

AI based Design Management and Architectural Practice

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Abstract

The increasing complexity of current design projects has fuelled the urgent need for an innovative management approach to design. This research paper aims to evaluate the effective tools and practices used in architectural firms in New Delhi for design management.

The design process is iterative, and analysis is frequently done through synthesis. The design managers operate in knowledge-intensive companies that cannot be governed only by the establishment of rules and processes. Design itself is a complex field, hence managing design becomes critical. Therefore, it also becomes critical for architectural firms to make robust strategies in place to manage the entire process to keep within the realistic scope, schedule, and time framework. The notional loss in terms of motivation to mitigate the design management practices. To keep in check, the architectural firms are oriented in design management practices in day to day working. There is a wide range of design management principles, we are currently focusing on majorly five components, namely, the Role of Design Managers in a firm, Design Communication, Design Coordination, Technology Integration and lastly the Future Prospects of design management.

Keywords: Design, Management, BIM, Architecture, Communication, Coordination

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I. INTRODUCTION

Design Management is necessary for developing processes and styles that can integrate into the core faculty of a business. Design management is an essential process that helps organizations effectively manage the design of products, services, and systems. Effective design management requires the integration of various aspects of design, such as aesthetics, functionality, user experience, and sustainability, to achieve desired outcomes. The duties assigned to design managers are always changing. The applied side was mostly focused on work inside the design division and other units, as well as on managing its design suppliers. Traditionally, design managers were limited to design conditioning relating to products and services. The way design is understood and used nowadays spans many different jobs across vibrant organizational units and departments. There's a growing demand for design management from industries outside of traditional commerce, similar to specialized consulting or strategic design approaches when tasked with creating human-centered, innovative, and sustainable value propositions. Design management is becoming less and less practiced outside of the design industry as well. Examples include marketing, product, brand, and invention operation. Understanding design management may assist create a sustainable future and make a significant difference in this area. The paper focuses on five major aspects of design management as key

parameters for evaluating firms. The scope of this paper discusses the present scenario of design managers and strategizes their positions in the industry through the mentioned parameters through surveys in architectural firms of Delhi and extensive literature study.

1.1 Role of Design Managers

The first aspect is the role of design managers in a firm and their responsibilities, these include establishing appropriate procedures and protocols at the beginning of a project is crucial for successful project outcomes. This includes coordinating the design team, managing costs, staying within budget, and ensuring that milestones are met, and progress is made. Challenges in implementing protocols and procedures at the beginning of a project may include a lack of time, resistance to change, and lack of resources. Reviewing and updating project procedures and protocols during the design management process should be done frequently every few weeks or as needed when issues arise, rather than just at the beginning and end of the project. Clear communication among project stakeholders can be ensured through regular meetings, status reports, communication management plans, and providing stakeholders with access to project information. Relying solely on email as the primary method of communication or communicating only with the project sponsor may not be sufficient. Waste management on construction sites can be addressed through the implementation of a waste management

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plan, recycling, and reusing materials as much as possible, and using prefabrication techniques to minimize waste. Challenges in implementing sustainable agendas and integrating environmental management into existing construction culture may include a lack of awareness and education among stakeholders, resistance to change, financial constraints, and limited availability of environmentally friendly materials and technologies. The primary responsibilities of a design coordinator in dealing with unforeseen circumstances related to material waste and ensuring environmental compliance include monitoring and managing construction activities, collaborating with contractors and stakeholders, reviewing, and updating compliance plans, and coordinating with waste disposal and recycling facilities. Strategies to integrate environmental management into existing construction culture may include incorporating sustainability goals into project objectives, providing training and awareness programs for construction personnel, establishing green procurement policies, implementing waste reduction, and recycling programs, and encouraging collaboration and communication among stakeholders. Ensuring that all team members are aligned with the correct procedures and protocols at the beginning of a project can be achieved through regular training sessions, written documentation, project management software or tools, and assigning designated roles and responsibilities for design management tasks. Incorporating best practices into current projects can be achieved by following industry standards and benchmarks, learning from past mistakes and failures, and seeking feedback from team members and stakeholders.

