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Lean Thinking as an Approach for Improving Client Communication During the Design Process

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Abstract Lean thinking is perceived as a successful strategy for saving time and cost, while improving at the same time the position in the market. Lean thinking is about eliminating waste and increasing the quality. When applied correctly, lean thinking is a well understood and well examined platform upon which to build firm practices. In the architectural profession miscommunication has a lot of consequences including time and cost overruns, conflict and ultimately project failure. The aim of this research was to investigate the role of lean thinking in improving the communication between the client and the architect during the design process. To achieve the aim of this research, an indepth firstly, a literature review was used to build a comprehensive background about the research topic including the design process, causes and impacts of poor communication during the design process, and lean thinking. Secondly, an analysis of case studies was used to investigate the role of lean thinking in enhancing the client communication during the design process. It was found that comprehending, understanding and incorporating lean thinking principles in the design stages can assist in reducing the causes of poor communication between the architect and the client.

Keywords Lean thinking · Communication · Design process · Architecture design

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1 Introduction

In the field of architecture, the communication between the client and the architect is based on using all forms of communication whether it is verbal, non-verbal or computer-generated architectural drawings to communicate [1]. Communication is defined as a process of exchanging ideas, opinions, and goals [1]. Communication is more than just gathering information. The information must be trustworthy, heard by the right people, and result in appropriate outcome. Communication has become more problematic in the architectural projects because of complicated design projects, the advancement in technology and design information management systems, as well as the diversity in the stakeholders [1].

Communication issues between the client and the architect can be classified into technical and social. The most complaints from the clients were the misunderstandings and dissatisfaction of the architectural services [2]. Though the client is the centre of the design process, they are not aware of the design processes and what information needs to be passed on to the architect [1]. Traditional methods created problems as they were not well coordinated and intelligent and the knowledge was not well managed [1]. Miscommunication has a lot of consequences including time and cost overruns, conflict and ultimately project failure [3]. To achieve the aim of this research, the researchers investigated how lean principles can improve communication between the architect and client utilising case studies.

2 Literature Review

2.1 The Design Process

The design process according to the architect is characterised by doing the same in a different way each time. Accordingly, every design project is unique, but the process and the methods used in creating it are somewhat similar each time. Several requirements are needed to develop architecture: consisting of legal provisions and regulations, brief by local authorities, economy, and most important clients brief. This assembly of requirements covers the creative process. The creative process attends to each of these specifications along with aesthetic and technological aspects and take constant considerations [4].

The design process does not signify the process of creating, however it is based on the principle of deduction of the final structure of the basic primary introductions, and the importance of those introductions and the final structure depends, however, on three basic methods:

1. Collecting information: which include gathering information, organising, and analysing them to ensure that they contribute to the design role, and how such information is incorporated into the picture.

2. Testing: which include the design choices through the process of showing the architect's analytical ability, intuitive, and personal experience.
3. Evaluation process: which requires a judgment on the suitability of these choices regarding the design problem [5].

2.1.1 Stages of the Design Process

The RIBA plan of work [2] identified eight stages that need to be conducted to assist anyone associated with building a project, from the professional architect through to a client going through their first project. This research discusses the first five stages of the RIBA plan of work. These five stages discuss the design process that the architect and the client go through.

0. Strategic Definition

The primary objective of Stage 0 is strategic confirmation of a construction project. It is the best way to achieve the client requirements. Stage 0 is not about the functional specifics or the design. It focuses on making and capturing the necessary strategic decisions in a business case. The stage involves stating the advantages and disadvantages, project risks, project budget, and execute site surveys, and recommending the best solution for carrying out the client requirements. In this stage, only the client team is involved. The client may ask for advice from a wide range of professional advisors to help them establish the client requirements and the business case [2].

1. Preparation and Briefing

The outcome of this stage is developing the project brief approved by the client and confirming that it could be established on the site. The client requirements are discussed in more detail, in connection with a certain site, and the result is documented in the project brief. The project outcomes, sustainability outcomes, and quality aspirations are all included in the project brief. This stage is mainly about collecting all the information needed for the design team to start stage 2. In this stage, the client team only is involved [2].

