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Full Paper

Mitigating Hospital Design and Delivery Failure: A Retrospective Auto-ethnography Study

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Abstract: There is an urgent need for further research in hospital design and delivery to understand the integrative, nuanced, and intricate nature of healthcare project delivery and design management. Historically, each new hospital programme has developed a new delivery model that takes a different approach to the management of design. However, this approach is not sustainable. Hospitals have significant complexity, which may be impacted by role changes and procurement methods that can result in significant errors, costly delays, and a lack of ability to learn from failure. A retrospective abductive, auto-ethnographic case study approach was taken in the examination of five major hospital projects of similar size and complexity reflecting five temporal periods. The examination was carried out by a project architect who subsequently became a construction design manager, spanning a career of over 30 years. This variant of action research involved a retrospective mode of abductive reasoning. An approach to hypothesis testing (using literature) is used to explain and theoretically frame historical practices. It was found that National delivery models (and their change over time) have had a significant influence on hospital project delivery , particularly on design and engineering systems integration. The role standards have played in design has also played a significant role, and, in part, may have constrained innovation and unduly increased cost. Recommendations are made for a new integrated healthcare delivery model that supports an approach to innovative design and construction of new hospitals responding to advanced clinical and technological approaches.

Keywords: Retrospective, autoethnography, integrated design and delivery

1. Introduction

The concept of integration in the design and construction of major hospitals in the UK is not new, but it has now been nearly 30 years since the last fully developed system of 'Nucleus' was phased out in England and Wales (Scotland adopted the standards but not the template). This rigid framework and template developed and controlled by the wider healthcare delivery system was replaced with over 50 major hospitals (throughout the UK) procured through the Private Finance Initiative and over 500 smaller schemes through the P21 and P22 Procurement Schemes. Following the setting up of individual NHS Trusts and allowing freedom of choice for patients, the former prescriptive briefs were abandoned and trusts were able to set their own project briefs. These briefs could be in the form of schedules of accommodation, or they could be written in terms of output specifications, where the designers, with the aid of healthcare planners, could prepare their own schedules. This latter method was seen as an opportunity for creating innovation. At the same time, the rigid template had outlived its ability to accommodate new models of care and advances in technology.

Not only did the wider delivery system change its approach to hospital design, but it also changed the methods of procurement, introducing contractor led design and build with the aim of achieving cost certainty with what was considered a more 'integrated approach' only a single contract between client and contractor. Now, after 30 years, this model is again under review.

This paper looks at five major hospital projects, four of them having been completed and the fifth under construction, to ascertain the level of integration achieved and how design management has developed within both the wider delivery and project delivery systems. All of the case studies deliver secondary and tertiary care, acute facilities such as emergency departments, and are associated with university medical and nursing education. Design management is researched as to how it can integrate the diverse activities that contribute to the design and construction of these hospitals. Figure 1 sets out the developments and relationships over the five temporal periods.

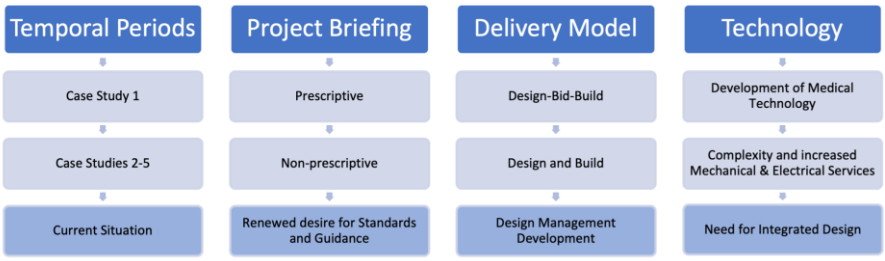


Figure 1. Development through Temporal Periods

2. Theories and Methods

2.1 Design Management

There are different definitions of design management in terms of when it occurs during the project cycle and the roles and responsibilities involved. Enyon (2013) defines design management in three project stages:

- Pre-project: defined as 'Project Definition';
- Project: defined as 'Project Procurement' and 'Project Delivery'; and
- Post-project: defined as 'Project Operation'.