1.2 Design Communication

Collaboration and communication are a necessity in the field of construction and architecture. This underscores the need for collaborative management and communication among various managers in a construction project, particularly between the chief designer and project management consultant, to ensure that all project leaders are aligned in their goals and working towards the same objectives. Construction is a field of economics, and good communication management is essential for providing mutual satisfaction. The designer's role is pivotal, and the more he understands the need for communication with the owner/investor and the contractor, the more successful he will be. Good communication management is essential from the planning to the design through the erection stages, and the more he meets these needs, the more successful he will be. Collaborative working can lead to enhanced creativity and innovation by allowing team members to bounce ideas off each other and

generate new solutions to problems. By working collaboratively, teams can combine their unique skills and expertise to achieve better results, while also improving communication, creativity, and job satisfaction. Collaboration between different stakeholders, including designers, contractors, and project owners, can help ensure that everyone is on the same page and working towards the same goals. This can lead to better project outcomes, such as higher quality buildings, completed projects within budget and on time, and greater client satisfaction. Collaboration and teamwork between the design and construction teams are encouraged by creating a culture of mutual respect and trust. Early involvement of both the design and construction teams early in the project to identify and resolve any conflicts or issues before they escalate. At the start of the project, a communication strategy should be prepared to specify how the information will be transmitted, who will oversee communication, and which channels will be used. To keep everyone informed of the project's status, communication needs to be regular and constant. To keep everyone informed of the project's status, communication needs to be regular and constant. Collaboration on a team requires open lines of communication between members. All parties involved should be encouraged to share their thoughts, and communication channels should be open. To communicate with everyone, it's crucial to use a variety of channels, including emails, meetings, reports, and project management tools.

1.3 Design Coordination

The interface between design and construction teams in building projects shows that little interaction often led to incomplete designs along with change orders resulting in rework and delays. Hence, improvement tools were designed and implemented. Designing many tools was necessary after reviewing the most frequent design defects found during the construction phase in the building projects to prevent their occurrence. To set priorities for the implementation of tools effectively QFD (Quality Function Deployment) was used to identify them. The construction company should implement changes resulting in significant impacts on performance. Additionally, there is an explicit definition of internal customer requirements and design attributes. Focuses are laid upon identifying activities that add value to optimize design and construction processes while also reducing waste production. The small design and build contractor managed their interactions with designers effectively by following a design management protocol that consisted of orientation meetings and collaborative planning workshops. These efforts yielded improved communication and collaboration, streamlined

schedules, and a deeper understanding of the lean thinking philosophy, ultimately resulting in better project outcomes and improved sustainability for the company. It can be inferred that effective communication and collaboration, timely decision-making, adoption of design management processes, and the ability to recognize the need for change and process improvements are essential for the success of a construction project. The value management approach can be a powerful tool for design managers to motivate people, develop skills, and promote synergies and innovation to maximize overall performance. It is argued that collaborative technologies can help designers to make more informed decisions about the environmental impact of their designs, and they provide examples of successful sustainable design projects that have used digital technologies to support collaborative decision-making. Delays in decision-making, especially in critical areas such as ordering essential items, can negatively impact the project outcome. Small businesses require straightforward and efficient design management processes to grasp the project's scale and emphasize the client's needs.

1.4 Technology Integration

Choosing the right communication media is critical in construction design management and can greatly affect message conveyance. Physical models, graphical communication, and BIM software are some of the most effective ways to convey information in the construction industry. It is essential to discuss and review design, facilitate the exchange of information, ideas, and opinions, and develop trust between individuals. Meetings, facilitated workshops, and collaborative planning workshops are essential. The use of digital technologies to support collaborative design processes, the evolution of digital technologies in the design industry and how they have transformed how designers work. With increasing advancements, there are benefits and challenges to using collaborative technologies, such as BIM (Building Information Modelling), cloud computing, and virtual design environments. The most important aspect is how to choose the right technology for a collaborative design project and how to manage and implement these technologies effectively. It is highlighted that communication and collaboration are important when using digital technologies, and they provide strategies for managing the flow of information between project team members. A building's or infrastructure's physical and functional attributes are represented digitally using BIM (Building Information Modelling). It is a collaborative method for designing, building, and operating projects that make use of a shared digital model to increase productivity, decrease errors, and

improve communication among project stakeholders. By offering a single source of truth for all project-related information, BIM can be utilized to increase a project's efficiency. This contains details about the materials, tools, and systems utilised in the building and the design, erection, and maintenance of the structure. By offering a visual depiction of the building that can be easily shared and updated in real time, BIM can also help to decrease errors and enhance communication among project stakeholders.

1.5 Future Prospects

The prospects of Design Managers and management depend on various factors, most notably a better understanding of design. The increased understanding of design has gone hand in hand with the construction and management design role. A better understanding of design has also resulted in contractors and other stakeholders giving greater attention to the management of the early design stages. Thus, the construction design manager's role tends to be more concerned with risk and dealing with uncertainties that affect the development of the design.

