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Preparing a Project Manual: A Comprehensive Project View

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In partial fulfillment of the requirements for a capstone project, Construction Management students are required to prepare a construction project manual, in addition to developing a complete proposal for a construction project, responding to a request for proposals (RFP). In previous years, students found it easier to copy and paste procedures from existing construction companies' manuals, acquired through their co-op experiences, which lacked consistency as they reflected the experiences of different employers, and focused primarily on the construction phase of the project. A new experiment was conducted requiring the students to prepare a project manual from scratch, to cover the project in its different development phases; Initiation, Pre-Design, Design, Pre-construction, Construction, Handing over, and Commissioning. Developed procedures had to be self-contained, including their purpose, scope, definitions, Key Performance Indicators (KPI), and any relevant forms or checklists. Additional components included a Responsibility Assignment Matrix (RAM), and a newly coined term TPRC which stands for: Tools, Personnel, References, and Controls. A flowchart was developed for each procedure to graphically represent the flow of its activities, as well as its inputs and outputs. The final deliverable consisted of a multi-phased manual, sorted by project phase and reflecting the points of views of the parties involved. Deliverables were evaluated and judged by a panel of construction professionals from the local industry, representing different project roles on a project team (Client, Developer, Financiers, Designer, Construction Manager, General Contractor, Subcontractors, and Users).

Keywords: Construction Management, Project Manual, Project Lifecycle, Capstone Project, Knowledge Management

The Project Manual Background

Capture, documentation, storage, retrieval, dissemination, and use of past experience in construction projects are some of the keys to success in the construction industry (Cooke-Davis, 2002). Companies that do not capture such knowledge tend to repeat the same mistakes from one project to another (Schindler et al, 2003). Knowledge management is the area responsible for creating a structured framework through which all the previous functions can be performed. Its infrastructure consisting of technology, structure, and culture, along with knowledge process architecture of acquisition, conversion, application, and protection (Gold et al, 2001). Knowledge management is the area responsible for creating a structured framework through which all the previous functions can be performed. A project manual is a medium for the concentration of an organization's past experience, and its standardization in the form of operational procedures (Robinson et Al, 2005). Most previous efforts at developing a project manual were limited to the scope of the organization for which that manual was developed, and limited to its role within the project and its interaction with certain limited aspects of the project depending on that role. This paper discusses a comprehensive effort at developing a "Project" manual rather than a "Project Team Player Manual".

Problem Statement

In partial fulfillment of the requirements for graduation, graduating seniors participating in the capstone project had to submit two separate deliverables over the span of two consecutive academic quarters. The first of these two deliverables is a project manual, representing the procedures to be followed to manage a construction project. A

great advantage to the students is the co-op system adopted by the University, allowing for students to alternate academic semesters between classes and practical experience with different regional and national construction organizations. By the time of graduation, each student would have acquired four semesters (almost 1.5 years) of professional hands-on experience.
Historically, instead of developing the project manual on their own, students resorted to copying and pasting, or as it was referred to "integrating" procedures already followed by their co-op employers. The result was an inconsistent manual reflecting different practices belonging to construction organizations with different objectives, and performing in different fields of the construction industry (Residential, Commercial, and Heavy Civil). In addition, the manuals were primarily developed from the point of view of a General Contractor, or a Construction Manager, and catering primarily to the activities performed during the pre-construction and construction phases of the project.
The second deliverable, to be developed in the following academic quarter, consisted of a complete proposal responding to an RFP, and representing a complete project proposal including a cost estimate, a time schedule, and an integrated project management plan addressing project scope, safety, risk, communications, sustainability, and quality.

A New Approach for the Project Manual

Upon taking responsibility and ownership of the capstone project, the author embarked on a redesign of the first deliverable, the project manual, to represent a bottom-up effort based on a team approach, addressing the project from the point of view of the project life-cycle, rather than addressing limited phases therein, and conforming to a standard and consistent format representing the different procedures included in the manual.
This paper documents the process of developing the manual in its new format, including the standard components of each of the procedures included therein which can be listed as:

A- Procedure title and number
B- Purpose
C- Scope
D- Definitions
E- Inputs / Outputs
F- Procedural steps
G- Responsibility Assignment Matrix (RAM)
H- Tools, Responsibility, Reference, and Controls Chart (TPRC)
I- Key Performance Indicators (KPI)
J- Flow Chart
K- Forms and Templates