The design management roles are defined according to the project stages as:

- Strategic Front-End Design Manager during the pre-project phase;
- Preconstruction Design Manager during procurement;
- Delivery Design Manager (site based) during project delivery; and
- Strategic Back-End Design Manager post project/ project operation.

Although these stages correspond roughly with the RIBA Plans of Works (1964, 1976, 2007, 2013, and 2020), the descriptions align with design and build procurement rather than the traditional route of the RIBA – design-bid-build. In identifying the different design management roles, Enyon (2013) suggests that strategic design managers could possibly be consultants to the client and that the preconstruction design manager could be either a member of the construction company or the lead designer, with the delivery design manager being a member of the site team. Hillebrandt (1984) recognised that in many large construction firms, the role of project manageror project director is carried out by civil engineers. While they are fully engaged on engineering projects, on building projects, once the frame has been completed their involvement ceases.

Emmitt (2007 and 2014) looks at a different role of the design manager, one that relates to design quality within the architects' office, where "the design manager is employed to oversee (manage) all design activity within the office and ensure a consistent and coordinated approach to every project in the project portfolio". (p.9). The creation of this role is to allow the design architect to concentrate on creating and developing

the design with the engineers by reducing unnecessary administration and the burden of office management. The role exists in many architectural offices but is given different titles; on some large projects this role is designated as 'project manager'. In this model, the Design Manager is the link between the architectural team and the contractor's 'Construction Design Manager'. Emmitt develops this further in Den Otter and Emmitt (2007), Emmitt (2010, 2011 and 2016), and Emmitt and Ruikar (2013).

2.2 Integrated Design and Open Building Theory

Integrated design, as developed by Louis Khan, Giurgola and Mehta (1976), was seen as a turning point in defining the separate engineering systems and demonstrating how they needed to be integrated. In 1971, Sir Alex Gordon, RIBA President, coined the phrase 'Long life, loose fit, low energy'. Brand (1994) looked at the stages in a building's lifespan, and Habraken (2000 and 2008) introduced 'Open Building Concept', all of which led towards a structured or systems approach to design. Jones (2008) identifies an important factor in healthcare construction as the ability of the infrastructure to support the use of support technology. He recognises that changes are likely to be required during the building programme and suggests:

- Building unfinished or shelled space in strategic locations or entire floors in a building tower to provide room for expansion in service areas where growth is expected;
- Designing and building acuity-adaptable patient rooms that are easily converted from standard medical/surgical rooms to critical-care rooms; and
- Building additional capacity into the system infrastructure.

The open building concept is developed by Kendall (2007), who concludes there is little systematic research carried out and lessons learned, resulting in comments such as "we should design column-free spaces, make floor to floor heights greater, and don't bury pipes in concrete". These are comments that we still hear today. Kendall and Ando (2011)and Kendall (2015 and 2019) conclude that open building outlines systems separation where the different levels of construction and fit-out can allow for flexibility and future proofing, describing healthcare architecture as infrastructure. Astley et al (2015), Olsson and Hansen (2010), and Hansen and Olsson (2011) continue with the theme of flexibility, linking it with lean thinking and a layered approach. They highlight the difference between the design stages and construction in terms of lean thinking and how, by adopting a layered approach, this not only aids flexibility but can embrace lean thinking into the design. Hansen and Olsson (2011) describe the three levels as:

- The Primary System: Fixed: building frame designed to last 100 years, which can accommodate different hospital departments;
- The Secondary System: Adaptable: internal fit-out in terms of partitions, services designed to function for a maximum of 20 years; and
- The Tertiary System: Flexible: room focused, fixtures and fittings and interior design with a useful life of 5-10 years.

The Netherlands Board for Healthcare Institutions (2007) Layers Approach to Building separates the building functions into four categories:

- Hot Floor: high-tech, capital-intensive functions specific to hospitals;
- Hotel Accommodation: patient accommodation, nursing care;
- Office: outpatient consultation, offices, staff accommodation, management activities; and
- Industry: all medical supporting and facilitating functions.

Caixeta and Fabricio (2012), who focus on reconfiguration of healthcare projects, and Mills et al. (2015) demonstrate the difficulties in trying to apply standardisation in

contrast to Montgomery (2007), who defended the Nucleus capability to be flexible. Fawcett (2011), referring to the "Duffle Coat Theory" Llewelyn-Davies Weeks et al. (1973) conclude there is no evidence that confirms that modular room sizes lead to flexibility and activity-space tolerance.