2. Concept Design

Stage 2 establishes the architectural concept for a project. Proposals that match with the site information, project brief, and spatial requirements are prepared during this stage. The proposals for the architectural concept must also be reconfirmed to satisfy input from the design team and specialist consultants, including the criteria for strategic engineering. Proposals will need to be synchronised with the project strategies, as well as with everything found in the stage report along with the cost plan. In this stage, the client team and the design team are core players, along with specialist consultants. In some cases, the construction team may also be included in this stage [2].

3. Spatial Coordination

The outcome of this stage is architectural and engineering information spatially coordinated. To confirm the assumptions made during stage 2 and to layer more detail on the concept, detailed design studies and engineering analysis are conducted. Stage 3 is not about changing the architectural concept, which should remain substantially unchanged, although adaptations to ensure that the building is spatially coordinated may be needed for detailed tasks or engineering tasks. In this stage the key players are the lead designer and design team. The client team are involved where decisions are required in stage 3. The construction team may also be needed if the chosen procurement route needs early inputs by a contractor or a subcontractor [2].

4. Technical Design

This stage involves preparing all details needed for a building to be manufactured and constructed. The basic documents needed at the start of stage 4 are the information requirements, responsibility matrix, and stage 4 design programme, which the procurement strategy has a great influence on. Before work starts on site, a building regulations application should be developed during stage 4. In this stage, the design team and the specialist contractors employed by the contractor complete the design. A client monitoring team may be assigned under certain types of procurement to review the information that is generated [2].

2.1.2 Client Issues Occurring During the Design Process

Several studies have highlighted different variables that rationalise the communication between the architect and the client and their participation in the design process [6]. These are some issues that occur during the design process:

- At the beginning of each design brief, there is a significant lack of information.
- Clients frequently have too many expectations.
- The final decision in the design is not decided by the architect.
- As the design progresses, the scope of the design frequently expands.
- The terms of definition differ according to the architect and the client.
- Architects are not making enough effort to keep clients connected to the progress.
  • Architects do not look up the client's background history in proper depth.
- Project solutions are based essentially on the subjective considerations arising from the clients need [6].

2.2 Communication During the Design Process

The initial phase of a project implementation is the design process, which is based on the requirements of the client, and greatly influence the value of the project [7]. Communication is a certain necessity during the design process, and it is important

to communicate extensively between the architect and the client in order to prevent conflict by deciding the messages and information to be sent by the right sender to the right recipient in the correct manner by the right media [8]. In order to solve problems at the initial design phase of the project, it is important to develop a convenient communication management system [9].

2.2.1 Communication

In its broadest sense, communication is the transfer of information from one individual to another [10]. Communication is the method of information exchange between the sender and the recipient to equalise data on both. Communication can influence the architect-client interactions. The concept of communication was expanded by Gabriel and Maher [11] into the field of architecture when he said, "architecture is mainly about communication". The foundation of such claim lies in the fact that architects' theories are the product of close communication between the architect and the client, which is ultimately reflected in the constructed environment [6]. Problems can be overcome with respect to collaborative design by using different forms of communication instead of relying on additional communication [12]. Communication means more than receiving information, it also implies that the information must be reliable, heard by the right audience, and lead to a suitable response. The communication process is complicated but it is this process that eventually leads to project-relevant knowledge and ensures success [6].

2.2.2 Causes for Poor Communication During the Design Process

Miscommunication is defined by insufficient and incorrect communication; furthermore, frustration and misunderstandings are all sources of miscommunication. The architectural design process is harmed by ineffective communication between the architect and the client [13]. Table 1 depicts the causes for poor communication during the design process.

