effect on her cost and date of completion may be fully appreciated. Alterations while building.

4. A careful record of all alterations and additions authorised during construction, and their estimated cost, is to be kept at each Yard so as to be easily accessible for reference. Record of alterations and additions.

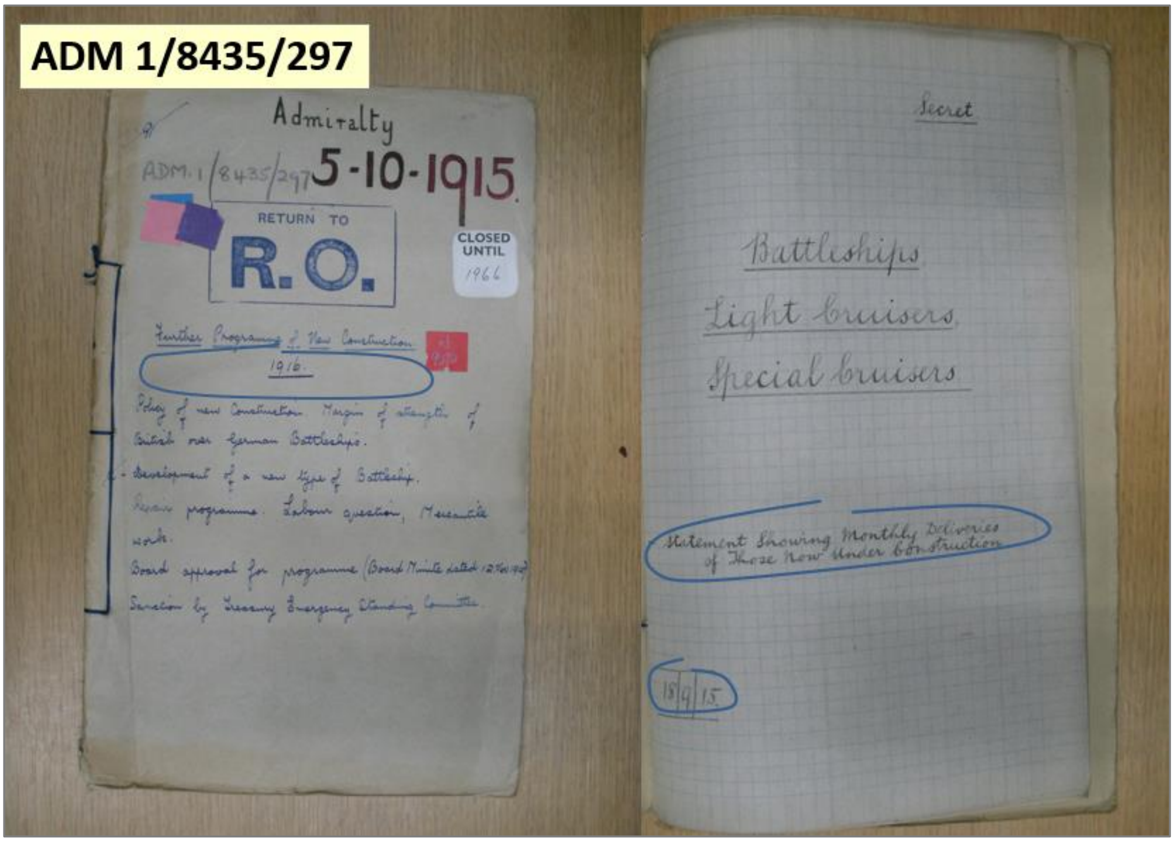
5. A report is to be made to the Admiralty giving the date of— Dates to be reported.

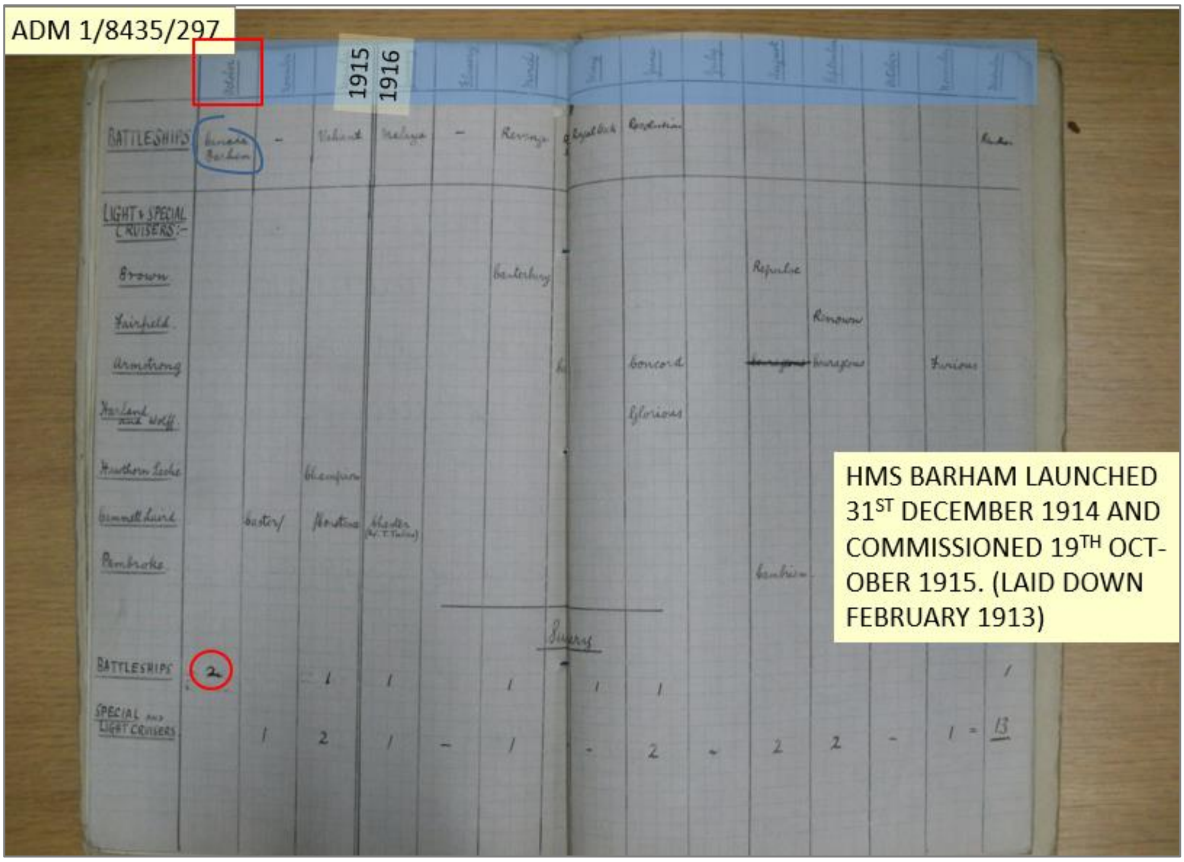
(a) commencing to "lay off" on mould loft floor.
(b) laying of keel plate;

