Tracking Construction Documents Development Process in an Architecture & Engineering Firm

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Abstract *— A local Architecture & Engineering firm needed to evaluate current option to track the Construction Documents Development Process. They wanted to know what new technologies or strategies are available to reduce production cost, and track progress and quality. They studied their Construction Documents Development Process, researched what National organizations are publishing, researched technology applications, identified key performance indicators to track progress and quality, and defined project team members roles and responsibilities. Results demonstrate procedures must be in place for progress and quality reviews to culminate each project development phase, industry national organizations do offer updated guidance in publications and their websites, tracking at the project, phase and task level will document progress and improve quality, and clear roles and responsibilities empower team members to do better, more focused work, and help boost operational efficiency by reducing confusion and redundancies.*

Background

A local Architecture and Engineering (A & E) firm founded in the 1960's has transformed its business model to keep up with the impact of technology advancements in the industry. The construction documents development process is critical for the success and profitability of an A & E firm. Drawings were drawn by hand on drafting tables. Then came computer aided design, when technology like AutoCAD eliminated the need of drafting tables. Current 3D modeling tools like REVIT are revolutionizing the industry.

The A & E firm is facing an opportunity of a lot of work resulting from the recovery effort after hurricane Maria. It is a great moment to put procedures in place to scale up the operation and analyze the impact of new technologies in the construction documents development process to improve quality and profitability.

Objective

The objective of this project was to evaluate options to track the construction documents development process to collect data to make informed decisions towards:

- Identify Key Process Indicators to collect process data.
- Reducing production cost
- Improve quality control – reduce risk
- Insert new technology to benefit the process.
- Increase profit.

Methodology

- Study the current construction documents development process.
- Research the publications by industry national organizations.
- Research technology applications available
- Identify key performance indicators.
- Define a progress tracking strategy
- Establish a quality control program.
- Establish roles and responsibilities.

Results

Construction Documents Development Process

Projects are typically developed in phases. Table 1 presents an example of a project broken down into phases. In the initial phase, Pre-Design, the architect focuses in understanding the client goals and objectives and transforms them into a space program and design concept. The construction documents are developed in phases 1 thru 4, as shown in Figure 1.

Once the construction documents are completed, they are issued for bid or negotiated with a contractor**.** The Services During Construction phase consists of submittals and RFIs review and periodic site visits. Project Closeout phase is the final punch list to complete the construction and obtain occupancy permit [1].

Project managers define project budget and resources for proposals and when projects are awarded, guide teams to execute the project within the parameters established. Traditional strategies to define resources and budget to execute construction documents include:

- Estimating quantity of drawings and assigning a cost per drawing.
- Calculate cost of resources in alignment with the project schedule.
- Use values tabulated by local regulators based on a percentage of the construction cost.

Table 1
Project Phases

	Phase	% Fees	$ Fees	Hours
1	Pre-Design	2	4,000.00	40
2	Schematic Design	10	20,000.00	200
3	Design Development	23	46,000.00	460
4	Construction Documents	37	74,000.00	740
5	Bidding/ Negotiations	2	4,000.00	40
6	Services During Construction	25	50,000.00	500
7	Project Closeout	1	2,000.00	20

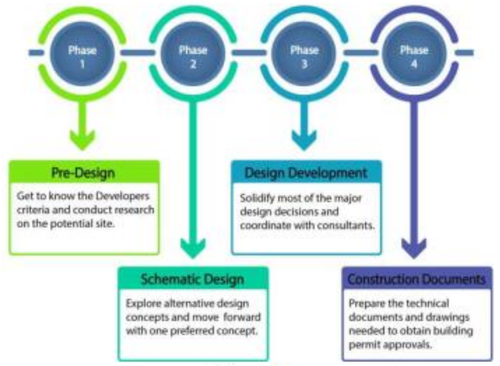


Figure 1
Construction Documents Development Phases

Industry National Organizations

The *American Institute of Architects* publishes and regularly updates "The Architect's Handbook of Professional Practice". It contains guidance in business, legal, and technical trends in architecture.

The *Project Management* Institute publishes and updates regularly "The Standard for Project Management" and "A Guide to the Project Management Body of Knowledge".

ISO 9001 Quality Management is a standard related to quality management that awards certifications that are recognized in the industry as a symbol of top quality.

Technology Applications

There are many apps for project management. Few are tailored for Architecture and Engineering firms' management.

- BQE Core is the most complete app studied. It was designed by an architect for architects with colorful graphics and friendly interface but lacks human resources and accounting capabilities.
- Procore is a powerful tool for Construction Project Management, but it is not geared for the design phase. Could be adapted to include the design phase but their pricing structure is attached to project construction cost [2].
- Bluebeam is a great tool for drawings coordination and tracking.
- Bill Quick: Predecessor of BQE Core. Capable to track the hours and expenses of projects.
- Teams: Microsoft communications application for teams is useful for remote meetings, team communication and information sharing. Add-ons for project management to consider are:
  - Tasks - Has an attractive dashboard to see the entire project. Limited reporting capability.
  - Approvals - Could serve to force QC review by mangers prior to issuing deliverables.
  - Timeclock 365 is a time tracker within 365 but it requires a subscription.

There is a trend towards monthly subscription per user for project management which could be a burden for small firms and defeat the purpose to reduce operational costs.

Key Performance Indicators

Key Performance Indicators are used to monitor Project Development progress, quality, and other project characteristics to ultimately measure return of investment and make decisions considering impact on profit.

