Quality Management of the Architectural Design Phase in Professional Practices:
RFIs as an Assessment Tool

May Fathallah Abouraya, Yasser Ahmed Farghaly, Alaa-El Din Sarhaan

Abstract—Management is the key to the success of any project or process. Architectural Design Management is the management that takes place in the architectural office; during the design process. It tackles a wide range of issues amongst which are; Quality management, Time management, Financial Management among aspects. Practitioners of effective architectural design management should realize its multiple benefits and should see the facilitation in provides towards the success of the practice. It is necessary to satisfy all four pillars (scope, time, cost and quality) of an architectural project in order to reach a project balance. While three of these pillars are easily quantifiable, quality management remains a qualitative aspect, making it challenging to transform the aspects into measureable values and therefore making it difficult to find a calculated harmony/balance in-between these pillars. This research follows a deductive approach, exploring the basis of quality management and unearthing a metric tool that can be used to quantify the quality of the architectural product.

Index Terms— Architectural Design Management, architectural practice, design phase, office management, project management, quality control, quality management, management, quality control, time management, value engineering.

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1 INTRODUCTION

THE importance of management in people's lives is non-questionable. It is present in all the daily activities and its absence clearly causes distress and unnecessary tasks.
In architectural practices, management occurs in every stage of the project's lifecycle, from the inception or the idea through design, construction, operation and maintenance and finally recycling or demolition. All these project stages include management and include communication with different personnel. [9][5]

Architectural Design management includes the management of the project and the running of the office. The former includes financial management, time management and control and quality management. While office management includes but is not limited to: HR management, organizational structure, managing meetings and communication within the office [3][1]. This paper focuses on Quality Management and discusses the possibility of formulating a metric tool using RFIs (Requests for Information) to measure the quality of the practice's product (drawings).

1.1 Problem Statement

It has always been known that balancing between the four pillars of an architectural project has been the most challenging aspect of architecture. Clients usually need projects done with minimum cost, minimum time and maximum quality. [2]

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While the scope of a project is measured by the number of items in the program or the number of sheets produced and time is measured by the number of days spent to complete a set of drawings, and the cost is measured by the total amount amount spent, the quality of a project remains *unmeasurable*. Both the unawareness of the scope of quality control during the design phase and the lack of quality-measurement tool that can quantify the drawings' quality are obstacles in the value engineering of the project and consequently the practice.
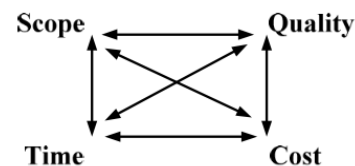

Fig. 1. The four pillars of an architectural project. – [2]

1.2 Aims and objectives

In order to find a balance between these four pillars to the satisfaction of the client, the architect and to the benefit of the project, it is necessary to transform all pillars into measurable quantities.
This research aims to:
1) Explore aspects of quality management of the architectural design phase.
2) Determine methods used to measure the quality of architectural products.
3) Provide a reliable metric tool that can be used by architectural practices in order to measure the quality of the product.

1.3 Methodology

The research nature of this paper is exploratory, it is a diagnostic study that helps deepen the understanding or architec-

tural management. It follows a deductive approach. This is a qualitative research, surveying the different methods that practices use to measure/quantify the quality of their product through a series of semi-structured interviews with practice-owners and employees/architects.

The sampling technique used is purposive sampling which lies under non-probability sampling. With a homogenous sampling size of 4 offices. This research is targeting medium sized, (local) Egyptian offices, specifically offices based in Al-exandria. It targets firms that are multidisciplinary. Which makes the sampling homogenous in nature, with the least variation between the samples.