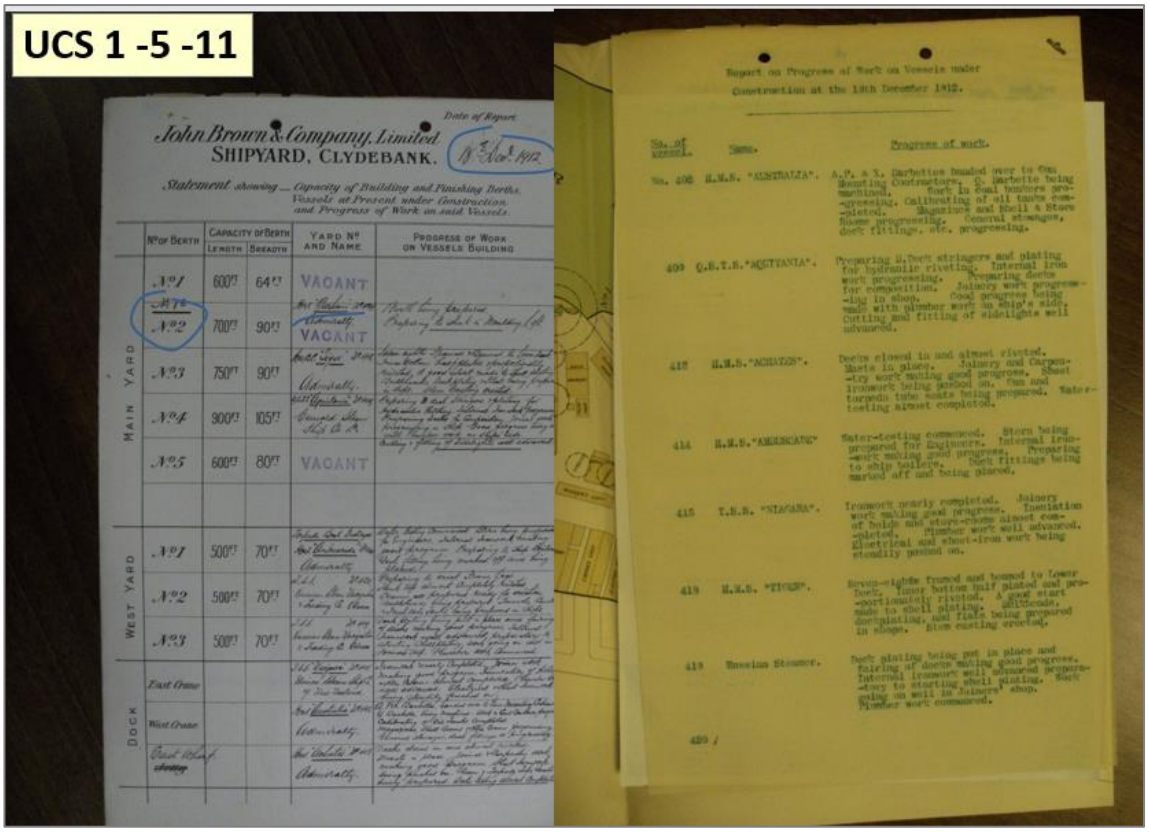
for every vessel ordered to be built in a Dockyard as soon as the events occur.

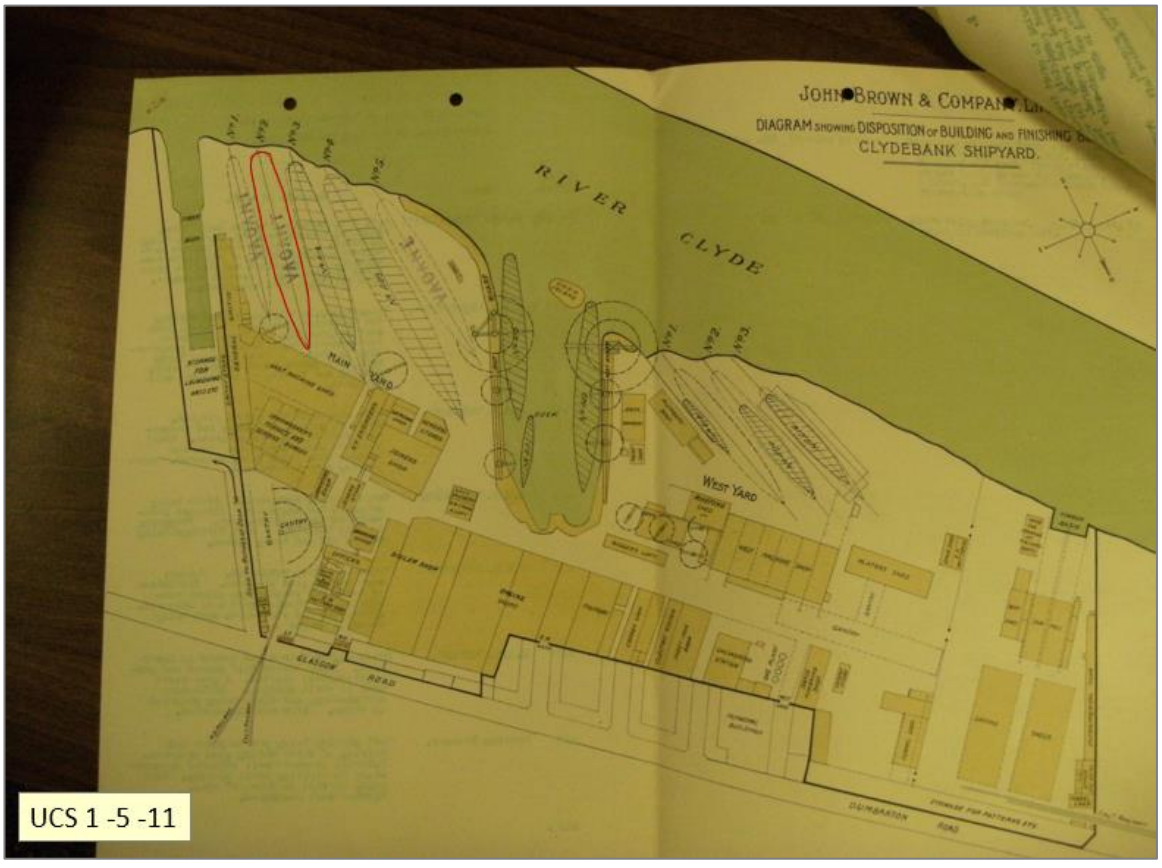
376.

With a view to reducing correspondence as far as possible, the details, of such structural arrangements of ships building as are clearly defined in specifications and building drawings, are to be settled locally by the Dockyard departmental Officers concerned, unless otherwise directed, it being, however, understood that the Officers will, in these, as in all other matters, endeavour Details of certain structural arrangements of ships building to be settled locally.