Progress Tracking

Project Managers should track separately the deliverables of each project phase [3]. To track deliverables progress within each project phase, tasks required to accomplish each phase must be tracked. Each project must start with a project execution plan defining phase, deliverables, resources, roles, and responsibilities.

Tasks to be tracked during the Pre-Design phase include space programming, adjacency diagrams, conceptual presentations, code review, typology research. New tasks resulting from technology advances include 3D modeling and renderings

Task to be tracked during the Construction Documents Development phase include demolition plans, floor plans, furniture plans, equipment plans, finishes plans, ceiling plans, ceiling details, roof plans, roof details, signage plans, life safety plans, enlarged plans, kitchen enlarged plans, restrooms enlarged plans, stairs enlarged plans, elevators enlarged plans, elevations, sections, wall sections, wall types, door schedule, hardware schedule, and windows schedule.

Deliverables for each phase must be defined in the project execution plan to have a metric for evaluation of completeness at each phase checkpoint.

Other tasks to be tracked are field data gathering, existing condition documentation, reports, cost estimate, communications, meetings, meeting minutes, schedule, action items list, QC review, materials research, and LEED.

The tracking dashboard should include hours per cost contracted and spent per phase and task. Tools for tracking projects progress include deliverables lists, checklists, progress reports, schedules, and time sheets.

To document effort, employees must enter their time and assign it to a project, phase, and task. This collects information such as details of how many hours were taken to complete floor plans.

To compare effort required to develop projects, more information is needed than just the hours and cost spent. Important project information for future comparison is the following:

- Square foot area of new construction.
- Square foot area of renovation.
- Building Typology
- Construction cost
- Construction cost per square foot
- Duration to accomplish each task

Quality Control

Implementing a quality control program will result in less re-work and an increase in productivity [4]. A quality program should start with standardization. Standards will help maintain consistency in the way projects are developed.

Standard templates can be created for deliverables lists, progress reports, schedules, time sheets, meeting minutes, progress reports, letterhead, transmittals, e-mail signature, technical specifications and drawings.

In alignment with the Project Development phases, a phase gate or quality assurance (QA) meeting must occur. QA meetings are a cross discipline coordination meetings prior to every deliverable with ample time to adjust deliverables before the due date with the client. In the QA meeting, the drawings are reviewed for general coordination, constructability, and to determine the status of the drawings. A QA log is generated listing cross discipline coordination pending items and other observations to track them and make sure they are corrected.

Checklists will be used to verify compliance with standards, and project requirements such as space program, site conditions, or design guidelines. Checklists can list deliverables for each phase and task.

QA meetings are a great opportunity for junior architects to learn how to put together a set of construction documents. Discussion and action items must be documented for follow-up. Project documentation should have Lessons Learned and Opportunities sections for improvement.

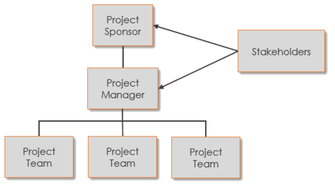
Other opportunities for QC are the drawings review by the cost estimating team. Cost estimators identify tasks that cannot be estimated and therefore cannot be priced by contractors. Technical specification writers can identify materials with incomplete information for bid.

During the bidding process, is a good practice to go over the drawings and technical specifications with the lower or preferred bidder to confirm complete understanding of the project scope prior to awarding the project.

Roles and Responsibilities

Clear roles and responsibilities empower team members to do better, more focused work, and help boost operational efficiency by reducing confusion and redundancies. Typical project roles include:

- Project Director – Responsible for administrative tasks related to the project.
- Project Manager – Leads team to execute projects. Develop project execution plan.
- Project Discipline Lead – A licensed architect or engineer responsible for the design of a discipline. Leads discipline team thru the project.
- Project Support Architect or Engineer – Architect or engineer in training developing drawings under the supervision of the discipline lead.



Conclusions

To track the construction documents development process, a standard procedure must be in place that establishes QA review meetings with reasonable time before deliverables deadlines with clients to complete each project phase. National organizations have publications that can be referenced about project progress and quality tracking.

Technology apps offer attractive options, but ROI must be carefully evaluated because they can be costly. Key Performance Indicators must be tracked at the project, phase, and task level. Standard Procedure will collect data which can be analyzed and compared to make informed management decisions.

Projects must have an execution plan with defined phases, deliverables, roles and responsibilities. Checklist can be used to measure progress and quality at each project phase. Clear roles and responsibilities empower people to do better, more focused work, and help boost operational efficiency by reducing confusion and redundancies.

Future Work

The following actions could be taken to continue developing this project:

- Analyze data collected by tracked projects to identify patterns and opportunities for process improvement.
- Study ISO 9000 requirements to adjust typical execution plan to comply with standard to apply for certification.

References

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[2] Project Management Institute, Inc., Chapter 1 Section 1.2.4.3 "PHASE GATE", in "A Guide to the PROJECT MANAGEMENT BODY OF KNOWLEDGE", Sixth Edition, pp. 21

[3] R. L. Hayes, Ph.D., AIA, in chapter "12 Quality Management", in "The Architect's Handbook of Professional Practice," 15th ed. Hoboken, New Jersey, Wiley, 2014, ch. 12, pp. 813.

[4] Alex Caya. (2021, January 20). Using Procore During Design and Preconstruction to Set Your Projects Up for Success (1st edition) [Video]. Available: http://www.https://www.youtube.com/watch?v=sZ903InFT7I.