The manual development process started with a breakdown of the project life-cycle into different distinct phases, starting with the project initiation phase that results in a decision of "Go / No Go" for the project. In case of a Go, the main deliverable from this phase is a project charter, outlining the main project objectives, assumptions, risks and plans to manage them, and a feasibility budget depending on preliminary studies and estimates. This is followed by a pre-design phase, starting with the criteria for the selection of a design professional, and ending with a contractual agreement between an Owner and a Design Professional. The third phase is the Design phase, starting with schematic design, followed by design development, and ending with the development of the construction documents to be issued in the following phase in the form of a tender, or a Request for Proposals (RFP). The following phase, building on the produced deliverables in the previous phase, is pre-construction, starting with setting the criteria for contractor selection, and ending with a signed agreement in the form of a contract between the Owner and a construction professional, or Contractor. The fifth phase is the physical execution of the project, or construction, ending with a physical transformation of the project documents into a real project. The project life-cycle, as the project manual is concerned, ends with the final phase of handing over, commissioning, and the start of operations of the completed project. These phases are graphically represented in Figure 1.

Figure 1: Project Life-Cycle

Best Practices and References

The development of the project manual took into consideration the incorporation of the best practices through three means; the selected references, the synergy of the team, and the cross organizational experience.
The references utilized as benchmarks to develop the project manual were selected to reflect the best practices according to well established organizations including the Project Management Institute (PMI) through the Project Management Body of Knowledge 4th edition (PMBOK), the Construction Management institute (CSI) in the form of the Project Resource Manual, and the International Standards Organization (ISO) in the form of the ISO 9000 quality standards.
Instead of being an individual effort, it was decided that the project manual will be a group effort, through the interaction of several individuals with different practical experiences. Teams of five students were formed, which allowed for a synergistic and competitive environment, as each team strived to have an edge over the other teams. The formation of teams allowed for cross sectional knowledge transfer among the team members representing different construction organizations including developers, designers, construction managers, contractors, and specialty sub-contractors.

Project Manual Development

The project manual development started by looking at the larger picture, and deciding on the number of procedures to be included in each phase, taking into consideration the short time frame available due to the quarter schedule (10 weeks of instruction time). The main deliverable out of this effort was a general map of procedures, listing the number of procedures in each project phase, and linking them in a logical order through a network-like diagram reflecting any interdependence and flow continuity. The general map of Procedures was color coded to visually reflect the project phase to which each procedure belonged. Also included in the map were stage gates or milestones denoting the start or finish of a project development phase, and following the logical decision making points along the project development effort. Figure 2 shows the General Map of Procedures which were divided primarily into four groups; technical (Initiation, Design, and Construction), Financial, Human Resources, and Quality of the system.
After listing the proposed procedures, and due to the abovementioned time limitations, the exercise was limited to the deep coverage of the technical procedures only.