Another factor is having better commercial awareness, and it is becoming a day-to-day notion for "one stop one stop" or providing integration and collaborative working hence improving the business qualities of the contractor. Therefore, it is required for the design managers to have a precursor knowledge of the current trends in the market, which seems to be missing these days.

II. RESEARCH STUDIES

The literature review has been formulated by studying existing research work and synthesizing the learning's to understand the state of design management practices in the architectural firms.

2.1 Critical perspective of design collaboration: A review

Author: DanfulaniBabangidaIdian, Khairul Anwar Mohamed Khaidzir

Component Covered: Design Communication

Inference: Understanding the position of various conventional cognitive design activities, such as sketching, thinking, and reasoning in the collaborative ecosystem. The privation of this effect pre-empts the earlier assumptions that digital-supported collaboration presumes improving building design.

2.2 Architect Critical Challenges as a Project Manager in Construction Projects: A Case Study of Malaysian Architectural Firms

Author: MohammadrezaYadollahi, Mohammad Mirghasemi, Rosli Mohamad Zin, and Bachan Singh

Component Covered: Role of Design Managers

Inference: Throughout the building and maintenance process, architects are responsible for a wide range of tasks. "Improper planning," "unfamiliar technology," "unfamiliarity with green buildings and materials," "inappropriate scheduling," and "poor workmanship" were among the major issues confronting architects.

2.3 Construction Management Issues for Architects in Indian Construction Industry

Author: Sharmin Khan

Component Covered: Role of Design Managers

Inference: It was noted that while the concept of team integration is acknowledged, contractors are not generally seen as essential members of the team during the conceptual planning and design development phases. This limits their ability to contribute and save money and time. In order to facilitate construction and improve site administration, less attention is paid to minimizing scaffolding and organizing the site effectively. In the beginning, it is not recommended to have regular review meetings. Generally speaking, procurement schedules are not created. All members of the team should encourage regular review meetings. The team should give particular attention to the following issues: water conservation methods, site drainage, recycling considerations, waste management of building materials on site, and waste management of wastewater on site.

2.4 The role of design management in the sustainable building process

Author: MirkkaRekola, TarjaMa"kela"inen and TarjaHa"kkinen

Component Covered: Design Coordination

Inference: The chief designer is responsible for ensuring that the building is user-friendly, taking into consideration the needs and comfort of the end users, as well as coordinating the production of a maintenance manual to ensure the long-term sustainability and functionality of the building. Crucial role of chief designer: The chief designer plays a crucial role in ensuring the success of a construction project, by managing the design process, incorporating sustainable practices, and coordinating with other stakeholders to achieve project goals. Overall, the importance of sustainable building practices in the role of the chief designer and highlight the need for collaborative management and communication among various stakeholders in a construction project for successful project outcomes.

2.5 Collaborative Design Management

Author: J.-E. Park, Y. Choi, and C. Holt

Component Covered: Design Communication

Inference: The purpose of DM is to strategically manage design, design activities, and resources [Borja de Mozota 2003], [Best 2009]. Building DM or architectural management has been implemented in the architectural field. However, both are DM at project level, focusing on an architectural project in the short term [Emmitt 2014]. To flourish in the longer term, architectural practitioners should clearly envision business scenarios and formulate design strategies with a strategic intent through the introduction of DM.

2.6 Approaches to Design Collaboration Research

Author: Nancy Yen-wen Cheng

Component Covered: Design Communication

Inference: Team contact could be streamlined with improved interfaces for exchanging design information and standardized file metadata and procedures. By regularly monitoring and assessing the developing systems in both regulated and unrestricted professional settings, we must maximize their potential. The best communication tools are those that combine building performance with visualization, and offer practical features at every stage of the structure's life. For the instruments to function properly, they must be both sturdy and versatile, from pre-design to facilities management. Large changes to early organizational decisions must be made easier by them, and they must support the subsequent creation of intricate databases. Instead of trying to replicate the possibilities of in-person communication, we can take use of chances to identify intrinsic qualities in the media.

2.7 Design management: changing roles of the professions

Author: S. Male, D. Bower, MILT, and B. Aritua

Component Covered: Design Coordination

Inference: The benefits of effective design management, including improved project outcomes, increased client satisfaction, and better project team collaboration. The authors conclude that architects have a critical role to play in design management, and that they should work to develop their skills in this area to ensure the success of their projects. Overall, "Design Management: Exploring the Role of Architects in the Process" is a valuable resource for architects and design managers who are interested in improving their understanding of the design management process and the role of architects in managing the design process.