ADM 1/8435/297
Admiralty
5-10-1915
RETURN TO
R.O.
CLOSED UNTIL
1966
Further Programme of New Construction
1916.
Secret
Battleships
Light Cruisers
Special Cruisers
Statement Showing Monthly Deliveries of Those now under Construction

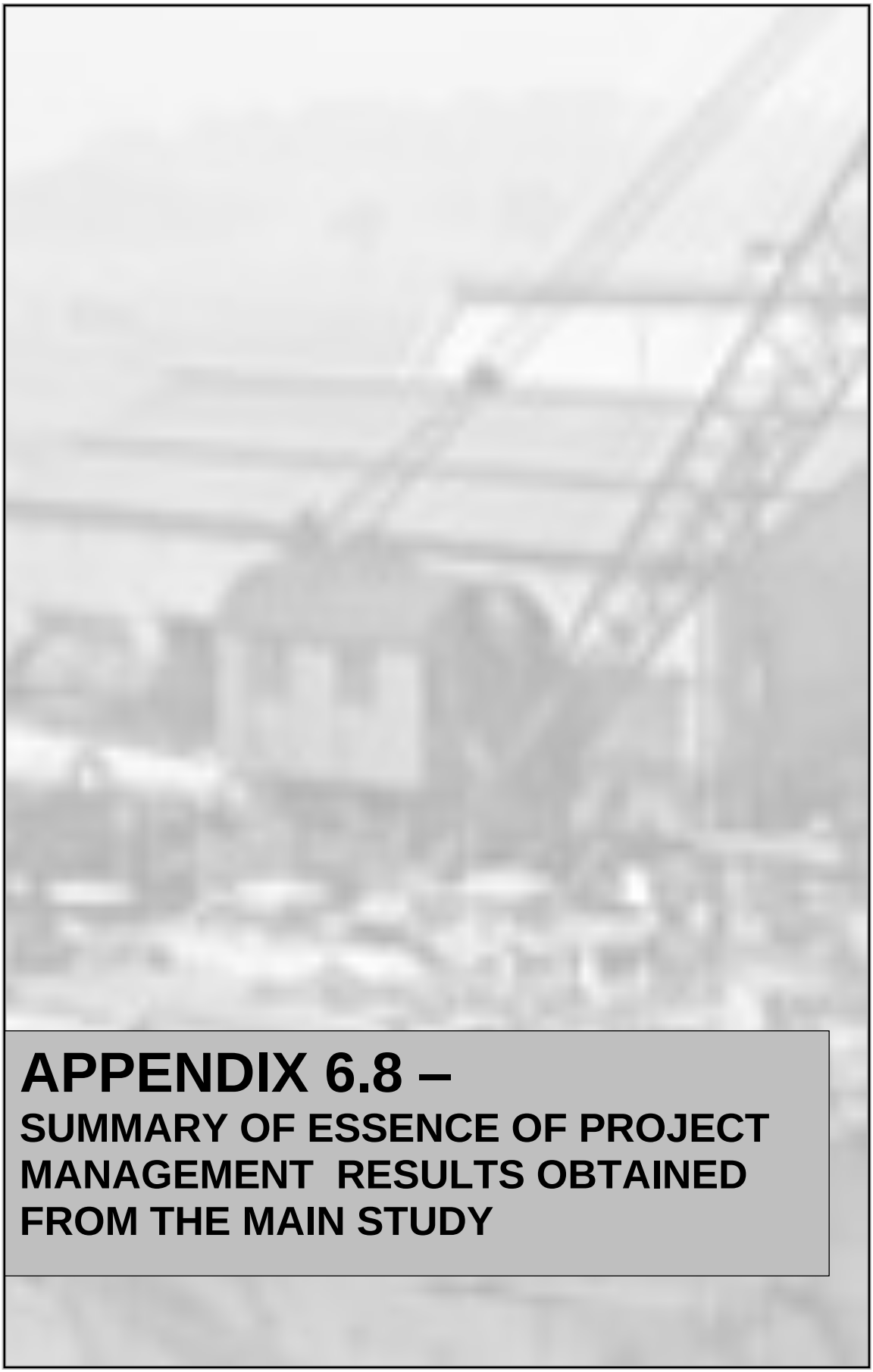

ADM 1/8435/297
1915
1916
BATTLESHIPS
LIGHT & SPECIAL CRUISERS:-
BATTLESHIPS
SPECIAL AND LIGHT CRUISERS
HMS BARHAM LAUNCHED 31ST DECEMBER 1914 AND COMMISSIONED 19TH OCTOBER 1915. (LAID DOWN FEBRUARY 1913)


UCS 1 -5 -11
John Brown & Company, Limited
SHIPYARD, CLYDEBANK.
Statement showing — Capacity of Building and Finishing Berths, Vessels at Present under Construction, and Progress of Work on said Vessels.
Date of Report
1st Nov. 1912
Report on Progress of Work on Vessels under Construction at the 18th December 1912.
Progress of work.


JOHN BROWN & COMPANY
DIAGRAM SHOWING DISPOSITION OF BUILDING AND FINISHING
CLYDEBANK SHIPYARD.
RIVER CLYDE
MAIN YARD
WEST YARD
GLASGOW ROAD
DUMBARTON ROAD
UCS 1 -5 -11

APPENDIX 6.7 –
SUMMARY OF SYSTEMS MODEL RESULTS OBTAINED FROM THE MAIN STUDY

DATA SOURCE DETAILS:			RESEARCHER'S RATINGS							MAIN STUDY RESPONDANT 004							MAIN STUDY RESPONDANT 005							MAIN STUDY RESPONDANT 006							MAIN STUDY RESPONDANT 009						
SOURCE ARCHIVE	SOURCE FILE	REVIEW QUESTION No.	ALIGNED TO ELEMENT 'X' OF SYSTEMS MODEL (and strength of opinion recorded by the researcher.)							ALIGNED TO ELEMENT 'X' OF SYSTEMS MODEL (and strength of opinion recorded by the participant.)							ALIGNED TO ELEMENT 'X' OF SYSTEMS MODEL (and strength of opinion recorded by the participant.)							ALIGNED TO ELEMENT 'X' OF SYSTEMS MODEL (and strength of opinion recorded by the participant.)							ALIGNED TO ELEMENT 'X' OF SYSTEMS MODEL (and strength of opinion recorded by the participant.)						
			A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G
GLASGOW	UCS1-74-6	Q1			4	3					4									2						4	3							4			
GLASGOW	UCS1-12-1	Q2	3			4							4				2		3					4		4						4	4				
GLASGOW	UCS1-5-12	Q3	3			4							4				1							5			4						4			
BRASS FOUNDRY	DSCF3510	Q4	4					3		4			4				4											5	5			4		3			
GLASGOW	UCS1-61-2	Q5		5	4						5							3							4				-				4			
GLASGOW	UCS1-5-11	Q6			5			4			5	4									4					4			5				4		3	
GLASGOW	UCS1-59-1	Q7		4				3			5				3			3							4				5						5	
GLASGOW	UCS1-65-3	Q8		4				3			5							3							5				4				4		4	
NATIONAL ARCHIVE	ADM1-8425-297	Q9			4			3				5							4							5			4				3	3		
GLASGOW	UCS1-36-9	Q10		3				5			5				5							3				4			5						4	
GLASGOW	UCS1-64-1a	Q11							✓																					✓							✓
BRASS FOUNDRY	DSCF3426	Q12		4	5							4						3		2					5	5								4			
BRASS FOUNDRY	DSCF3595	Q13					4	3		4			4							1								5	5								
GLASGOW	UCS1-64-1b	Q14			5			3					4		4					-							4	3						4		
BRASS FOUNDRY	DSCF3575	Q15			3			4					4									3			4	5								3		
BRASS FOUNDRY	DSCF3539	Q16			4	3						5	5								2					5	5							4		