2 QUALITY CONTROL

"Most firms don't deal with issues of architectural quality and innovation at the organizational level. The common perception is that all a firm needs to do to produce architectural excellence is to employ the right designers." – Cesar Pelli, FAIA [4]

Quality Management (QM) is a system that supports and improves a firm's performance. More than a document checking system, quality management provides guidelines, support and metrics to holistically advance the practice. The idea of QM can be seen in two approaches; inspection based systems and process based systems. [8]

2.1 Inspection based systems

As observed in the history and the evolvement of management, and according to Moser [7], the origin of QM lies in control and inspection, the product is made and then measured and inspected to see whether it meets the requirement before being delivered to the client. Similarly, Architectural Quality Control is also based on the development of inspection based systems. Whereas the service provided (drawings, manuals) are tested in requirement to meet the client's approval.

Inspection based systems are built on drawing review and revision. This requires a skilled staff and team, as well as continual training, in order to be effective. It also requires that there be organizational standards within the practice to act as a baseline for acceptable delivery. A few years ago it was naturally the responsibility of the project architect to monitor the quality control, overseeing and reviewing the work of junior staff. Today however, with the development of new drafting technologies, the "over the shoulder review" is no longer common. Computer drawings need to be plotted out and redlined for input back into the program (CAD). This introduced a gap in the oversight process. The development of multiple hard copies with separate multiple inputs and outputs has potential to create numerous opportunities for mistakes and miscommunication, which is obsolete to the concept of Quality Management and Control. [3]

2.1.1 Checklists

Checklists can only target the transfer of explicit knowledge such as project requirements (e.g. project program and code requirements). It can also include firm pricing methods/procedures, file and folder arrangements and client billing. Checklists help team members understand a firm's standard methods. The knowledge learnt on the job, tacit knowledge, cannot be integrated into a checklist, but rather by hands-on experience. Tacit knowledge can entail knowing just how to talk to contractors and clients or how to manage a difficult coworker. [6]

TABLE 1
A COMPARISON BETWEEN CHECKLIST KNOWLEDGE AND TACIT KNOWLEDGE

Checklist knowledge	Tacit knowledge
• Enables the transfer of explicit knowledge • Helps identifying the firm's methods	• Cannot be identified in checklists • Learning on-the-job
• Project requirements • Programming • Pricing a job • Billing clients	• Dealing with a difficult coworker • Understandings the nuances that result in a successful drawing package • Talking to clients and contractors

Checklists should not contain detailed information or tacit knowledge, for a checklist to be effective, it needs to be perceived as a simple functional tool by the project team. The length and the complexity of the checklist should be tailored to the task at hand. [4]

There are checklists for every project design phase in the project lifecycle, from predesign to post construction. Project phase checklists can be organized into categories according to the nature of the checklist and the level of detail.

Again, in order to keep the checklists more manageable, they should focus primarily on broad issues and will not be sufficient to serve as detailed technical task checklists. They are also adaptable to the size of the project.

2.1.1.1 General Phase objectives Checklist

For instance, in the Schematic Design (SD) phase, it is important for the architect to know what the SD drawings will be used for. Different uses require a different completion and quality levels. The general phase objectives also set the tone for the scope of the services intended for the phase, which is crucial and provides a great clarity. These objectives affect the percentage of fee earned in the phase, the labor needs, schedule implications and technology needed to generate the documents. Figure 2 shows the different uses for the SD phase documents. Figure 3 is an excerpt from the AIA Handbook of Professional Practice showing a General Phase objective Checklist. [4]
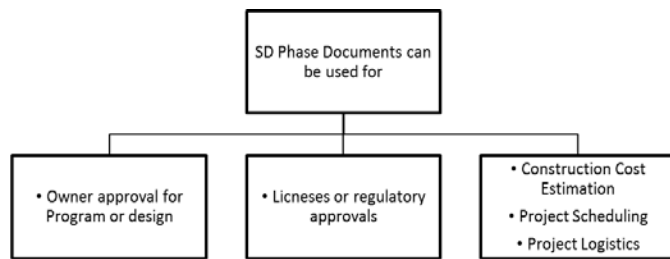
Fig. 2. Uses of Schematic Design (SD) phase documents –by Researcher