2.2.3 Impacts of Poor Communication During the Design Process

An architect is a person who plans, designs, and models a construction project. An architect uses a broad range of knowledge from a variety of fields, including arts, science, technology, to bring a building design to life. Previously, traditional approaches caused issues because they were not well-coordinated and intelligent, and clients were not given the useful details. As a result, the building design process would be hampered, and bad choices would be made. The client is the most essential person in the architect-client partnership. They are the only one who can have a close relationship with the architect, and they need detailed information about the building design [23]. Despite technological advancements, architects are faced with

Table 1 Causes for poor communication during the design process

Number	Causes for poor communication	Explanation	References
1	Physical barrier (face to face meetings)	It is the environmental and natural conditions that act as a barrier in communication when transmitting messages from sender to receiver. It is the most significant impediment to successful workplace communication, as well as the overall environment	[6, 13]
2	Linguistic barrier	Architectural language is confusing by nature, and its words are symbols, so if the client understood it in their own way, it may lead to misinterpretation	[6, 14]
3	Diversity of culture	Age, thinking behaviour, social position, economic status, ethics, motivations, and priorities are all examples of cultural barriers that occur when two people belong to different cultures	[6, 14]
4	Lack of honesty from the architect	Architect's honesty is essential for the success of the project as the architect should be honest and candid while avoiding deception. If the architect is not sure about his/her ability to carry out certain task, they should inform the client as soon as possible	[15, 16]
5	Poor feedback received from the client	Can delay the project and cause confusion to the architect	[17]
6	Work pressure on architectural firm	When people are under pressure, they are more likely to make mistakes. Personnel errors may manifest themselves in the form of incorrect or inaccurate outcomes. People may be affected psychologically and physically by pressure, which would have an impact on their output	[18]
7	Poor communication management	Failing this multidimensional process means inefficient information exchange, which will result is major project issues	[18]

(continued)

Table 1 (continued)

Number	Causes for poor communication	Explanation	References
8	Ineffective communication between the client and the architect	Means that it was completed but the results or the process were insufficient. Two major key contributors to ineffective communication are time and quality	[14, 18, 19]
9	Lack of collaboration and representation between stakeholders	Instead of leaving their knowledge base locked in the perceptual domain, stakeholders must take the time to express it in a truthful and clear manner	[16]
10	Unclear communication channels	Can cause many problems for both the architect and the client, causing miscommunication. So, the absence of this medium will result in message transmission and arrival failure, the architect and the client must establish an agreed-upon route	[18]
11	Unclear requirements from the client	Sometimes the client may only have a hazy notion of the problem that needs to be solved, maybe he cannot describe it precisely	[20]
12	Different level of education	A well-educated client will have more insight and will be able to be better understand the architect's conceptual solutions and make valid suggestions as a result contrary to an uneducated client	[1]
13	Lack of architect's experience	Many architecture schools place a greater emphasis on math, theory, and other technical subjects instead of on effective communication [20]	[20]
14	Unavailability of information in time of need	Will halt the team's readiness to communicate	[18]
15	Technology malfunctions	Have bad impression on the architect, as it implies poor work quality and unsatisfied client	[21, 22]

ever-increasing amounts of data to handle. In addition, the time it takes to complete projects has shrunk. For example, the use of ICT allows for fast communication between stakeholders, which speeds up the project by reducing wasted time [24].

There are numerous impacts of poor communication between the architect and the client have on the project during the design process which are listed below:

(1) **Project failure** is the most serious consequence of poor communication. This is typically the result of several causes that were not resolved over a long period of time, resulting in a project being labelled as a failure [25].
(2) **Disputes** are a common effect that can be seen throughout the project's life cycle. Dispute may occur because of inaccuracies in information or poor communication between organisations and individuals. This may also be the result of bad or dishonest feedback, causing the client to apply aggressively, resulting in a disagreement [26].
(3) **Over budget** is one of the most important risk factors of any construction project. This dangerous impact can be attributed to a lack of project management skills, poor coordination, and ineffective communication [25, 27].
(4) **Time overrun** is a common occurrence that can result in charges and losses for the client. To ensure that the project is delivered on time, the schedule must be continuously updated and communicated to the client [25, 28].
(5) **Poor quality of design** is a significant source of inefficiency in the design process, resulting in delays, rework, and variations as well as increase in project cost and time for both the client and the architect [26].
(6) **Reworks of project design** are both financially and time-consuming. The tiniest error or misinterpretation of data can result in days of redesign in the office [27].
(7) **Poor collaboration** between the client and the architect is caused by a variety of communication flaws. Collaboration is particularly important between the architect and the client, where goals are accomplished by combing the efforts of many different professions [28].
(8) **Unmotivated client** can cause the project's demise if they reach a point where the continuation or success of a project is insignificant to their interests [26].
(9) **Untimely reactions** in important situations can cause problems during the design process. The clarity with which a client with responsibilities provides feedback and reacts can either solve or cause a problem [28].
(10) **Low productivity rates** can be caused by a variety of causes, but the fact remains that bad work is performed in terms of quality and quantity, which has a direct impact on the design's outcome [27].
(11) **Poor understanding of data** means that the communication mechanism that carried this data from the sender to the receiver failed [26].
(12) **Misinterpretation** means that knowledge was misinterpreted, which can result in unsuccessful actions that waste time and money [26].
(13) **Mistakes** have different consequences depending on the severity of the harm they inflict. Effective communication can mitigate the quantity and consequences of mistakes during the design process [25, 27].
(14) **Unsatisfied client** is the product of several negative process that persisted unabated during the project lifecycle. Client communication is critical, and client satisfaction must be a goal for all parties involved in the project [25].
(15) **Client's constant design changes** during the design process in terms of additional resources, expense, and project length have a negative effect the design process [25].