APPENDIX 6.8 –
SUMMARY OF ESSENCE OF PROJECT MANAGEMENT RESULTS OBTAINED FROM THE MAIN STUDY

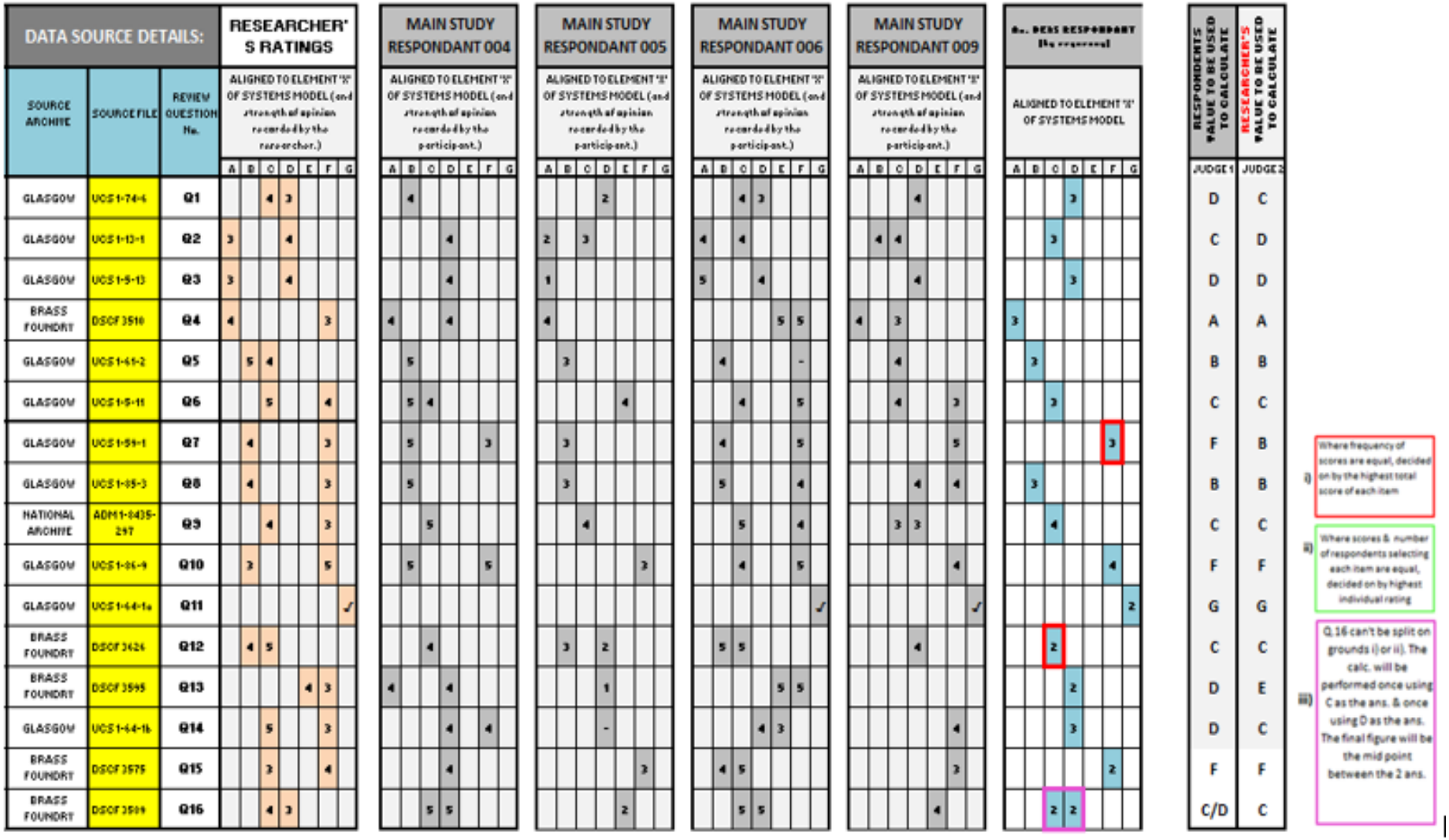
DATA SOURCE DETAILS:			ESSENCE OF PM – DE&S SCORES (RESPONDENT 004)																																	
SOURCE ARCHIVE	SOURCE FILE	Presentation Question number	1	S	2	S	3	S	4	S	5	S	6	S	7	S	8	S	9	S	10	S	11	S	12	S	13	S	14	S	15	S	16	S	17	S	18	S
GLASGOW	UCS 1-74-6	Q1							✓	2	✓	3																								
GLASGOW	UCS 1-13-1	Q2	✓	3									✓	4																						
GLASGOW	UCS 1-5-13	Q3	✓	3									✓	4																						
BRASS FOUNDRY	DSCF 3510	Q4																											✓	5						
GLASGOW	UCS 1-61-2	Q5							✓	4	✓	4	✓	4	✓	2	✓	4													✓	2				
GLASGOW	UCS 1-5-11	Q6							✓	5			✓	5																	✓	2	✓	3	✓	2	✓	3
GLASGOW	UCS 1-59-1	Q7	✓	4			✓	3					✓	5					✓	5																
GLASGOW	UCS 1-85-3	Q8	✓	4					✓	5	✓	4	✓	4																						
NATIONAL ARCHIVE	ADM 1-8435-237	Q9							✓	4			✓	5																						
GLASGOW	UCS 1-86-9	Q10											✓	5							✓	3							✓	4					✓	2		
GLASGOW	UCS 1-64-1a	Q11																																		
BRASS FOUNDRY	DSCF 3626	Q12									✓	4																								
BRASS FOUNDRY	DSCF 3595	Q13																																		
GLASGOW	UCS 1-64-1b	Q14																											✓	5						
BRASS FOUNDRY	DSCF 3575	Q15									✓	4					✓	5																		
BRASS FOUNDRY	DSCF 3589	Q16																											✓	5						