Fig. 3. General Phase Objectives Checklist – [6]

2.1.1.2 Phase Deliverables Checklist

The Phase deliverables checklist is used to share with the client, in order to have clear, established deliverables for each phase. This is crucial to avoid miscommunication and disputes. Figure 4 is an example of a phase deliverables checklist. The Phase Deliverables Checklist should naturally be in line with the Phase Task Checklist. [6]

Fig. 4. Sample of the Phase Deliverables Checklist – [6]

Making a checklist should be supported by the need to do so. This may be due to team errors made in the past or the expediency of having such a tool to track the progress. After a checklist is generated, it should be tested on a few projects, evaluated and then changed appropriately.

2.2 Process based systems

Despite the importance of inspection based quality systems, reliance on checklists and inspection alone does not guarantee that correct work will be delivered to the client. A more process-related approach is needed to assure a better product quality. Inspection based quality systems would not cover inspector oversight, or a team's incomplete understanding of a project's requirement. It also does not serve well in the era of technological advancement, globalization and increasingly more complicated building types.

Process based systems promote quality by incorporating quality reviews in to the process, instead of waiting to inspect the results at the end. They include, but are not limited to, ISO 90001, six sigma, lean systems and a customer- based approach/program. [8]

2.2.1 Process quality

Process quality aims to eliminate variance by minimalizing the human intervention. It aims to create automated systems and routines that would enable the staff to focus on other value-added activities. It follows the ideology of "*Fix the process not the problem*" —Harold L. Sirkin and George Stalk. A process quality system could be as simple as a basic software that assigns a job number once a project is under contract, and initiates automatic infill of client information for billing. This decreases human intervention and therefore minimizes the chance of human error. [8]

2.3.2 Lean systems

Lean systems thrive on the concept of eliminating waste within the process system. It is about smarter information flow and understanding how information is perceived and processed in order to become better communicators among ourselves and with the users of the service. It is summarized in several principles:

- Defining processes around the customer's needs and requirements not the internal systems of the practice. The value-added service and delivery to the customer is the first priority. The customer defines quality.
- Structuring work effort so projects 'flow' better, by identifying processes and tasks that contribute value (to the client) and eliminating those that don't.
- Reducing variation in the work method and in the deliverables produced.
- Identifying, eliminating or mitigating barriers and constraints that hinder the completion of good work.
- Pursuing perfection

These principles can be applied to architecture in several ways:

- Thinking through and resolving project issues such as codes and constructability during the earlier design phases and not allowing problems to accumulate.
- Determining what are the appropriate amounts of

documentation that effectively convey scope and intent

- Utilizing standardized sheets and details, and drawing the atypical situations only.
- Employing consistent drawing and modelling practices across the firm or office
- Viewing team members as internal clients; understanding the parameter affecting their work, ensuring that the information they require, along with that which they provide flows to all concerned parties in a timely and coordinate manner. [8]

3. DEVELOPING A QUALITY PLAN

In order to develop a quality plan, you should agree with the client to a certain level of quality during the project briefing phase. Quality is adaptable to the service and deliverables provided. A meticulous level of quality, although costly for the office and for the client, could be required for a certain phase, while a less detailed level of quality (in some areas of the project) could be welcomed by the client to compensate for the higher cost mentioned earlier. This is a customer centric approach, where the client decides the level of quality that they desire and are aware of the costs that go with it. Such decisions should be made early in the brief and contract negotiating period. [3]

Concerning the office quality plan, one of the most successful approaches is to treat quality as an organizational activity, with costs. There are 4 types of quality costs

- Prevention costs; embodied in staff training and education. This current cost would significantly affect future incurrences.
- Appraisal costs; reviewing and checking drawings and documents before delivery to clients (Owner or contractor)
- Internal failure costs; costs incurred due to process failure such as incomplete drawings.
- External failure costs; costs associated with failure after project delivery.