2.3 Lean Thinking

Lean has its origins in the automobile industry, specifically the Toyota Production System. The Japanese company was able to build a long-term work environment in which they could cut costs, improve process quality, and sell their goods at a fair price. In reality, when Toyota first entered the US market, they were able to sell their vehicles for a fraction of the cost of American manufacturers. Since they were able to find a way to speed up the production process without losing efficiency, they were able to do this. They were also able to recognise and eliminate unnecessary practices in their methods as lean thinkers [29]. Lean thinking, is a method to specify value, line up value-creating behaviours in the appropriate sequence, execute these activities without interruption if anyone requests them, and execute them more and more efficiently [30].

2.3.1 Brief About Lean Construction

Lean Construction involve owners, designers, suppliers, architects, engineers, builders, and end users. Lean construction is a method of designing development systems to minimise waste of materials, effort, and time in order to produce the most value possible [31]. Lean construction employs the same principles as lean manufacturing to minimise the waste while improving productivity and efficiency in construction work. Workflow accuracy and labour flow are presumed to be the major factors of construction, but lean construction changed the conventional view of the project as transition and promotes the principle of flow and value generation. It also has the same goals as lean production, such as reducing cycle time, elimination waste, and reducing variability. The implementation of lean construction has been guided by continuous improvement, pull production control, and continuous flow [32].

2.3.2 Lean Architecture

The continuous process of rethinking and improving architectural methodology is known as lean architecture. It is the quest of better work through the application of lean principles to all areas of practice. It is about having smarter information flow and understanding how the architect realises and handles information in an attempt to be better communicators with themselves and with their clients. It is the process of determining what adds value and reducing or eliminating what does not [33]. Since architects are not making identical projects, architectural production practices must not be confused with lean manufacturing. Because architects work with people and organisations, design phase usually includes managing a great deal of subjectivity. Nevertheless, analysing the thinking behind good manufacturing processes

and applying the theories and values to the more repeated aspects of the architecture practice can have a great impact [33].

2.3.3 Lean Thinking Principles

Lean thinking has five main principles, they were implemented to address the numerous challenges that exist as a result of variations in business culture and management thought process. To optimise the benefits of lean performance, there are five basic principles for lean thinking that must be followed.

1. The first lean thinking principle is to identify the value from the perspective of the client. The principle requires the architect to consider and rethink who their real clients are, as well as what the client consider valuable. The clients eventually determine the value of the design, so the principle emphasises determining the value from the client's perspective [26]. The goals for each of the activities surrounding the outcome from design to delivery to the client [34].
2. The second lean thinking principle is 'identify the value stream'. The definition of value stream differs from the conventional supply or value chain concepts. The pervious is a narrow view of the value adding process, referring to the activities that go into adding value to the development of the design, while the latter encompasses all the activities that are required in the design process [35]. The 'identify the value stream' principle encourages companies to:

   - examine and identify all activities involved in the development of the project,
   - identify activities that add value,
   - remove activities perceived as waste in a value stream [36].