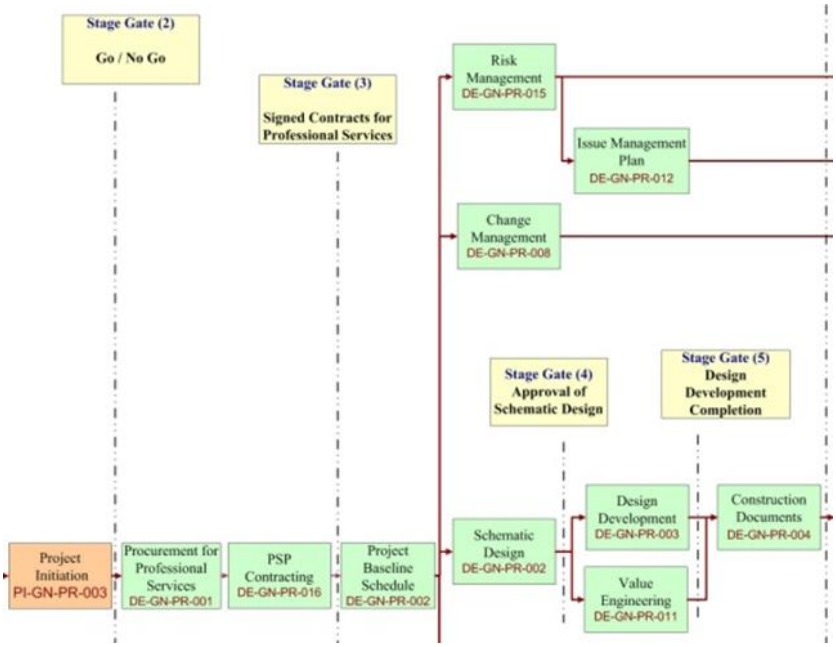

Figure 2: General Map of Procedures

Procedure Standard Format

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In an attempt to standardize the outputs, a standard format was provided for the students to follow as a template, allowing for a quick and meaningful comparison between the different teams' outputs, and the exchange of experiences among students. As mentioned earlier, each procedure was designed to be self contained, including all relevant information pertaining to that procedure as well as methods of assessing its efficiency. The following elements were selected to be the standard components of each procedure:

A- Title and Number: Each procedure was given a serial number reflecting the phase to which it belongs [Initiation, Design (Including pre-design), Construction (including pre-construction), and Commissioning, as well as its order within the phase.

B- Purpose: A brief description of the purpose for which this procedure is prescribed.

C- Scope: A brief description of what is covered, or not covered within the scope of this procedure.

D- Definitions: A listing of the different terms used in the procedure, and what are they meaning for that particular procedure.

E- Inputs / Outputs: A listing of required inputs for the procedure to start, including both outputs from other procedures in the form of forms or deliverables, as well as external inputs. Listed also are the outputs from the procedure and how they may serve either as an end product, or as an input to a following procedure.

F- Procedural Steps: A bulleted verbal description of the sequential steps or activities involved in the procedure, together with the required forms/documents pertaining to each step. The documents were hyperlinked so that the user can access them in digital format upon clicking on their reference.

G- Responsibility Assignment Matrix (RAM): Representing the interaction among different participants in the procedure and showing their particular responsibilities within each of its steps. The responsibilities included Lead Action (or Ball in Court), Secondary or Part in Action, Review, Approval, or Information. Figure 3 shows an RAM.

A	Approve
B	Lead Action
I	Information
P	Part in Action
R	Review

Notes:

The Design Consultant will incorporate any remarks or modifications included in the Construction Documents review prior to issuing the construction Documents for procurement of construction services.

Topic: Construction Documents	Responsibility							
Activity	CEO	PM	TG	DC	PMC		GC	
1. Produce Construction Documents	I	A	P	B	R			
2. Prepare and Issue for Procurement	I	A	P	P	P		I	

Figure 3: Responsibility Assignment Matrix (RAM)

H- TPRC Chart: Which stands for Tools, Responsibility, Reference, and Controls chart. The tools determine what software or techniques will be used, Responsibility lists the parties involved, Reference lists the reference sources including codes, best practices, and lessons learned from previous projects (also referred to as organizational process assets), and finally Controls include the control measures to gauge the results of the procedure. Figure 4 shows a sample TPRC chart.

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Tools	Personnel
- Qualifications Based System - Technical comparison and evaluation - Financial comparison and evaluation	- Project Manager (PM) - Professional Service Provider (PSP)
Reference	**Control**
- Prequalification Criteria - Evaluation Criteria	- Compare schedule to Projected Project Duration Estimate - Compare offer to Projected Project Budget - Review of technical and financial proposals

Figure 4: TPRC Chart

I- Key Performance Indicators (KPI): Representing measures of the procedure efficiency. These KPI could be raw numbers (such as the EMR reflecting the Contractor's safety record and used for contractors' pre-qualification) or an index (such as a Scheduling or Cost Performance Index used in the Earned Value Analysis to report on the project progress). An explanation of the different values of the KPI were also provided to reflect the outcome of the measured task (> 1 is good or <1 is bad). Figure 5 shows a sample of the developed KPI for the design manual.