It is clear to see that as time progresses in the project, the damages incurred due to poor quality management are increased and with it the cost of fixing the damage and the effort required to restore the reputation of practice also increases.

3.1 RFI Metric Tool (Request for Information)

It is possible to utilize the RFI document as a tool to measure quality. According to the AIA the RFI is defined as an approved communication tool between the design team and the contractor. It is used by the construction team when drawings and specifications are incomplete (omissions), incorrect (discrepancies) or when unforeseen conditions or circumstances arise. [8]

RFIs can act as a post-delivery checklist to determine the quality by calculating the cost incurred based on labor hours required for rework. By developing a point system proportional to the number of hours needed to respond to different level RFIs a metric is established.

Type 1: Graphic/Confirming RFI. The most straightforward

type of RFI would take approximately one to two working hours. Could be a result of illegible information issues created during the Construction documentation phase. *Type 1 equals 2 points.*

Type 2: Coordination/Missing Information RFI: this type is more complicated to handle, it would take about 3-7 working hours. Could result from deficiencies in the construction documentation or design development phase. *Type 2 equals 5 points.*

Type 3: Code/Contract Information RFI: this type involves project scope errors or omissions. It is the most serious RFI to process, taking approximately 8 or more working hours. May be the result of issues overlooked earlier in the schematic design phase. *Type 3 equals 10 points.*

RFI Type	Labor Hours (LH)	Hour-Point	# of RFIs	Total Hour-Points
Type 1: Graphic/Confirming	approx. 1–2	2-hour point	4	8
Type 2: Coordination/Missing Information	approx. 3–7	5-hour point	2	10
Type 3: Code/Contract Information	approx. 8–12	8-hour point	1	8
Total Hour-Points				**26**

Fig. 5. RFI metric Table – [8]

By multiplying the frequency/number of RFIs with their equivalent score point, quantitative data is obtained that can be easily translated to cost (working hours). By obtaining numerical data grouped into types 1, 2, and 3 as earlier demonstrated, it is clearer to determine which type causes most liability/cost and so preventive measures are taken.

3.2. The Balanced Scorecard (BSC)

The architectural practice's value is generated by intangibles (people, expertise, intellectual property and knowledge) a balanced scorecard provides tools to identify, capture, and measure the activities within a firm. It also provides a mechanism to create holistic performance goals that include all aspects of a practice. In a BSC, each aspect supports its adjacent aspect. For example, people support processes, processes support customers, customers support finance and finance supports the organization. When using the BSC to monitor a certain goal first the goal is identified, then performance metrics are set to achieve that goal within each aspect. [7]

After using the RFI as metric tool, having fewer RFIs could be a firm's goal, Table 2 below shows the performance metrics set in order to work towards (and achieve) less RFIs.

TABLE 2
PERFORMANCE METRICS FOR FEWER RFIS

ASPECT	PERFROMANCE METRICS

People	Provide additional training for all staff members, junior, seniors and management.
Processes	Investigate the *tools* used to produce the construction drawings (e.g. CAD, BIM…) Investigate specifications, construction phase communication and feedback.
Customers	(Customers in the RFI phase are not just the client, they include the consultants, staff, contractors…) Review activities with customers, support new activities e.g. Kickoff meetings or more integrated services during construction.
Financial	Providing financial support for all the previous aspects.