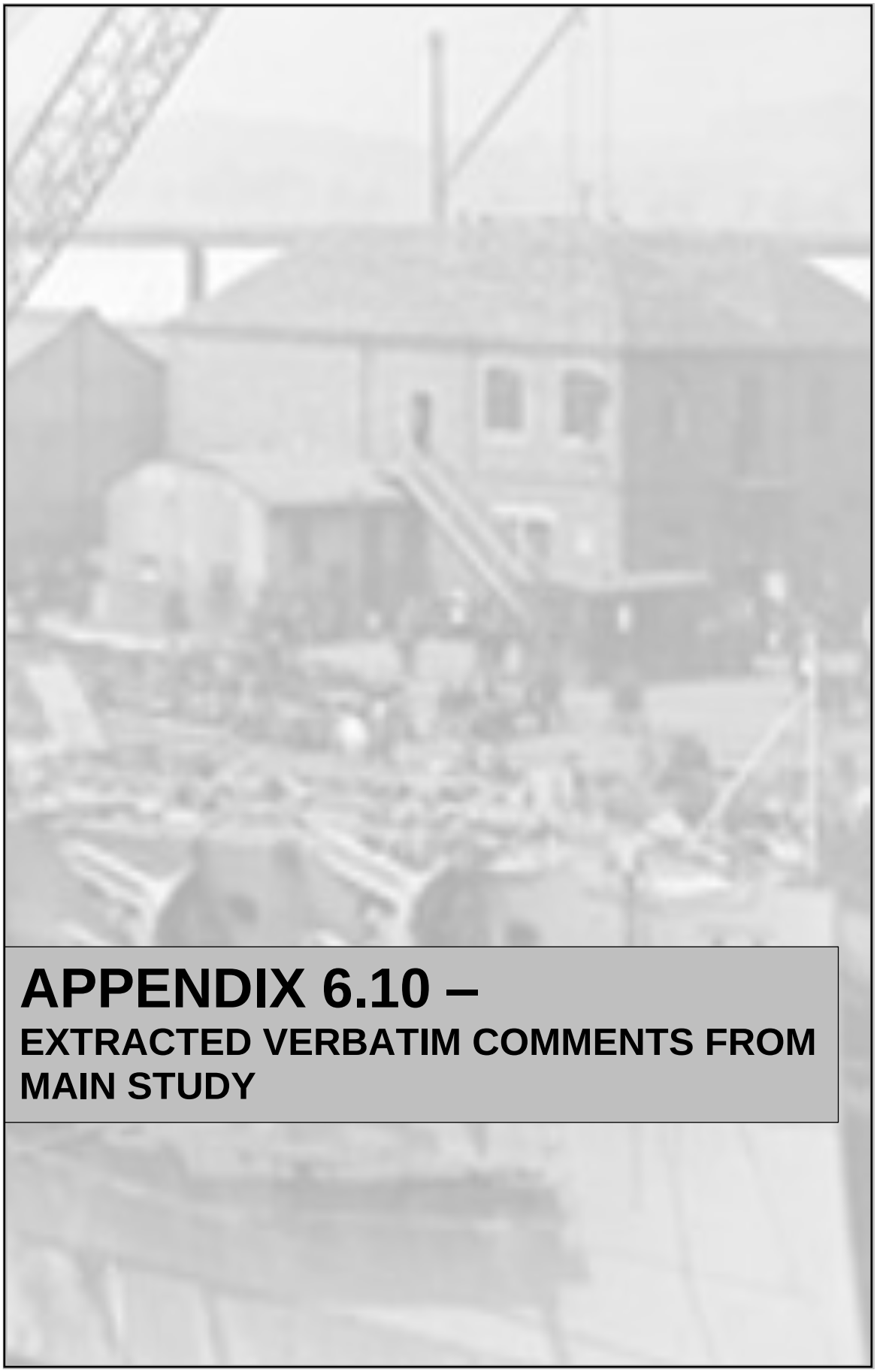
DATA SOURCE DETAILS:			ESSENCE OF PM - DE&S SCORES **(RESPONDENT 005)**																															
SOURCE ARCHIVE	SOURCE FILE	Presentation Question number	1	S	2	S	3	S	4	S	5	S	6	S	7	S	8	S	9	S	10	S	11	S	12	S	13	S	14	S	15	S	16	S	17	S	18	S
GLASGOW	UCS 1-74-6	**Q1**	✓	1																											✓	1				
GLASGOW	UCS 1-13-1	**Q2**							✓	1			✓	2													✓	4								
GLASGOW	UCS 1-5-13	**Q3**									✓	1																								
BRASS FOUNDRY	DSCF 3510	**Q4**							✓	2			✓	2															✓	2						
GLASGOW	UCS 1-61-2	**Q5**	✓	2			✓	1	✓	2	✓	1	✓	1	✓	1																				
GLASGOW	UCS 1-5-11	**Q6**									✓	1																					✓	1		
GLASGOW	UCS 1-59-1	**Q7**	✓	3					✓	1	✓	2			✓	2			✓	3	✓	4														
GLASGOW	UCS 1-85-3	**Q8**	✓	3					✓	2									✓	1	✓	2														
NATIONAL ARCHIVE	ADM 1-8435-297	**Q9**	✓	2			✓	2	✓	2			✓	3			✓	2																		
GLASGOW	UCS 1-86-9	**Q10**																																		
GLASGOW	UCS 1-64-1a	**Q11**																																		
BRASS FOUNDRY	DSCF 3626	**Q12**									✓	3																								
BRASS FOUNDRY	DSCF 3595	**Q13**																																		
GLASGOW	UCS 1-64-1b	**Q14**	✓	2							✓	1																	✓	4						
BRASS FOUNDRY	DSCF 3575	**Q15**							✓	3	✓	3																	✓	2	✓	3				
BRASS FOUNDRY	DSCF 3589	**Q16**	✓	2							✓	1																	✓	4					✓	1