KPI Summary Table - Design Manaul

No.	KPI	Equation	Interpretation		
			>1	=1	<1
Procurement for Design					
1	Tendering efficiency	Number of tenders issued / Number of contracts signed	Bad	Good	NA
2	Tendering time efficiency	Actual duration of tendering process / Estimated duration of tendering process	Bad	Acceptable	Good
Schematic Design					
3	Budget conformance Index	Modified (Updated) project budget / initial project budget from previous phase	Bad	Acceptable	Good
4	Schedule Conformance index	Projected construction duration / estimated construction duration from previous phase	Bad	Acceptable	Good
Design Development					
5	Value Index	Cost/Worth For Value Engineering (VE) Evaluation	Use VE	Neutral	Don't use VE
6	Budget Compliance	Revised (Updated) budget Projection / Original budget Projection	Bad	Acceptable	Good
7	Schedule Compliance	Revised Schedule projection / Original schedule projection	Bad	Acceptable	Good
Construction Documents					
8	Estimate Accuracy	Construction Documents Cost Estimate / Project initiation Cost Estimate	Bad	Acceptable	Good
9	Duration Accuracy	Construction Documents Duration Estimate / Project Initiation Duration Estimate	Bad	Acceptable	Good
Design Baseline Schedule					
10	Schedule Performance Index (Ratio) (SPI or SPR)	Earned Value (EV) / Planned Value (PV)	Good	Acceptable	Bad
11	Cost Performance Index (Ratio) (CPI or CPR)	Earned Value (EV) / Actual Cost (AC)	Good	Acceptable	Bad

Figure 5: Sample KPI

J- Flowchart: A graphical representation of the different steps of the procedure, together with decision forks, loops, and inputs and outputs. Microsoft Visio was used for the development of the flowchart providing the standard symbols for flowcharting and a suitable means for communicating the flowcharts as they can be exported to different formats. Figure 6 represents a sample flowchart.

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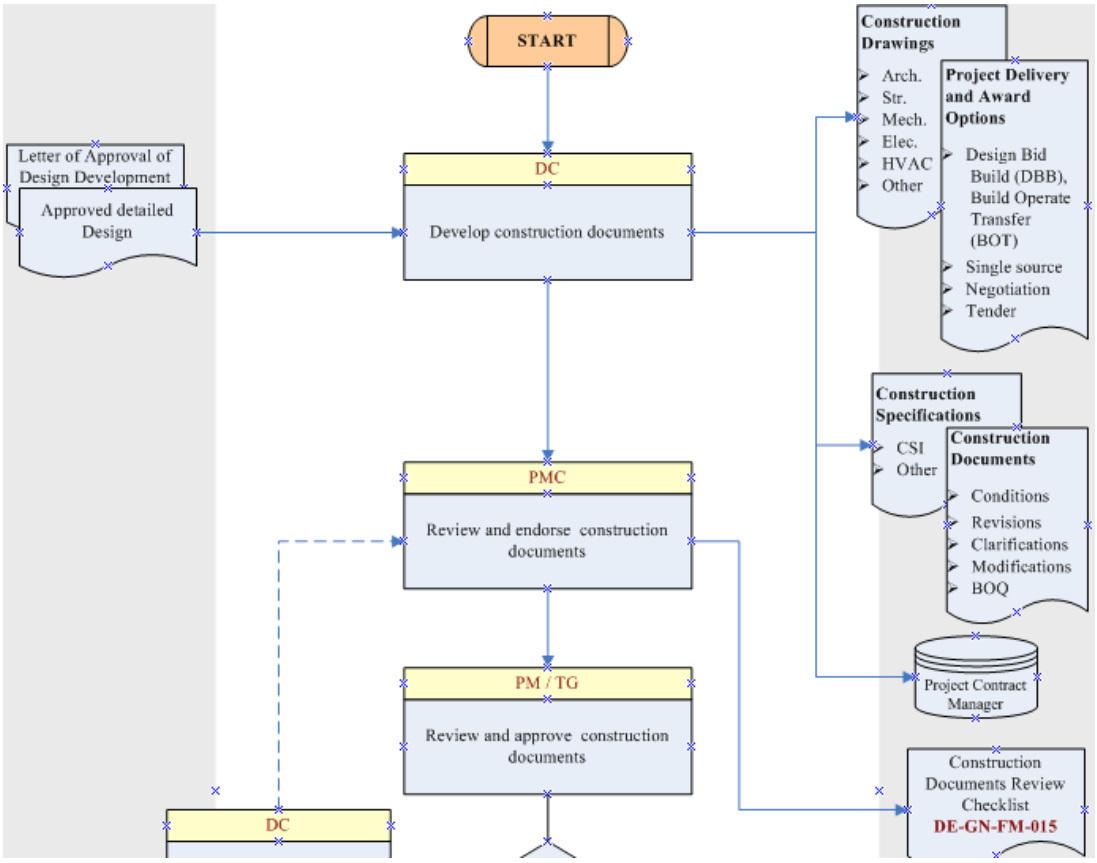

Figure 6: Procedure Flowchart

K- Forms and Templates: Including any forms, attachments, or templates referenced in the procedure, or serving as inputs for its start, or outputs from its completion. As mentioned earlier, all attachments were in a digital format, and were hyperlinked in the procedure's body, allowing for easy access. The templates were provided in an editable form format to facilitate data entry.

