

Collaborative Design Management

Stephen Emmitt and Kirti Ruikar

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COLLABORATIVE DESIGN MANAGEMENT

The design process has always been central to construction, but recent years have seen its significance increase, and the ways of approaching it multiply. To an increasing degree, other stakeholders such as contractors have input at the design stage, and the designer's role includes tasks that were traditionally the realm of other professions.

This presents challenges as well as opportunities, and both are introduced, discussed, and analysed in *Collaborative Design Management*. Case studies from the likes of Arup, Buro Happold, VINCI Construction UK Limited, and the CIOB show how technologies (BIM, podcasting), innovative working (information management, collaboration), and the evolution of roles (the designer-contractor interface, environmental compliance) have changed design management as a process.

Starting from a basic level, the reader is introduced to the key themes and background to the design management role, including definitions of the responsibilities now commonly involved, and the strategic importance of design. Influential technologies currently in use are evaluated, and the importance they are likely to have in the future is explored.

This combination of case studies from leading practitioners, clear explanations of design management roles and activities, and an exploration of how to successfully achieve collaborative design management makes this a highly topical and uniquely valuable book. This is essential reading for professionals and students of all levels interested in construction design management, from all AEC backgrounds.

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INTRODUCTION

Since the turn of the century there has been a rapid increase in the number of design managers employed by contracting organisations in the UK. This trend has also been witnessed in many other countries around the globe as contractors seek to deliver better value to their customers and also respond to the challenge of constructing environmentally sustainable buildings. In responding to these and associated drivers, such as more stringent legislation, rapidly changing technologies, evolving procurement systems, and greater responsibility for design quality, many contracting organisations have recognised the value of design. In responding to a changing marketplace, contracting organisations have started to appreciate the impact of effective design management throughout the entire lifecycle of a project, resulting in increased efficiency and competitiveness, and hence better value for their patrons. In turn, this has brought about increased knowledge and understanding of the strategic power that design management brings to their businesses; with design management integral to the management of the project portfolio and the management of the organisation.

The collaborative and integrative nature of the design management role appears to fit very well in many contracting organisations as the constructors take on greater responsibility for individual design packages and with it the overall quality of building design. Working alongside project managers and construction managers, it is the construction design managers who take overall accountability for design quality; coordinating design information, reviewing designs and managing design changes. Addressing design value helps to promote leaner processes and realise greener buildings, resulting in less waste and better value for clients and building users. Managing design value also helps contracting organisations to improve their effectiveness, resulting in higher levels of profitability. Fundamental to unlocking the potential of good design is the ability to work collaboratively with a large number of disciplines and trades, and with a diverse range of organisations and individuals, in a temporal project coalition.

Desire for closer integration and better collaboration between the participants in construction projects has been helped and facilitated by developments in information technologies. Information communication technologies (ICTs) such as project extranets, intranets and mobile technologies allow project participants to communicate and share information much more easily than was

previously possible. Advances in software design have resulted in the development and use of building information modelling and building information management (BIM) packages. ICTs allow the development of building designs in a collaborative environment, helping to resolve common challenges such as the coordination and flow of information as well as identifying clash detection long before it could pose a problem on the construction site. Building information models allow the building to be constructed in a virtual environment, allowing designers and constructors to model the construction process to find the most effective, and safe, process for assembly and disassembly before moving into the physical act of building. Thus the building is 'built' twice, first virtually and then physically. Digital technologies are making a significant impact on the manner in which buildings are designed, constructed and maintained. Developments in ICTs and BIM also impacts on the day-to-day tasks of the construction design manager; an area that will quickly evolve as BIM is taken up more widely over the coming years.

Many of the individuals currently working as construction design managers have previously held positions as architects, architectural technologists, engineers and project managers, and now find themselves, through choice or circumstance, in a new and rapidly evolving role. Terms such as 'design manager', 'design integrator' or 'design coordinator' have become commonplace, although the exact nature of the role has not always been well defined or understood. Part of the confusion appears to stem from the wide interpretation and application of the role in industry; partly from the paucity of education and training programmes for aspiring design managers; and partly from the way in which the terms design management and design manager are used in separate fields of literature. Given that design management is an emergent discipline in the construction sector, a lack of clarity is to be expected as industry refines the role and academics try to make sense of a rapidly changing landscape.