2.3 Delivery Models and Systems Integration

Cacciatori and Jacobides (2005) describe the recent changes in the British Construction Industry as going from vertical specialisation to vertical reintegration. This is due to the introduction of the Private Finance Initiative with the use of design and build contracts and the perception of a single systems integrator, as described by Smyth and Edkins (2006), Barlow and Koberle-Gaiser (2008). Several papers are also written about major and complex projects, including Davies et al. (2009), Davies and Mackenzie (2014), and Davies and Brady (2016). The focus is on infrastructure rather than healthcare projects, which have a much higher percentage of mechanical and electrical services. By contract, Lightig (2005), Chambers (2010), Lostuvali et al. (2014), and Mesa et al (2016) concentrate on the delivery of healthcare projects using Integrated Project Delivery (IPD) using the American Institute of Architects (AIA) form of contract (2007), where the architect, contractor, and client adopt a tripartite agreement. Jorgensen and Emmitt (2008) also discuss lean construction.

2.4 Methodology

The research methodology used was retrospective autoethnography for case studies one to four and a form of action research for case study five. Autoethnography is a research method that uses personal experience to describe and interpret cultural texts, experiences, beliefs, and practices (Adams et al., 2017). Anderson (2006), in response to Hayano (1979), addresses some of the paradigmatic problems associated with group relationships, the role of the researcher, and their level of subject matter knowledge and issues of subjectivity by setting out five key features in what he describes as "Analytical Autoethnography".

- Complete member researcher
- Analytical reflexivity
- Narrative visibility of the researcher's self
- Dialogue with informants beyond the self
- Commitment to theoretical analysis

Giorgio (2013) looks at memory, the re-living and re-imaging of what happened, in a form of storytelling using a short story method, something that I have adopted in my "ramblings". She defines autoethnography as, question "How do you begin to write autoethnography?", to which she replies, "By closing your eyes and remembering". Jarzabkowski et al. (2014) examine various techniques for presenting ethnographic evidence, with particular reference to vignettes built up through rich storytelling.

This variant of action research involved a retrospective mode of abductive reasoning. It occurred in the context of ontological, conceptual, and theoretical assumptions, where the researcher does not start with a blank slate. But rather, it involves abductive reasoning applied retrospectively making a hypothesis (from literature) that appears to explain what has been observed (in practice); it is observing some phenomenon and then iteratively claiming what it was that gave rise to it (based on literature and theoretical framing). Auto-interviewing was used as a technique for recording one's own views, as defined by Boufoy-Bastick (2004), used in conjunction with autoethnography. It was used to extract and recall retrospective case study data. The process involves creating a narrative of the project history and then identifying critical incidents and significant developments. It allowed for the analysis of critical incidents that show implemented changes in action that are later evaluated for their impact (Greenwood & Levin, 2007; Susman & Evered, 1978).

2.5 Study Methods

The study method analysed five case studies,Yin (2014) creating data from narratives or 'ramblings', the term used to set down my recollections of the projects. They were narratives from which data could be collected. For each of these narratives, critical incidents (events that required immediate action to prevent serious consequences for the project (Flanagan, 1954)) and instances of positive integration were identified. As critical implies a serious or negative bias, the use of positive integration enabled a more balanced approach for 'lessons learnt', as if something works well, it is not recorded for future adoption. These incidents were tabulated using temporal bracketing (Langley, 1999) in five project stages:

1. Pre-Design
2. Concept Design
3. Design Development
4. Works Package Design
5. Design in Construction

A different form of analysis was developed for Case Study 5 based on Ferrance's (2000) six-stage action research model for use in education adapted for construction. As part of the 'rescue plan', the existing design had to be validated and a due diligence exercise carried out before construction work could recommence with a new design and build contractor. The six stages therefore reflect the stages carried out in Case Study 5, as in Table 1, where the data is interpreted differently rather than additional data collected.