DATA SOURCE DETAILS:			ESSENCE OF PM - DE&S SCORES **(RESPONDENT 006)**																																			
SOURCE ARCHIVE	SOURCE FILE	Presentation Question number	1	S	2	S	3	S	4	S	5	S	6	S	7	S	8	S	9	S	10	S	11	S	12	S	13	S	14	S	15	S	16	S	17	S	18	S
GLASGOW	UCS 1-74-6	Q1	✓	4					✓	3			✓	4															✓	2	✓	3	✓	4	✓	3	✓	2
GLASGOW	UCS 1-13-1	Q2	✓	3					✓	4			✓	4											✓	3	✓	3			✓	4					✓	4
GLASGOW	UCS 1-5-13	Q3									✓	3	✓	3																					✓	4	✓	4
BRASS FOUNDRY	DSCF 3510	Q4	✓	3	✓	4					✓	4	✓	4																								
GLASGOW	UCS 1-61-2	Q5	✓	4					✓	4			✓	3																								
GLASGOW	UCS 1-5-11	Q6			✓	4							✓	4	✓	3																						
GLASGOW	UCS 1-59-1	Q7	✓	3					✓	4	✓	3	✓	4	✓	4																						
GLASGOW	UCS 1-85-3	Q8											✓	4	✓	4											✓	4										
NATIONAL ARCHIVE	ADM 1-8435-297	Q9	✓	4			✓	5	✓	3	✓	4	✓	5																	✓	4						
GLASGOW	UCS 1-86-9	Q10	✓	5	✓	4					✓	4	✓	3	✓	5															✓	4	✓	4				
GLASGOW	UCS 1-64-1a	Q11																																				
BRASS FOUNDRY	DSCF 3626	Q12									✓	3									✓	3					✓	5										
BRASS FOUNDRY	DSCF 3595	Q13																																				
GLASGOW	UCS 1-64-1b	Q14			✓	3					✓	4			✓	3					✓	3					✓	4	✓	5			✓	2			✓	4
BRASS FOUNDRY	DSCF 3575	Q15									✓	5			✓	4					✓	3			✓	2	✓	4	✓	5	✓	3						
BRASS FOUNDRY	DSCF 3589	Q16	✓	4							✓	3			✓	3	✓	2									✓	5	✓	5	✓	3					✓	4

DATA SOURCE DETAILS:			ESSENCE OF PM - DE&S SCORES **(RESPONDENT 009)**																															
SOURCE ARCHIVE	SOURCE FILE	Presentation Question number	1	S	2	S	3	S	4	S	5	S	6	S	7	S	8	S	9	S	10	S	11	S	12	S	13	S	14	S	15	S	16	S	17	S	18	S
GLASGOW	UCS 1-74-6	Q1	✓	4			✓	4																												
GLASGOW	UCS 1-13-1	Q2	✓	2			✓	3																												
GLASGOW	UCS 1-5-13	Q3	✓	3																																
BRASS FOUNDRY	DSCF 3510	Q4	✓	4																							✓	5								
GLASGOW	UCS 1-61-2	Q5	✓	4									✓	4																						
GLASGOW	UCS 1-5-11	Q6			✓	4									✓	5																				
GLASGOW	UCS 1-59-1	Q7							✓	4					✓	3					✓	4														
GLASGOW	UCS 1-85-3	Q8					✓	3													✓	3				✓	3								
NATIONAL ARCHIVE	ADM 1-8435-297	Q9							✓	4																	✓	4								
GLASGOW	UCS 1-86-9	Q10	✓	3			✓	3							✓	2																				
GLASGOW	UCS 1-64-1a	Q11																																		
BRASS FOUNDRY	DSCF 3626	Q12									✓	4																								
BRASS FOUNDRY	DSCF 3595	Q13																																		
GLASGOW	UCS 1-64-1b	Q14																									✓	4								
BRASS FOUNDRY	DSCF 3575	Q15									✓	3			✓	4											✓	4								
BRASS FOUNDRY	DSCF 3589	Q16	✓	3																							✓	4								

APPENDIX 6.9 –
TABULATION OF VALUES FOR SYSTEMS MODEL RESULTS USED RE COHEN'S KAPPA


DATA SOURCE DETAILS:
RESEARCHER'S RATINGS
MAIN STUDY RESPONDANT 004
MAIN STUDY RESPONDANT 005
MAIN STUDY RESPONDANT 006
MAIN STUDY RESPONDANT 009
SOURCE ARCHIVE
SOURCE FILE
REVIEW QUESTION No.
ALIGNED TO ELEMENT "X" OF SYSTEMS MODEL (and strength of opinion recorded by the researcher.)
ALIGNED TO ELEMENT "X" OF SYSTEMS MODEL (and strength of opinion recorded by the participant.)
A B C D E F G
GLASGOW UCS1-74-6 Q1
GLASGOW UCS1-13-1 Q2
GLASGOW UCS1-5-13 Q3
BRASS FOUNDRY DSCF 3510 Q4
GLASGOW UCS1-61-2 Q5
GLASGOW UCS1-5-11 Q6
GLASGOW UCS1-59-1 Q7
GLASGOW UCS1-85-3 Q8
NATIONAL ARCHIVE ADM1-8435-297 Q9
GLASGOW UCS1-86-9 Q10
GLASGOW UCS1-64-1a Q11
BRASS FOUNDRY DSCF 3626 Q12
BRASS FOUNDRY DSCF 3595 Q13
GLASGOW UCS1-64-1b Q14
BRASS FOUNDRY DSCF 3575 Q15
BRASS FOUNDRY DSCF 3509 Q16
RESPONDENTS VALUE TO BE USED TO CALCULATE
RESEARCHER'S VALUE TO BE USED TO CALCULATE
JUDGE 1
JUDGE 2
D C
C D
D D
A A
B B
C C
F B
B B
C C
F F
G G
C C
D E
D C
F F
C/D C
i) Where frequency of scores are equal, decided on by the highest total score of each item
ii) Where scores & number of respondents selecting each item are equal, decided on by highest individual rating
iii) Q.16 can't be split on grounds i) or ii). The calc. will be performed once using C as the ans. & once using D as the ans. The final figure will be the mid point between the 2 ans.



APPENDIX 6.10 –
EXTRACTED VERBATIM COMMENTS FROM MAIN STUDY

1st SET OF COMMENTS RE: QUESTION 2 (Please explain your thinking behind your answer(s) to Q1.)

REVIEW QUESTION No.	FILE REFERENCE	RESPONDENT 004	RESPONDENT 005	RESPONDENT 006	RESPONDENT 009
1	UCS 1-74-6	This is an early, high level estimate that pulls in past performance information, known costs and potentially historic (norms) for hull, engineering etc.	Appears to be an initial breakdown of costs but difficult to determine any true linkage to a project concept except for initial cost estimate linked to previous build of another ship therefore an element of learning from experience.	This is base estimates-setting expected budget and expectations. Decisions would be based on that accordingly and monitored against.	The slide shows evidence of costing for the build of building a ship using previous figures from historic builds.