3.3 ISO 9001

The International Organization for Standardization (ISO) is the world's largest developer of guidelines for best practices, helping to make all types of organizations more efficient and effective. The ISO 9001 system of Quality management is designed to help firms ensure that they meet the needs of clients and other stakeholders. The eight management principles shown below in Table 3 address the fundamentals of quality management and form the basis of the system. Third party certifications provide independent confirmation that organizations meet requirements. [4]

TABLE 3
ISO 9001 EIGHT MANAGEMENT PRINCIPLES

Client focus	Architectural firms are client centric, they depend on their clients and therefore should understand their current and future needs, meet their requirements, and strive to exceed their expectations
Leadership	Only firm leaders can establish unity of purpose and direction of the firm. They should create and maintain the internal environment in which staff can become fully involved in achieving the practice's objectives.
Teamwork	Staff at all levels are the essence of a firm, and their full involvement enables their abilities to be used for the practice's benefit.

Process approach	A desired result is achieved more efficiently when activities and related resources are managed as a process.
System approach to management	Identifying, understanding, and managing interrelated processes as a system contributes to the firm's effectiveness and efficiency in achieving its objectives
Continual improvement	Continual improvement of the firm's overall performance should be a permanent objective of the practice.
Evidence based approach to decision making	Effective decisions are based on the analysis of data and information.
Mutually beneficial consultant relationships	A firm and its consultants are interdependent, and a mutually beneficial relationship enhances the ability of both to create value.

The ISO 9001 is flexible and adaptable, registration to the ISO 9001 does not necessarily guarantee quality. Instead the ISO 9001 only confirms by a third party that the practice has accomplished what it set out to do. The ISO 9001 QM system is well suited to solving the QM needs of fast growing, larger practices, focused on business with diverse clients. Fig 6 shows different firms' characteristics and suggests which firms are more likely to benefit/use ISO 9001 systems for Quality Management.

Firm Characteristic	More Suitable/ Needed	Less Suitable/ Needed
Size	Large	Smaller
Location	Several branches	One office
Practice	National/ international	Local/regional
Focus	Business	Design
Project management	Discipline	Part of architecture
Culture	Rigorous practice	Creative freedom
Change	Fast growing	Established
Staff	Multidiscipline	Closely knit
Recruitment	Young talent	Stable staff
Expertise	Unique/diverse	Standard
Computer literacy	Firm-wide	Staff only
Clients	Diversity	Alike
Project types	Variety	Similar
Building technology	Highly technical	Standard practice
Project work plans	Detailed	Casual

Fig. 6. Suitability of ISO 9001 – [4]

4 CASE STUDY

Five architectural offices were chosen for this study. The initial

choice was made according to the office size (medium sized offices according to the number of employees), location (local offices based in Alexandria, Egypt) and office discipline (multidisciplinary office with architecture as a lead discipline). To guarantee research reliability, two offices were excluded because they showed biased answers and a lack of consistency. To ensure the validity of the research, and justify the choice of case studies, a snow balling technique was used where each office recommends two other offices for the next specimen.

An interview with semi-structured and open ended questions was conducted with the practice-owner, the design manager and most of the employees (random sampling).

5   RESULTS & DISCUSSION

Results showed that 64% of the participants believe that Quality management is practiced in their office, 21% claim it is not practiced and 14% are uncertain or say it is not practiced regularly or officially.

Fig. 7. Survey results - % of participants with QM practiced in their office. -

When asked how quality was controlled in the office, 90% of participants answered "by revision" either superior revision or peer revision. 10% answered by inspection, as in 'over the shoulder review' but there were no participants that said they follow any process based system such as ISO 9001 or any guidelines for the production process.
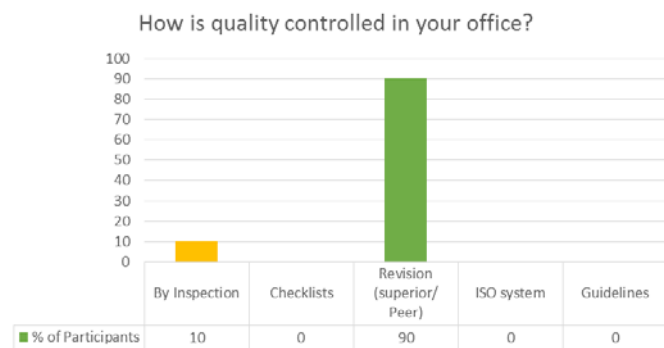

Fig. 8. Survey Results – most popular method for controlling architectural design quality in offices. – By Researcher

These results show that 100% of the participants follow an inspection-based process of quality control rather than a pro-

cess-based method. There is no correct or incorrect method of quality control, however having a process-based method could prove less time and effort consuming.