Table 1: Ferrance's Model Adapted for Case Study 5

Stage	Design	Construction
Identify	Areas of design requiring validation	Compliance of construction works
Gather Data	Desk top design study	Survey existing construction works
Interpret Data	Due diligence exercise	Analyse survey results
Act on Evidence	Make proposals to the Client	Estimate time and cost to rectify
Evaluate Results	Agreement on how to proceed	Agree time and cost
Next Steps	Proceed with validated design	Recommence construction

These critical incidents and positive integration instances were then tabulated according to type, e.g., mechanical and electrical services, who caused them, who resolved them, and whether they recurred. These findings were then reviewed with literature and grey literature (post occupancy studies, mini case studies, and a revue of the Nucleus Hospital System).

The five case studies resulted in five temporal periods, which I defined as shown in Table 2 below.

Table 2: Temporal Periods

Temporal Period		Reference	National Delivery Model
Prescriptive Integration	1975-1993	Case Study 1	Nucleus/Design-Bid-Build
Dysfunctional Integration	1993-2001	Case Study 2	First Wave PFI/Design and Build
Adaptive Integration 1	2001-2006	Case Study 3	Second Wave PFI/Design and Build
Adaptive Integration 2	2007-2012	Case Study 4	Third Wave PFI/Design and Build
Disintegration	2013-2020	Case Study 5	PF2 / Design and Build

3. Results

The key findings from the study are set out in terms of issues relating to the temporal periods and a summary of the critical incidents.

3. 1. Temporal Periods

The outcomes are set out in Table 3

Table 3: Outcomes from Temporal Periods

Temporal Period	Positives	Negatives
1.	Understanding roles and responsibilities Underpinning of professional qualifications Support from central government Standards and guidance	Rigidity of the Nucleus Template Lack of stakeholder engagement Designers did not need to understand user requirements (England and Wales)
2.	Enablement of major hospital schemes (PFI) Trusts are able to prepare their own briefs Contractors are able to introduce innovation (construction techniques)	Architects lacked knowledge of healthcare design (England and Wales) Steep learning curve for contractors Quality control transferred to the contractor Move from professionalism to commercialism
3.	Contractors recognise the need for design management	Department of Health began to reduce investment and support for standards and guidance. Architects losing skills in client engagement and construction detailing due to lack of site inspection

4.	Trusts begin to realise the importance of standards and guidance in formulating the Trust Core Requirements (TCRs)	Further reduction in healthcare research
5.		Department of Health ceases to update standards and guidance Failures start to appear: 1. Wall collapse at Edinburgh Schools PFI 2. Fire at Grenfell Tower 3. Collapse of Carillion during two major hospital PFIs

3.2. Critical Incidents:

The analysis of the critical incidents highlighted a number of re-occurring themes relating to:

- The integration of mechanical and electrical services, with a particular problem relating to coordinated ceiling layouts
- The integration of the structure
- The integration of major medical equipment and new developments in hospital infrastructure, such as pneumatic tube systems
- The interpretation of roles and responsibilities of individuals and how they reacted
- The use of a structured approach to design and project compliance checking

Table 4 outlines the critical incidents for Case Studies 1-4.

Table 4: Critical Incidents in Case Studies

Activities	**Issues**	**Case Studies**			
		1	**2**	**3**	**4**
Client Engagement	Briefing	0	3	1	1
	Stakeholders	2	2	3	3
Design Integration	Layouts	0	1	2	1
	Structure	0	2	2	4
	M&E Services	2	3	2	0
	Ceilings	1	1	1	0
Design Information	Issue to contractor	1	0	0	2
	Quality	0	0	0	1
Programming	Activities	1	1	0	0
	Phasing	0	1	1	0
Equipment	Imaging	1	1	0	0
	Theatre Tables	1	0	0	0
	Medical Gas Pendants	0	1	1	1
Cost	Cost Control	1	0	1	0

Commercial	Procurement	0	2	0	2
Construction Works	Buildability	0	0	0	2
	Installation	0	2	3	0
Management	SPV/Contractor	0	0	0	2
	Totals	**10**	**20**	**17**	**19**
		.			

Design integration in Table 4 highlights how developing an integrated approach with the mechanical and electrical engineers and subcontractors (common to case studies 2, 3 and 4) led to the elimination of critical incidents in case study 4. In contrast, the close relationship between the main contractor, the structural engineer, and the steelwork subcontractor led to reoccurring issues with wind bracing in Case Study 4.