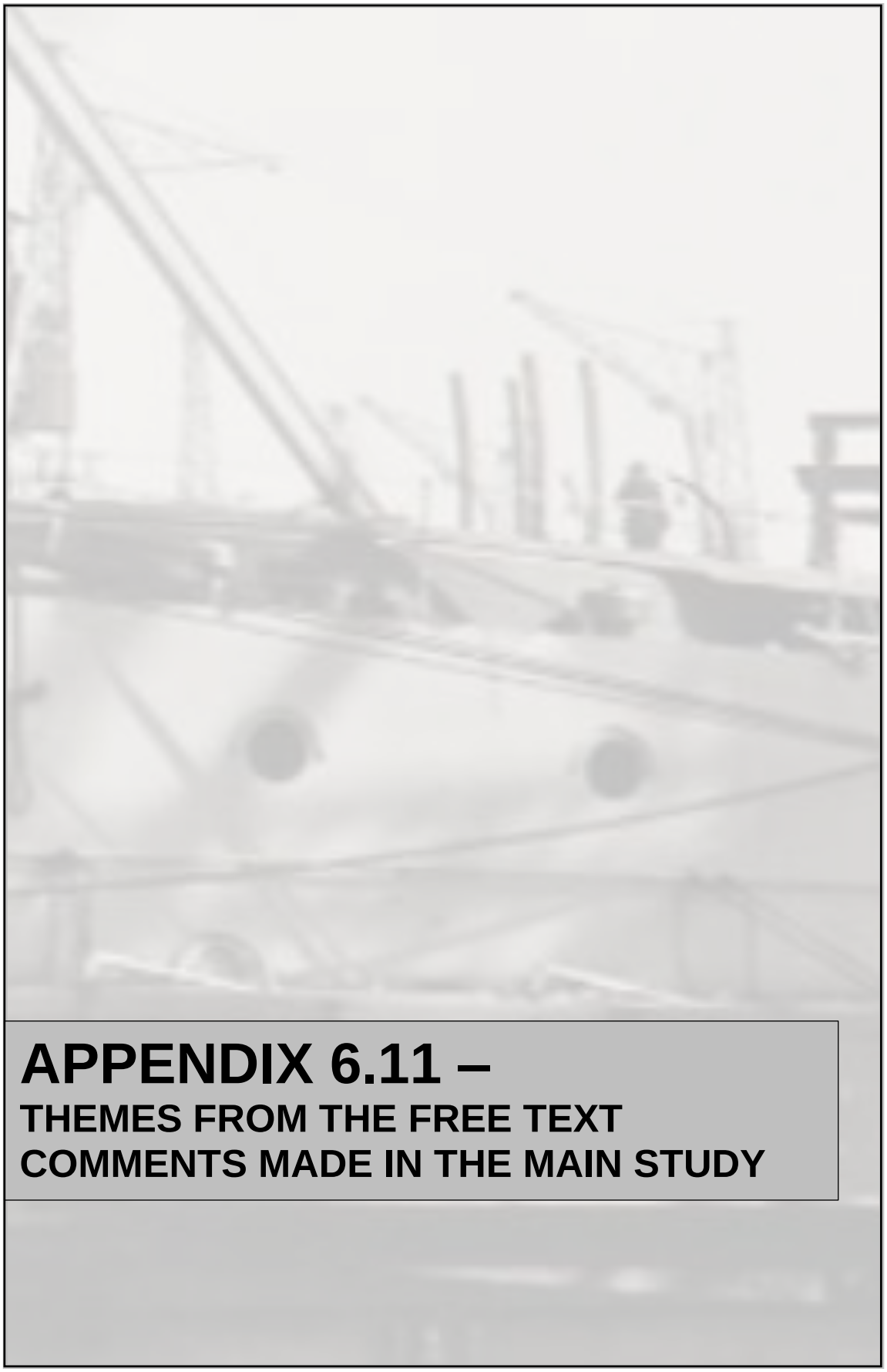
2	UCS 1-13-1	Assuming that the letter is responding to a 'specification' / Tender request then this response is informing a requirement that was set by the 'Wider System' in this case the Admiralty.	The document provides an initial overview of performance in terms of what the output will achieve. An element of design is covered and appreciation of what the solution will provide.	This is a response to Tender. They're offering a potential solution which is as Industry do today. Limited detail but enough to set expectations. Costings would then feed their forecasts.	The tender response sets out the expectations of its deliverable to the project team, and the wider system, it defines exactly the performance output of the deliverables and provides 2 options. These options can then be used by the system to decide the option the project will select.
3	UCS 1-5-13	See UCS 1-13-1	There is an element of formulating an initial design in that there appears to be two options to down select from.	This is capturing requirement options – providing detail/ options on the design in order for the Admiralty to make a decision. A quotation received which would feed the costings, included expected profit.	The slide provides quotes for 2 options against the build, design A and B offering 2 or 3 shafts. Although there are prices which influence decisions there are no performance metrics to justify the extra costs.

4	Br/Fndry DSCF 3510	Valiant is the baseline. - This is a list of 'extras' now managed through Customer Led Change. - This assumes a Standardised Class of Ship which can be tailored by the Admiralty (Control) against an initial design.	Evidence of breakdown of components and uses LFE from previous Valiant build in terms of cost and requirements.	Changes to design. Reporting changes to initial Performance/ Quality.	The document seems to be capturing the design changes on HMS Barham. The information is then compared to a previous build HMS Valiant in a base-lining activity to set expectations of costs against the project.
5	UCS 1-61-2	This appears to be a costed breakdown by category that has been developed as part of a pricing schedule to determine cash-flow.	Appears to be some form of cash flow ledger but difficult to ascertain how this relates to an overall budget. There is some form of crude breakdown between hull and machinery.	Reporting payments against activities, in a given timeframe/ period.	Slide 1-61-2 appears to be a cashflow / milestone payment plan. This would be used to set expectations of cash flow within the project.

6	UCS 1-5-11	Identified movements, progress and capacity to undertake the work.	Planning by John Brown evidenced in the documents and scheduling.	-	-
7	UCS 1-59-1	This ledger is effectively the 'actuals' tab of the cost model. This is consistent with current practices within shipyards which go on to inform their productivity metrics and actual reporting.	Breakdown of time spent by each element of labour and therefore resource consumed. Assume an estimate would have developed that this was compared to.	Monitoring hours – Reporting of.	The document records the cost of resources used to build HMS Barham, captured on a weekly basis.
8	UCS 1-85-3	This is a cost model. It is consistent with current approaches – materials/ labour.	Fascinating breakdown of cost comparison between HMS Hood and the proposed to provide an analytical comparison.	-	The slide is showing they have used historic data to build on estimates of the current design, this would help to understand costs of the whole build and

					support on decision making/ cost cutting.
9	ADM 1/8435/297	Forecasted ship delivery schedule. Based on Admiralty requirement. Enables the Admiralty to plan their workforce / crew etc	Planned dates in a form of crude schedule.	-	The document looks to be a schedule of delivery of warships, this would help to support training requirements and planning other areas of resource planning/ spend.
10	UCS 1-86-9	Planned v. actual view. Conducted on a monthly basis. Extremely consistent with current processes within ship-building.	Fascinating depiction of cost v. estimate and description of any variance which would have been helpful.	-	-
11	UCS 1-64-1a	n/a	-	-	-
12	DSCF 3626	Letter essentially changes acceptance and contract terms as an instruction, compromising on quality	Decision making is linked to the need to get into service to meet deployment needs.	-	The decision has been made that the completion of the build must be completed at whatever cost (crashing with resource) due to

					the start of WWI which was driving the decision behind this.
13	DSCF3595	See DSCF 3510 Comparison of differences Could be extrapolated to view risk areas.	-	Same as DSCF 3510.	-
14	UCS 1-64-1b	Change Control Log	Change Control documentation	-	The document appears to be a change log, recording any additional cost incurred when building the ship.
15	DSCF 3575	Acceptance of product is a product of the Wider System.	Appears to be an acceptance document from the customer.	-	The form appears to be an acceptance document to support hand over of the ship, forming part of the Handover Close out procedure.
16	DSCF 3589	Change log and acceptance across the Class, this is a change log as a snapshot.	Acceptance of Contract change to the original requirements.	-	The document appears to be a Change log that tracks change from the original design that was signed off from the tender stage.