   As a lean approach in architecture design these can include:

   - using only reliable, thoroughly tested technology during the design process and while communicating with the client, it can be like using BIM, 3D models [37].
   - Align the design to the quality requested by the client. Quality is described as absolute accuracy on what everyone agreed upon, since failure is viewed as inconvenience by the consumer, and providing something unique, which is difficult to measure but makes the client satisfied and connects them to the firm [38].
   - Respect the preferred modes of communication according to the client and the type of information delivered. Every mode of communication has its own set of advantages and disadvantages whether it is verbal, written, or visual communication [39].

3. The third principle of lean thinking is to implement flow in the value-added processes after removing the obvious wastes in the value stream step. The basic principle of flow, according to Lian and Landeghem [26] is to make parts preferably one piece at a time from production to delivery and to transfer them one

by one to the next workspace with no waiting in between. In case of communication, it is the flow of information to the client with minimum delay. This can be applied by the following:

- Levelling out the workload between the architects [40].
- Developing communication platform to facilitate communication and smoothly transfer information between the client and the architect [41].
- The encoding of information into proper communication like architectural terms and other important information.
- The information that is communicated must be transparent, descriptive, visible, and simple to understand [42].
- Repeat the information that was received to ensure correct understanding [34].

4. The fourth principle of lean thinking is pull production; it is the next essential part of lean thinking in ensuring clients receive their desired design when they want it [43]. When applying the pull principle to the flow of information, an architect should be able to control when and what information is delivered to him [44]. So, the architect should send the information to the client at the appropriate time when requested.
5. The final principle of lean thinking is to always strive for excellence. This can be implemented by training. There are two distinct fields of expertise and work in lean education and training. One region could be labelled lean teaching while the other could be called teaching lean. The teaching lean field can be described as the process of effectively training students and professionals in lean principles, concepts, and tools so that they can apply lean in real-world situations such as industries and other companies. The other field, lean thinking is characterised as the application of lean principles and concepts to learning and training practices [44].

2.4 Relationship Between Design Stages, Communication, and Lean Thinking

A relationship was created in Table 2 between the design stages and communication causes and impacts and how lean thinking principles and tools can be used to solve the causes of poor communication during the design process.

Table 2 Relationship between causes and impacts of poor communication during the design process and lean thinking methods

Number	Causes of poor communication during the design Process	Phases of architectural desig phases					Impacts of Poor communication during the design Process															Lean Thinking Principles									
																						Define Value from the client	Identify Value Stream			Flow				Pull	Perfection
		Startegic Definition	Preparation and Briefing	Concept Design	Spatial Coordination	Techincal Design	Project Failure	Dispute between the client and the architect	Over Budget	Time overrun for the Design process	Poor quality	Reworks of Project design	Poor collaboration between the client and the architect	Unmotivated Client	Untimely reactions	Low productivity rate	Poor understanding	Misinterpretation	Mistakes	Unsatisfied client	Client's Constant design changes	Defining value from the client	Use only reliable, thoroughly tested technology	Align design to quality	Respect Preferred Modes of communication	Level out the workload	Develop a communication platform	Encoding of knowledge like certain architectural terms	Repeat the information that was received to ensure correct understanding	Believer information as soon as it was requested	Training
1	Physical Barriers (face to face communication)	✓	✓														✓	✓									✓				
2	Linguistic Barriers between the client and the architect			✓	✓	✓						✓						✓	✓										✓		
3	Cultural Barriers (difference between cultures, age difference, thinking behaviour, etc).	✓	✓					✓					✓														✓				
4	Lack of honesty from the architect		✓		✓		✓	✓	✓			✓								✓				✓							
5	Poor Feedback Recevied from the client			✓	✓					✓		✓																		✓	
6	Work Pressure on Architectural team				✓	✓					✓					✓			✓							✓					
7	Poor communication management		✓	✓	✓	✓	✓	✓		✓																✓					
8	Ineffective communication between the client and the architect		✓	✓				✓					✓				✓									✓					
9	Lack of collaboration and representation between stakeholders		✓		✓								✓								✓			✓							
10	Unclear communication channels			✓	✓	✓					✓		✓			✓										✓					
11	Unclear requirements from the client	✓	✓	✓						✓							✓				✓	✓									
12	Different level of education			✓	✓	✓		✓									✓			✓								✓			
13	Lack of architect's experience		✓	✓				✓						✓																	✓
14	Unavailability of information in time of need			✓	✓	✓						✓			✓															✓	
15	Technology Malfunctions			✓	✓						✓									✓			✓								