2.8 Virtual reality used in a collaborative architectural design process.

Author: P. Frost, P. Warren

Component Covered: Technology Integration

Inference: The potential applications of VR in architecture, such as urban planning, interior design, and building maintenance. The authors suggest that VR

technology can help to improve the efficiency and effectiveness of the design process, and that further research is needed to explore its full potential. Overall, it provides valuable insights for architects, engineers, and other professionals who are interested in using VR technology to enhance collaboration and improve design quality. The paper presents a comprehensive framework for using VR in the design process, and highlights the benefits and challenges associated with this approach.

2.9 Contradictions and Challenges in Managing Design

Author: Colin Clipson

Component Covered: Design Coordination

Inference: The conflict between the role of the architect and that of the developer. The architect's aim is to design a good building. The developer's goal is to make a profit. I think it would be difficult for the same person to stick to good design and profit motives and do justice to both.

2.10 Construction Management and Design-Build: An Owner's Experience in the Public Sector

Author: David R. Dibner

Component Covered: Role of Design Manager

Inference: Both the owner and the guarantor must consider the potential bonding issues and decreased risk protection associated with these innovative construction methods when deciding whether to use a CM or design-build/fast track construction for a given project. The owner needs to acknowledge what the surety has been saying all along: neither design-build nor fast track construction have a monopoly on innovation, thus the bonding issues that each present should not be disregarded.

2.11 Architectural Design Management –a practical reflection on the development of a domain

Author: Ad F. den Otter, Stephen Emmitt

Component Covered: Role of Design Manager

Inference: It is crucial to acquire the business knowledge, abilities, and skills necessary to model design processes and contribute effectively as a responsible partner to the design process. Through this kind of training and the assessment of its execution, we have discovered that designers are capable of performing at a higher level due to their increased understanding of the intricate design procedures involved in large-scale construction and building projects, as well as their familiarity with the most recent advancements in business science that are pertinent to these fields. The success of this kind of innovation in practice was also demonstrated by the implementation evaluation.

2.12 The Benefits, Obstacles and Problems of Practical BIM Implementation

Author: Darius Migilinskas, Vladimir Popov, Virgaudas Juocevicius, Leonas Ustinovichius

Component Covered: Technology Integration

Inference: The paper recommends addressing legal and contractual issues related to BIM implementation and developing effective project management strategies that can facilitate collaboration and coordination among project stakeholders. In conclusion, the paper suggests that BIM implementation can bring many benefits to the construction industry, but it also presents challenges that need to be addressed. By adopting effective strategies for overcoming these challenges, BIM can become an increasingly valuable tool for building design, construction, and management.

2.13 A review of Building Information Modelling for Construction in developing countries

Author: Nam Buiab, Christoph Merschbrockb, Bjørn Erik Munkvolda

Component Covered: Technology Integration

Inference: The paper highlights the importance of BIM in the construction industry in developing countries and the potential benefits it can offer. The findings of this study could be valuable for policymakers, industry stakeholders, and researchers interested in adopting and implementing BIM in developing countries. The study calls for further research to address the challenges and opportunities of BIM in developing countries and to develop strategies for successful implementation.

III. RESEARCH METHODOLOGY

Finding the most typical and prevalent issues that arise in projects of this kind generally is the first step in determining the major difficulties that Delhi's design managers must overcome. In order to carry out the identification process, government records and previously published feasibility study reports were carefully examined. Creating a list of comparable difficulties that could be divided into smaller groups was the first step. Furthermore, a small number of interviews and discussions (conducted as a pilot research) yielded insightful feedback regarding the suitability of the initial challenge selection, which was integrated into the main questionnaire survey. To identify the critical challenges of design managers in firms of Delhi, the experts and professionals from selected organizations were interviewed. The aim of interviews was to evaluate design management in a firm through the set parameters and based on the data, conclude the research and prospects of Design Management.

IV. RESULTS AND DISCUSSIONS

The sample selection is considered that all the firms are of similar nature and similar types. All firms have a minimum employment size of 10-15 employees. They assume that all the firms are technically, socially, and financially of the exact nature. The survey is of architectural firms based in Delhi - NCR. The survey findings are as follows:

Design is an iterative process. Hence there are various approaches to managing a design or a project; Many firms operate on the **course of flexibility and adaptability** in the design process, whereas **many** firms focus on **understanding the need of the user** and **creating innovative** solutions.