APPENDIX 6.11 –
THEMES FROM THE FREE TEXT COMMENTS MADE IN THE MAIN STUDY

VIEW QUESTION No.	FILE REFERENCE	RESPONDENT 004	RESPONDENT 005	RESPONDENT 006	RESPONDENT 009	THEMES
1	UCS 1-74-6	This is an early, high level estimate that pulls in past performance information, known costs and potentially historic (norms) for hull, engineering etc.	Appears to be an initial breakdown of costs but difficult to determine any true linkage to a project concept except for initial cost estimate linked to previous build of another ship therefore an element of learning from experience.	This is base estimates-setting expected budget and expectations. Decisions would be based on that accordingly and monitored against.	The slide shows evidence of costing for the build of building a ship using previous figures from historic builds.	COSTS COSTINGS BUDGETS
2	UCS 1-13-1	Assuming that the letter is responding to a 'specification' / Tender request then this response is informing a	The document provides an initial overview of performance in terms of what the output will achieve. An element of	This is a response to Tender. They're offering a potential solution which is as Industry do today. Limited detail but enough	The tender response sets out the expectations of its deliverable to the project team, and the wider system, it defines	SETTING EXPECTATIONS OUTPUTS

		requirement that was set by the 'Wider System' in this case the Admiralty.	design is covered and appreciation of what the solution will provide.	to set expectations. Costings would then feed their forecasts.	exactly the performance output of the deliverables and provides 2 options. These options can then be used by the system to decide the option the project will select.	SOLUTIONS TENDERING
3	UCS 1-5-13	See UCS 1-13-1	There is an element of formulating an initial design in that there appears to be two options to down select from.	This is capturing requirement options – providing detail/ options on the design in order for the Admiralty to make a decision. A quotation received which would feed the costings, included expected profit.	The slide provides quotes for 2 options against the build, design A and B offering 2 or 3 shafts. Although there are prices which influence decisions there are no performance metrics to justify the extra costs.	DESIGN OPTION ANALYSIS
4	Br/Fndry DSCF 3510	Valiant is the baseline. - This is a list of 'extras' now managed through	Evidence of breakdown of components and uses LFE from previous Valiant	Changes to design. Reporting changes to	The document seems to be capturing the design changes on HMS Barham.	

		Customer Led Change. - This assumes a Standardised Class of Ship which can be tailored by the Admiralty (Control) against an initial design.	build in terms of cost and requirements.	initial Performance/ Quality.	The information is then compared to a previous build HMS Valiant in a base-lining activity to set expectations of costs against the project.	LEARNING FROM EXPERIENCE DESIGN CHANGES BASE LINING
5	UCS 1-61-2	This appears to be a costed breakdown by category that has been developed as part of a pricing schedule to determine cash-flow.	Appears to be some form of cash flow ledger but difficult to ascertain how this relates to an overall budget. There is some form of crude breakdown between hull and machinery.	Reporting payments against activities, in a given timeframe/ period.	Slide 1-61-2 appears to be a cashflow / milestone payment plan. This would be used to set expectations of cash flow within the project.	CASH FLOW
6	UCS 1-5-11	Identified movements, progress and capacity to undertake the work.	Planning by John Brown evidenced in the documents and scheduling.	-	-	CAPACITY PLANNING PLANNING

7	UCS 1-59-1	This ledger is effectively the 'actuals' tab of the cost model. This is consistent with current practices within shipyards which go on to inform their productivity metrics and actual reporting.	Breakdown of time spent by each element of labour and therefore resource consumed. Assume an estimate would have developed that this was compared to.	Monitoring hours – Reporting of.	The document records the cost of resources used to build HMS Barham, captured on a weekly basis.	RESOURCES USED
8	UCS 1-85-3	This is a cost model. It is consistent with current approaches – materials/ labour.	Fascinating breakdown of cost comparison between HMS Hood and the proposed to provide an analytical comparison.	-	The slide is showing they have used historic data to build on estimates of the current design, this would help to understand costs of the whole build and support on decision making/ cost cutting.	COMPARATIVE ESTIMATING ANALYTICAL APPROACH

9	ADM 1/8435/297	Forecasted ship delivery schedule. Based on Admiralty requirement. Enables the Admiralty to plan their workforce / crew etc. [1]	Planned dates in a form of crude schedule.	-	The document looks to be a schedule of delivery of warships, this would help to support training requirements and planning other areas of resource planning/ spend.	DELIVERY SCHEDULING
10	UCS 1-86-9	Planned v. actual view. Conducted on a monthly basis. Extremely consistent with current processes within ship-building.	Fascinating depiction of cost v. estimate and description of any variance which would have been helpful.	-	-	MONITORING OF SPEND AGAINST ACTUAL OR ESTIMATE
11	UCS 1-64-1a	n/a	-	-	-	-

12	DSCF 3626	Letter essentially changes acceptance and contract terms as an instruction, compromising on quality	Decision making is linked to the need to get into service to meet deployment needs.	-	The decision has been made that the completion of the build must be completed at what ever cost (crashing with resource) due to the start of WWI which was driving the decision behind this.	DECISION MAKING RE TCQ
13	DSCF3595	See DSCF 3510 Comparison of differences Could be extrapolated to view risk areas.	-	Same as DSCF 3510.	-	LEARNING FROM EXPERIENCE DESIGN CHANGES BASE LINING
14	UCS 1-64-1b	Change Control Log	Change Control documentation	-	The document appears to be a change log,	

					recording any additional cost incurred when building the ship.	CHANGE CONTROL LOG
15	DSCF 3575	Acceptance of product is a product of the Wider System.	Appears to be an acceptance document from the customer.	-	The form appears to be an acceptance document to support hand over of the ship, forming part of the Handover Close out procedure.	ACCEPTANCE SIGN OFF
16	DSCF 3589	Change log and acceptance across the Class, this is a change log as a snapshot.	Acceptance of Contract change to the original requirements.	-	The document appears to be a Change log that tracks change from the original design that was signed off from the tender stage.	ACCEPTANCE OF CHANGES / LOG