Results also showed that only 30% monitor their RFIs and only 30% agree to a quality plan prior to the project.
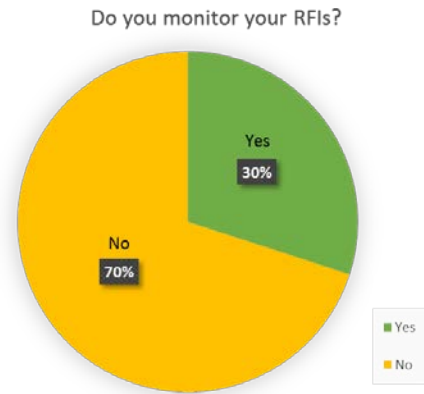

Fig. 9. Survey results – Percentage of participants who monitor their RFIs – By Researcher

Fig. 10. Survey results – percentage of participants who agree to a quality plan prior to the project. – By Researcher

Monitoring RFIs is very important as it is the only measurable method to determine the effectiveness of the product. A result of only 30% of participants that monitor RFIs is unsatisfactory, which leads to the following question, perhaps they use another method to quantify the quality level of their product. The survey showed that 60% of participants determine the quality of their final product by the comments of the contractor, consultant or superior. 13% determine the quality level by experience, 13% by the number of RFI received and 13% by following a checklist or set of guidelines to produce the document. It is notable that the comments of the contractor/consultant or superior is undocumented. There is no measure to the number or severity of comments received. Which renders this approach as inadequate and non-quantifiable. It was also observed that no offices followed the BSC approach for goal-setting.
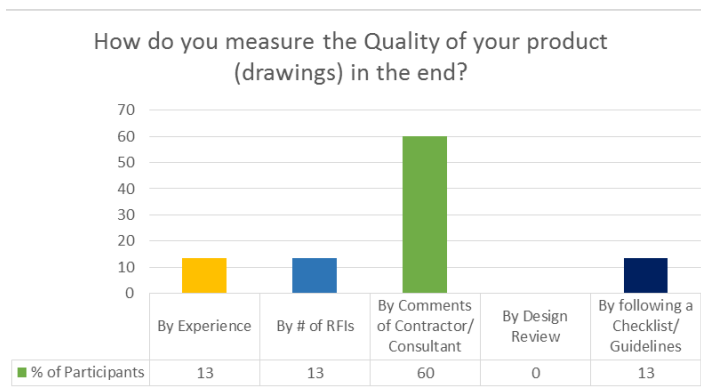
How do you measure the Quality of your product (drawings) in the end?

	By Experience	By # of RFIs	By Comments of Contractor/ Consultant	By Design Review	By following a Checklist/ Guidelines
% of Participants	13	13	60	0	13

Fig. 11. Survey results – Most popular methods for determining the quality of the architectural design product in the end. – By Researcher

6 CONCLUSION

Quality management should not be a separate activity within a practice. Instead, it should be an integral part of the way a practice is managed. It is more than making sure that deliverables are as accurate as required and meet the expectations of the customer. A quality *system* establishes policy and responsibilities, it measures and improves firm processes and deliverables which helps drive firms towards success and growth. A system should be firmly and clearly implemented, it should be a mix of both methods; process based and inspection based (as a second line of defense). A set of working procedures/manual should be announced in each office for all employees.

Quantifying the level of quality is crucial, this research concludes that using RFIs as a metric tool is a promising method to be able to measure the level of quality. Also applying BSC is a promising methodology to reach targets.

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