Table 5 shows how some of the critical incidents were translated into positive integration. Of the eight examples, six originated in Case Study 2 in Dysfunctional Integration and were adopted in Case Studies 3 and 4. It took until Case Study 4 to achieve the fully coordinated ceiling layouts (Item 7) and the integrated approach for major medical equipment (Item 8), developed during Case Study 3, being fully adopted in Case Study 4.

Table 5: Translation of Critical Incidents

Translation of Critical Incidents into Positive Integration through Lessons Learnt		
1.	Schedule of Accommodation	Standard format
2.	Checking Requirements	Departmental Reviews
3.	Information exchange	Electronic Data Management
4.	Building Control	On site presence
5.	Quality Control	Prefabricated Bathroom Pods
6.	Specialist Installations	Integrated packages (Aseptic Suites)
7.	Ceiling Layouts	Prepared by M&E Engineers
8.	Major Medical Equipment	Integrated approach

It was found that the national delivery models have had a significant influence on hospital project delivery and particularly systems integration by changing the method of procurement, transferring project control to individual trusts, allowing freedom of choice in relating to clinical functionality (self-derogation), and failing to maintain standards and guidance, or encouraging new research.

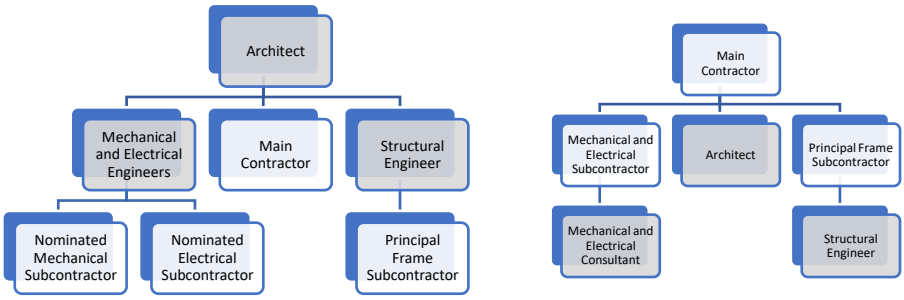
3.3 Summary

Results of the case study analysis can be summarised as follows:

- Healthcare design is unique in its complexity; it takes time to understand and assimilate all its requirements and communicate effectively with healthcare professionals.
- The wider system needs to support a framework of standards and guidance that keeps pace with innovation, new technology, and models of care.

- Design integration as design concept starts with integration of the structure and engineering services, which has the potential to develop into a layering system to deliver healthcare design.
- Design management is integral to all stages of the design process and involves several skill sets.
- When critical incidents arose, someone with a design background was required to solve them regardless of role or responsibility, suggesting that a systems integrator should be part of the design management team.
- The importance of teamwork and continuity of major players across the stages.
- Ensuring that the right people are involved at the right time and recognising individuals' skills and experiences.

The difference in team structures are visualised in Figure 2: from a design led team as in Case 1 to the contractor led team in Case Studies 2-5 separates the designers from the specialist subcontractors at an earlier stage and, without strong design management, fails to produce an integrated design as demonstrated in Case Study 5.



Case Study 1 Case Studies 2-5

Figure 2: Team Structures

4. Discussion

The findings from the case studies and literature review suggest that there is a need for design integration in both the wider delivery system to inform project delivery and within the project delivery system to create an integrated design management structure with defined roles and responsibilities that reflect the required capabilities.

The transfer from design,build to design and build in a short period of time failed to allow time for the development of design management and contract administration within the construction companies,which resulted in people being allocated roles in design management rather than being trained for the new roles or recruited from design disciplines, as demonstrated in the case studies. Design roles were created within construction companies at the preconstruction level but then transferred to site design management roles with the loss of continuity. Without a detailed transfer of project history, knowledge is lost, and a weak link is created. The preconstruction team, knowing that their involvement has ended, move on to the next project, and the site team is too busy planning the construction to make a detailed study of the project background. Similarly, at the end of the construction work, the site team is anxious to move on to the next project and fails to carry out project closure meetings related to 'lessons learnt'. The common link amongst these issues concerns design management and its ability to integrate with the different forms of contracts, where roles and responsibilities change according to the type adopted. The role of design manager varies considerably through the case studies, ranging from Senior Project Managers with backgrounds in civil engineering to junior engineers being assigned as design coordinators who actually carry

out design information management and then develop into design managers as a means of promotional status to my role as a Senior Design Manager .Whereas I was able to introduce design management skills that I had developed through my role as a Project /Site Architect and Supervising Officer in Case Study 1, the lack of design training and client engagement skills limits their ability to deliver integrated design management.