It is necessary for the firms to work collaboratively amongst as a team therefore, a large no. of the respondents feels that working in collaboration is much easier when the **roles and responsibilities** of each stakeholder is clearly established. **Many** of respondents experienced costly mistakes or rework due to communication breakdowns between the designer and contractor. It is further highlighted that **shared decision-making, establishing clear roles, and BIM** are effective tools for collaborative working.

One of the **major challenges** that the firms face during the construction process **are project delay, cost overruns and sustainability and environmental concerns**. Respondents also stressed the **significance of efficient communication** among construction design managers, architects, engineers, and specialist designers/subcontractors. **A large no. of employees** received **orientation meetings or collaborative planning workshops from the contracting organization**, which were found to be effective in improving collaboration. Around **66%** of the respondents found project management deemed **critical in ensuring effective communication** between the designer and contractor. Respondents who encountered issues with the **scope of work defined** in the contract handled the situation by **discussing it with the project manager** or other parties to negotiate a mutually acceptable solution. **Design-build contracts** were the most **common types of** contracts that respondents worked on, and a significant proportion of them faced issues with **scope creep during their projects**.

The challenges can only be overcome by improving efficiency, reducing costs, and ensuring effective stakeholder communication. Verbal communication, written communication, regular meetings are the most used ways to avoid communication gaps. Attending conferences, meetings seminars and workshops are the ways used to stay up to date with the latest trends.

The respondents believe that the **success of a project** is based on client satisfaction, meeting with the project objectives, profit, and team satisfaction. It can be achieved by defining specific business strategies for technology enabled collaborative working and ensuring that adequate resources (funds, and manpower) are available, collaborating with contractors and other stakeholders to identify and implement effective waste management practices on construction sites. Regulations is the primary responsibility of a design coordinator in dealing with unforeseen circumstances related to material waste on construction sites. It is believed that establishing green procurement policies for construction materials and resources can be adopted to integrate environmental management into existing construction culture. Many of the respondents believe that providing training and awareness programs for construction personnel on environmental best practices can be adopted to integrate environmental management into existing construction culture.

BIM is most **underutilised** in the handover phase now. Only a few select contractors are beginning to create final BIM enhanced deliverables to be used in maintenance and operations. Field is yet to use the BIM to its very potential. The implementation of any new technology for achieving business targets necessitates changes to an organization, its current practices, systems, human resources, processes, and workflows. To enable this, the **right strategies and implementation** plans need to be developed, communicated, implemented, and regularly monitored by the management. Collaboration led technology adoption can no longer be viewed by organizations from an isolated technology centric stance. Instead, it must be integrated into the 'collaborative' business, from strategy, to implementation, and then on to measurement, analysis, reflection, and feedback. Building information modelling (BIM) technology use in the construction sector is advancing quickly. The lack of standardisation and compatibility across various BIM systems, as well as the expense and complexity of BIM deployment, remain issues for the sector, nevertheless. Despite this, the BIM sector's future appears bright due to technological developments and rising demand from the building sector.

BIM has a promising future in the AEC sector since it is anticipated to lead to greater productivity, cost reductions, and improved decision-making. Increased demand for experts with BIM expertise who can successfully use this technology will result from BIM's rising popularity.

BIM is a crucial technology in the AEC sector, providing several advantages, including precise planning, cost savings, improved teamwork, and better

decision-making. BIM is poised to transform the sector, and its expanding use will open the door to a more effective and environmentally friendly building process. In conclusion, collaboration, shared decision-making, establishing clear roles and BIM are essential elements of successful project delivery in architecture. By adopting these practices, architects can ensure the successful completion of their projects while meeting the needs and expectations of their clients and other stakeholders.

V. CONCLUSION AND FUTURE DIRECTIONS

A collaborative process called shared decision-making entails the sharing of data, expertise, and knowledge in order to reach wise decisions. To ensure that the project meets the needs and expectations of all stakeholders in architecture, shared decision-making is crucial. Designers can make certain that their work satisfies users' needs, preferences, and values by involving clients, end users, and other stakeholders in the design and decision-making process. By incorporating a range of viewpoints and skills, shared decision-making can raise the project's quality, efficiency, and sustainability. The AEC industry needs BIM because it offers a number of benefits, including accurate planning, cost savings, increased cooperation, and better decision-making. BIM is set to change the industry, and its growing use will pave the way for a building process that is both more efficient and ecologically benign. In conclusion, effective project delivery in architecture requires the use of BIM, shared decision-making, clear responsibilities, and teamwork. By implementing these procedures, architects may guarantee that their projects are successfully completed while also satisfying the requirements and expectations of their customers and other stakeholders.

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