Background to an evolving discipline

Although the construction design management role has been eluded to in literature going back to the 1960s, the emergence of the role in the UK construction sector appears to have occurred in the early 1990s as contractors adopted new procurement routes, and in doing so took greater responsibility for managing design. Contractors had previously employed 'resident architects' and 'resident engineers' to help review and coordinate design information and deal with design changes. As design and build started to increase in popularity from the 1980s onwards, the major contractors started to appreciate the need to manage design, rather than just coordinate design information. A report published by Reading University *The Successful Management of Design* (Gray et al., 1994), later developed into a book by Gray and Hughes (2001), helped to further emphasise the importance of design to the contracting fraternity. These developments coincided with increasingly complex construction projects, the growing need to coordinate information better and the desire of the specialists involved in construction projects to collaborate more effectively. Reports

published in the 1990s (e.g. Latham, 1994; Egan, 1998, 2002) questioned the ability of the construction sector as a whole to deliver value to the construction client (the customer), and by implication, society. Reflecting the sentiments of earlier publications – Phillips (1950) had emphasised the need for better collaboration, management and coordination; Emerson (1962) the need for better communication – these reports urged a change in attitude and culture – urging, amongst other things, more collaboration, closer integration of work, and leaner working methods. This was coincident with clients starting to seek better value from their projects and in doing so demanding more for less financial outlay, better (environmental) performance, and higher quality levels: all areas in which design has a significant role to play. Combined with research findings and associated articles in the professional trade press, the Latham and Egan reports brought about pressure to change, with the adoption of new forms of contract, new ways of working, and with it shifting roles and responsibilities. One of these changes was further growth of contractor led procurement and with it the development of the design manager role in the UK (Gray and Hughes, 2001; Bibby, 2003) and internationally (e.g. Grilo *et al.*, 2007; Beim and Jensen, 2007). As the number of design managers increased, the job function started to be recognised as something different from a project manager or a construction manager. In 2007, the construction design manager role was formally recognised by the Chartered Institute of Builders (CIOB). The majority of the large and medium-sized contractors now have some form of in-house design management or design coordination team. Similarly, the management consultants are offering design management services to their clients. The design management function has also spread to many large client organisations with significant property portfolios, such as the food retail sector, with design managers instrumental in site identification and design development.

Early application of design management by contractors appears to have been confined to the construction site, with construction design managers being responsible for coordinating information, addressing buildability issues, dealing with requests for information, and managing the impact and cost of design changes. In this role the construction design manager works closely with the project managers and the site-based construction managers. More recently the remit has expanded to include responsibilities for the management of design during the pre-contract phase, ranging from client briefing and managing various approval processes, through to the detailed design phase. Both functions are to be found on new build and refurbishment projects, illustrating the rapid evolution of the discipline into two distinct roles (and requiring different skills sets); a point explored in more detail in Chapter 4. In both jobs, the construction design manager remit will cover the management of architectural and structural design as well as mechanical and electrical services design. Including all design stages has been instrumental in helping some contracting organisations to offer a 'one stop shop' for their clients, and in doing so promoting the benefits of integrated design as a vehicle to improve the efficiency of projects and the performance of buildings.

Expansion of the design managers' remit has allowed contractors to address buildability issues earlier in the process and better integrate technologies to

improve the environmental performance of buildings. Architects have long recognised the benefits of getting the design correct and the information complete before construction work starts. Unfortunately, this message is not always communicated to the client and the contractor, with the result that there is considerable pressure to start the physical act of building before decisions and information is complete. This results in requests for information, requests for design changes and additional (one could argue unnecessary) work for the constructors. By managing the design in such a way that design decisions and information are complete it is possible to start on site with increased certainty and less risk. Constructors are also better able to coordinate the design and construction work, resulting in more efficient and less wasteful work. Thus collaborative design management should be viewed as a value-adding activity.