The transfer of risk from the client to the contractor, which is appealing to clients, is no longer seen as such by contractors due to the complexity, the requirement of specialist knowledge, and the lack of up-to-date standards and guidance. Understanding the integration of the mechanical and electrical design, with the structure in the spatial design before splitting into work packages, is essential. Case Study 5 demonstrates this lack of coordination: many of the standard room types are derogated; 'shelled space' has been built into the design, but once the building has been occupied, these areas are very difficult to access.

In relation to the individual case studies, the outcomes of Case Study 4 in Temporal Period 4 reflected a good example of lessons learnt relating to the importance of continuity and the concept of alliancing, resulting from many of the same team members being involved in both Case Study 3 and Case Study 4.

5. Conclusions

I have tried to defend why the design and construction of major hospitals is different from infrastructure projects and requires independent research by taking the view of Symons et al. (2016) that the structural and engineering services provide the infrastructure to support the hospital.

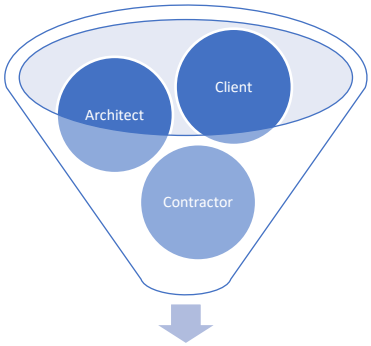
This longitudinal study has spanned a period of over 40 years and five temporal periods. It has demonstrated the cyclical nature of the construction industry and the fact that despite proposed reforms suggested by Latham (1994) and Egan (1998), there are major issues, particularly in relation to the building of major hospitals, including the collapse of a major contractor in Temporal Period 5, marking the demise of PFI. It signals the need for a review or 'deep dive'. It should not, however, replicate the situation at the end of Temporal Period 1, where both the wider delivery model and the form of contract were abandoned without analysis.

In relation to the wider delivery system, the need for greater direction and control by the Department of Health is apparent, as is the need for investment in research and development. Rather than creating a standard hospital, which will result in derogations, the softer approach taken in Scotland during the nucleus era, adopted standards and guidance without a rigid footprint, allowing greater flexibility. The failure to maintain standards and guidance is only partly to blame for the current situation. A form of contract that separates the designers from the client is also partially responsible.

Architectural projects involve both design and construction, but they are not like the car industry, where the prototype is designed and tested before going into mass production. The car designer is also an employee of the car company, unlike in construction, where design and construction are not integrated within one company. Effective integrated design management between the design team and the construction company can bridge this gap. Case Study 2 represented a huge learning curve for contractors trying to manage the design process.

The current design and build contracts have not proved any more successful than design, bid build in terms of design integration and have not reduced the acronymity between designers and contractors.

Consideration should be given to exploring different forms of contract, such as Integrated Project Delivery (IPD) (Figure 3), which has been successfully used in America on major hospital projects where the client, architect, and contractor are in a tripartite contract and share risk. This is also a leaner contract (AIA 2007), reducing the need for duplicate design teams.



Tripartite Contracts
Project Insurance and Cost Control

- Reduces adversity and blame culture
- Reduces 'duplication of consultancy advisors'
- Encourages staff integration between parties
- Introduces a 'Systems Integrator"
- Promotes GIRFT (Get it right first time)
- Agile – can accommodate dynamic briefing
- Supports Lean methods
- Easier adoption of off-site construction methods

Figure 3. Perceived Benefits from IPD

This study also confirms the value of using ethnographic and autoethnographic research in construction, particularly in relation to design management, an area previously not researched using these methods and not as a longitudinal study. It provides an opportunity for further research in relation to lessons learnt and knowledge transfer.

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