(Developed by authors)

3 Case Studies

3.1 Kuwait University and Gulf Consult.

Gulf Consult (GC) was assigned by Kuwait University as their local consultants in their College of Business package in collaboration with Cambridge Seven Associates, Inc. (C7A). During the design process of this project, it was clear that there was poor communication between the project partners. However, Gulf Consult was quick to identify and solve the problem by conducting unstructured interviews to find the root cause of the problem, which were identified as follows:

- Lack of knowledge was observed from some stakeholders;
- Lack of experience from the architects during the project;
- Unclear language circulated which caused miscommunication;
- Issues regarding the representation of stakeholders when the communication was needed.

These causes were met with proper action and solutions to solve the problem to prevent further communication problems that will affect the project greatly. The following where suggested to solve these problems which follows the lean thinking theories.

- Establishing a clear communication system;
- Level out workload between the staff by assigning tasks to capable staff members;
- Monitor and control the communication process.

In this case study, Gulf Consult used several lean thinking principles to solve the causes of poor communication. The lean thinking principles used were:

1. Identify the value stream which was reflected in focusing on the value adding processes, like the regular meetings and assigning tasks to competent staff members.
2. Flow which was used in making sure that the correct information is delivered to all staff members to ensure the flow of information.
3. Strive for perfection, which was reflected in continuous monitoring and controlling the communication process.

3.2 Istanbul Grand Airport IGA

Istanbul grand airport was built to operate Istanbul airport for 25 years. It has a total area of 76.5 million m^2. The method of designing, incorporating, and recording design and development details by creating an interactive BIM model developed during the design and construction stages in IGA for BIM-based project execution. The use of an optimised framework for automated data analysis during the project phases further represents lean architecture and construction practices. BIM

implementation in the IGA project during design and engineering provided a shared simulated world for all parties involved in the process. This is made possible by data sharing procedures through cloud-based data management software, as well as the creation of BIM models with required engineering decisions by incorporating various types of design knowledge. On a regular and weekly basis, the Istanbul Grand Airport BIM team holds meetings to realise and define each important assignment, workflow, and implementation plan schedules of the IGA construction. The strategic benefits of these meetings are defined as coordination and workflow between all disciplines, as well as regular, weekly, and monthly checks and quality controls. The quality of the design product is improved by applying these implementations. During the design process for collaborative clash detection phase, this workflow ensures that all participants are synchronised. As a result, produced construction documents (shop plans, BIM models, etc.) are updated in terms of potential clashes on site to prevent any on-site rework.

The following results were the outcomes of applying lean in the IGA project via BIM:

- Total costs as predicted;
- Correct and high predictability;
- High rate of production;
- High level of profit; and
- Easy information flow.

4 Conclusion and Recommendations

The design process is the start of any construction project. A lot of problems between the client and the architect as a result of poor communication could be easily prevented if managed early. The architect should know how to manage the communication between the client to have a better understanding of the project and the client's requirements. Lean thinking can solve this problem, with its five main principles; identifying the value, value stream, implement flow, pull production, and ensure perfection.

The aim of this research was to investigate the role of lean thinking in improving the communication between the client and the architect during the design process. It was achieved by understanding the design stages and the causes of poor communication as well as comprehending the lean thinking principles. Two case studies were discussed to show how lean thinking was implemented during the design process and the improvement that it had on the project and the team. Based on the above, the research comes to the following recommendations:

- Architectural design firms (ADFs) in Egypt need to adopt lean thinking strategies to manage the miscommunication between architects and clients, thus obtaining communication and better project quality.

- ADFs should provide training to architects about lean thinking principles. In addition, raising awareness toward the importance of applying lean thinking through means of education and the introduction of philosophies into architectural education.
- Finally, local authorities and governments should promote more research towards adopting lean thinking to manage the communication between architects and clients.

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