The constructors' thirst for construction design managers has led to innovations in education. An undergraduate programme designed entirely in response to the needs of contractors was started at Loughborough University in 2001. The BSc (Hons) Architectural Engineering and Design Management (AEDM) programme came about following interaction with major contractors and their request for a 'new' professional who was educated in design management. The result was an undergraduate programme that emphasises the value of design, integration and collaboration, which is underpinned by a sustainable design philosophy. The undergraduate programme at Loughborough University has proved to be very popular since its launch, with design management graduates joining major contracting organisations in the UK and overseas to work on complex and prestigious projects. Before the launch of the AEDM programme there were very few opportunities for individuals to gain education in construction design management. Now, a small number of institutions offer similar programmes at undergraduate level and increasingly at post-graduate level. Given that the numbers of design management graduates are still small in comparison to the established disciplines it is not surprising that confusion and misunderstanding about the discipline remain.

In many respects, it is the large and medium sized contractors that are setting the agenda for the construction design management field, with most research and teaching following industry application. However, many of the smaller contracting organisations are addressing design management in some form, although the role is not always explicit. Reviewing the small body of literature reveals inconsistencies in philosophy, theory and use of terminology; which are characteristics of an emergent discipline. These characteristics are mirrored in industry, with wide variations in interpretation, application and understanding of the design manager role by contracting organisations. Tzortzopoulos and Cooper (2007) have argued for improved clarity of the role so that different stakeholders can apply appropriate tools and methods to establish the most effective processes, and hence generate best value. However, there is still very little guidance currently available to students or practitioners studying and working with the construction design management field; an observation that led to this book.

Terms and responsibilities

Given the lack of clarity, it is necessary to define the term design management in the context of this book. To distinguish the role in construction from other fields, the term 'construction design manager' is used to signify an individual working as a design manager for a contracting organisation. Construction design managers will collaborate with many others during the life of a project, such as bid managers, estimators, contracts managers, construction managers, architects, engineers, manufacturers and specialist sub-contractors. The construction design manager's day-to-day tasks will overlap with others, most notably the project managers and the construction managers. The responsibilities of each (in simple terms) are:

- **Project management.** In the majority of contracting organisations, it is the project manager who has ultimate responsibility for the project. Typical performance criteria relate to completion of the project on time, to budget and to specified quality. Although design should feature strongly in the 'quality' criteria, it has not always been a major concern of project managers, the majority of whom are not educated in design, often leading to criticism of the design quality of finished projects.
- **Design management.** The construction design manager is responsible for all aspects of design, be it pre-contract or post-contract. Although the role encompasses many project management skills, a passion for design quality makes the role unique. It is the design manager who provides leadership in design.
- **Construction management.** Construction managers are concerned with realising the design safely and efficiently on the construction site. Their concern is with the effective management of resources, such as plant, people and materials. Their task is to translate the design, codified in drawings and specifications, into a physical artefact, thus their attention is on the accuracy and completeness of the information provided to them, not on the quality of design *per se*. Requests for design information and requests for design changes will be channelled through the construction design manager.

What do design managers manage?

Designers are paid to design; engineers to engineer. It is the design manager who is employed to oversee (manage) all design activity to ensure a consistent and coordinated approach to the project. This relieves the designers and engineers of unnecessary administrative and managerial burdens, so that they can concentrate on what they do best. If we ask ourselves what design managers manage, we come to a relatively simple answer, people and information:

- **People:** design as an activity involves interaction in the act of producing designs. This is carried out primarily within professional design offices and increasingly collaboratively through the use of collaborative information technologies. The output of the design process is design information.

- Information: design involves interaction to create, review and coordinate a vast quantity of information to prevent errors and to ensure accuracy. This information must be translated by constructors into a physical artefact. One of the design manager's most important tasks is to review information provided by architects, engineers and specialists to ensure that the building can be constructed safely and efficiently.