Manual Evaluation and Assessment

Pre-course and post-course surveys were conducted to measure student awareness of construction procedures and to gauge their learning/retention at the end of the course. During the interim submittals of the project manual components, students had to present their findings and developed procedures to a panel of industry experts representing different aspects of the construction industry (Owners, Developers, A/E or Designers, Construction Managers, General Contractors, Specialty Contractors and subcontractors), and incorporate the feedback in their following submittal cycle. Upon completion of the project manual, a final presentation to the same panel was made with a session of questions and answers to reflect the students' understanding of the procedure, and their rationale for the selection of forms and KPI. In addition to the verbal discussion, each judge on the panel was required to fill an individual evaluation form highlighting the positives, the deficiencies, and suggestions for further improvement and future development. The judging panel displayed interest in the process, and showed enthusiasm about both the student understanding and depth in the coverage of the procedures.

A survey is sent to graduates one year after graduation asking specific questions related to the areas of strength and deficiencies experienced during their academic career, and one of the consistently reported strengths is the broad understanding of the project stakeholders, their views and interests in the project, and their method of interaction through processes and procedures during different project phases. Recent graduates are invited to address their undergraduate colleagues during different events sponsored by the Construction Management Club (the CM student organization), where they report on their experience and their roles within the project team, and again, the project manual is one of their favorite exercises that facilitate their interaction with other team members.

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Suggestions for Improvement and Future Development

Many participants in the judging panel suggested further elaboration on the project manual to cover the following aspects:

1- Non-traditional project delivery methods including Integrated Project Delivery (IPD) and Design Build (DB)
2- With the growth of sustainability awareness, special procedures addressing sustainability issues during different project phases
3- With the growing trend of Building Information Modeling (BIM), special procedures addressing its use and the resulting impact on project functions (Time, Cost, Quality, Risk, etc.)
4- For project owners/users/operators, special procedures addressing the operation and maintenance up to the deconstruction or disposal of the project at the end of its service life.

Conclusion

Project manuals are an important tool for professional organizations to standardize their practices, document their project outcomes, and learn from past experiences, leading to better performance and an increased probability of success in future projects. Student involvement in the development of a construction project manual gives them better understanding of the different operations involved in managing a construction project, as well as the interaction between the different project team members along the project development cycle. Looking at the project from the point of view of the contractor is not enough to convey the efforts preceding prequalification for contractors which is performed in the pre-construction phase. Addressing the project from inception to completion reflects all the different parties' interactions and involvement in the management of the project. Standardization for the format used in developing the procedures leads to the ease of access of information and expedites editing the manual for future revisions.

References

Cooke-Davis, T. (2002). The "Real" Success Factors on Projects, International Journal of Project Management, (20) 2002 185-190

Schindler, M; Eppler, MJ (2003), *Harvesting project knowledge: a review of project learning methods and success factors*, International Journal of Project Management, - Elsevier

Gold, A. H.; Malhotra, A; Segars, A., (2001), *Knowledge management: An organizational capabilities perspective*, Journal of Management Information Systems.

Robinson, H., Carillo, P., Anumba, J., Al-Ghassani, A. (2005). *Knowledge Management Practices in Large Construction Organizations*, Engineering, Construction and Architectural Management, Vol.12 No. 5, pp.431-445

Project Management Institute. (2008). *A guide to the project management body of knowledge* (*PMBOK® guide*) (4th edition), Project Management Institute, Newtown Square, PA.

The Construction Specifications Institute (2005). *The Project Resource Manual: CSI Manual of Practice (5th edition),* McGraw Hill Publishers, ISBN 0-07-147398-X

International Standards Organization (ISO) *Quality Manual ISO 9001: 2000*