The process of designing and constructing a building comprises various 'threads' of inter-linking information, which vary in complexity and which evolve into new forms of information as the project progresses. The process of transformation from one information state to another is the result of a decision making process, driven by knowledge and information (Hicks *et al.*, 2002). Today's design and construction offices are awash with information systems that perform complex modelling tasks, which help to simulate effective design and build processes. Contained within these systems are complex threads of information, which collectively weave together the fabric of the building project. These threads contain information about the various building functions, such as its aesthetics, circulation, zones, services, safety, lifecycle costs, environment, operations and maintenance, etc. Thus, the challenge for the design manager is two-fold: first, a need to understand the project context and its information needs and second, to understand the systems within which the project knowledge is contained.

The recent developments in computer mediated 'single model' collaborative tools (e.g. BIM), combined with the UK government's mandate to use BIM on construction projects, has set a new trend for designing and developing building projects. This has added another dimension to the skills requirement: design managers need to possess knowledge of emerging technologies so that the processes of creating, manipulating, storing, sharing and using information resources are adequately supported. Managing these aspects requires impeccable coordination of information and processes, cooperation between team members and collaboration within the project portfolio. Thus design managers must stay informed of technological developments and renew their technical know-how so that the various design and construction processes are coordinated.

To be effective in the role, the construction design manager will also need to understand how designers and engineers work, and be able to communicate effectively across a broad spectrum of organisations and levels. This calls for a collaborative approach, excellent interpersonal ('soft') skills, and the ability to make informed decisions on a strategic and operational level.

- Strategic decision making. Strategic decisions are concerned with the long-term direction of a project or organisation. It is the strategic decisions that set the agenda for the effectiveness and profitability of each project. At a strategic level, the design manager will be working closely with the project manager to ensure project deliverables are met.
- Operational decision making. Operational decisions concern day-to-day problem solving in the workplace. Operational decisions are about getting

tasks completed and are concerned with the flow of resources (information, people and materials) and the adherence to processes. At the operational level, the design manager will be liaising with a wide range of designers and forming the interface between the designers and the constructors.

In the majority of contracting organisations a hierarchy is used for reporting and decision making, with construction design managers and construction managers reporting directly to the project manager.

Scope of the book

Motivation for writing this book comes from the authors' direct experience of teaching aspects of collaborative design management on the Architecture Engineering and Design Management (AEDM) BSc (Hons) at Loughborough University. This, together with feedback from graduate construction design managers working for major contracting organisations, highlighted the need for a balanced, clearly structured and informative book. A small number of books are available for architects and other design professionals, but there is very little that addresses design management from the contractors' perspective (Gray and Hughes, 2001 being a notable exception). Our aim is to provide an introduction to the field and also to provide clear guidance for readers studying to be, and working as, construction design managers. A number of case studies from industry are included to illustrate specific issues and recent developments in the design management role.

Chapters develop a logical narrative, with the first three chapters (Chapters 1–3) exploring collaborative working, the characteristics of design and design management respectively. In Chapter 4 we take a detailed look at the role of the construction design manager. This is followed by a chapter that deals with how we discuss design issues and how we review designs. In Chapters 6 and 7 we deal with collaborative technologies and building information modelling (BIM). This sets the scene for Chapter 8, in which strategies for collaborative working are addressed. In the final chapter (Chapter 9) we discuss the future role of the design manager in a digital, collaborative, arena.

We are conscious that the (construction) design management role is interpreted and applied differently among the contracting community in the UK and also internationally. Similarly, the interpretation and degree of collaborative working varies within organisations, within projects and within different countries. As such, our book should be seen as a primer, a source of information and inspiration, rather than one that tries to provide answers to complex and context specific challenges. We also hope the contents go some way to inform and inspire future generations of design managers in the AEC sector.

COLLABORATIVE WORKING

There is nothing particularly new about the concept of collaboration in construction, with master builders collaborating with workers and clients to realise their objectives long before the establishment of the building professions. Similarly, the concepts of collaboration and teamwork have featured within the literature for a long time. What have changed are the technologies available to designers and constructors as the digital revolution gathers pace. Now it is possible to collaborate in real time as easily with project collaborators geographically located the other side of the world as it is with those physically located in the same place. This, in theory at least, makes the task of designing a building much easier, although we need to remember that design is a social task and that the individuals contributing to the design process need to be able to work together effectively, i.e. they need to share some common values (Thyssen, 2011). In this chapter we introduce some of the main issues that underpin collaborative working.

Background

It was during the industrial revolution that some architects and designers made a strong argument for craft and collaboration. Phillip Webb, the pioneer of the Arts and Crafts movement and architects such as John Ruskin and William Morris promoted collaboration between architects and tradesmen, while Corbusier argued for closer collaboration between architects and engineers. The Bauhaus movement also pursued a collaborative ideal in its earlier years. In particular, Walter Gropius was devoted to the notion of collaboration between the fields of design and architecture eventually setting up the *Architects Collaborative* in 1945 (Gropius and Harkness, 1966).

In the UK, the design of buildings does not lie exclusively within the domain of the professional designers, such as the architects and design engineers. Although it may be desirable, one might argue essential, to engage the services of an architectural practice to design a building, many new and refurbishment projects are designed by others with varying degrees of design ability, or are 'borrowed' from standard building layouts. In the best examples, design is very much a collaborative activity, with project participants working together to try and realise the best possible solution for the client given the restraints of time, resources and budget.

A small number of government publications has been highly influential in bringing about greater awareness and subsequent attention to the importance of effective working. Two publications, *Trust and Money* (Latham, 1993) and *Constructing the Team* (Latham, 1994), were significant in raising awareness of teamwork, collaborative working and project partnering. These fundamental tenets of construction projects were subsequently reinforced in *Rethinking Construction* (Egan, 1998) and *Accelerating Change* (Egan, 2002). Combined, the Latham and Egan reports aimed to bring about a change in attitude from an adversarial and fragmented construction sector to one that is more trusting and better integrated. The publications express similar sentiments contained in earlier reports by Simon (1944), Phillips (1950) and Emmerson (1962), which also argued for better communication and more effective interaction between project participants. In many respects, the underlying message has not changed, but the context, technologies and the language have. The government reports have inspired many books, reports and articles that present a very positive argument for relational (interdisciplinary and collaborative) forms of working; examples being Baden Hellard's *Project Partnering: Principle and Practice* (1995) and *Trusting the Team* by Bennett and Jayes (1995). The message is that the AEC (architectural, engineering and construction) sector needs to move from 'segregated' teams to 'integrated' teams to improve performance.

Integration

The word integration is used to describe the intermixing of individuals, groups or teams who were previously segregated. Integration within temporary project organisations (TPOs) can occur on a number of different levels, from seeing the whole project process as an integrated one, to viewing the concept simply bringing together two separate work packages. The term 'integrated teams' has come into widespread use in the AEC sector, which although tautological, seems to be used to describe TPOs that are comparatively more integrated than might otherwise be the case. The majority of the literature promotes a highly positive view of integrated teams, while failing to acknowledge the inherent sociological and psychological challenges (see Emmitt, 2010).

Integrated design, supply and production processes are facilitated by cooperative interdisciplinary working arrangements. Integrated teams encompass the skills, knowledge and experiences of a wide range of specialists, often working together as a virtual team from different physical locations. Multidisciplinary teams may be formed for one project only, or formed to work on consecutive projects. Although there has been a move towards more collaborative working arrangements based on the philosophy of project partnering and strategic alliances, it is difficult to see evidence of real integration; instead there are pockets of collaborative work within and between projects.

Focusing on integrated processes is only part of the challenge. It is also necessary to look at the individuals involved with the project and look at how integrated their contribution is. How and when, for example, are the contractor and main sub-contractors involved in the early design phases? Are they an integral part of the design decision-making process or are they merely invited