



**De La Salle University**

**Web-based Document Management System for Shop Drawings**

**A Practicum Report  
Presented to  
The Civil Engineering Department  
Gokongwei College of Engineering  
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## **ABSTRACT**

As construction project management team of the Solaire Metro North Project, the team has several processes like administrative submittals, progress photos, product data and samples, daily construction reports, shop drawings order, etc. During the practicum program, the intern learned that there is a need to better the existing documentation system not to lessen the team's productivity and focus on their actual work and not wasting their time checking and reviewing papers or filing them. This practicum will focus on the review of the existing manual document management system to identify its gaps and weaknesses specifically those related to submission, routing, consolidating and inventory of the shop drawings used for construction to come up with a proposed procedural workflow and controls in preparation for the development of a Web-based Document Management System for Shop Drawings. This paper is limited to the preparation of detailed guidelines in developing a web-based document management system as it is not the intern's expertise to create such a system. Various literature has been reviewed and involved parties were interviewed to identify the strengths and weaknesses of the traditional existing document management system. The existing system's efficiency shows that it is slow in terms of routing and approval since it is done manually and not in parallel. In contrast, the proposed system can route instantly and check the drawings parallel with each designer/consultant. The proposed system utilizes chat boxes for communication of each user involved, storage of the file uploaded, and approval and revision of the files; hence, it would make the submission paperless. It is recommended that if the proposed system is implemented, training should be conducted for the staff from the project's involved companies. Capacity building is needed so that there would be an awareness of how the proposed system works. Once implemented, this system can ease the workload of document controllers, admin assistants, or even engineers who are having a hard time with internal audits and safekeeping of hundreds and hundreds of construction files and folders.



## CHAPTER ONE

### INTRODUCTION

#### 1.1 Company Background

Design Coordinates, Inc. (DCI) is one of the leading Construction Project Management companies in the country. Its network of fully capable and highly trained professionals makes DCI a renowned domestic company in the field. Their organization, composed mainly of construction project managers, engineers, architects, and technical personnel, has proven their integrity and commitment to their careers throughout the years (DCI, 2015).

Steered by a strong vision to deliver superior construction project management that passes all quality standards, Architect Oscar S. Salvacion established DCI in 1978. Since its inception, DCI has continuously improved its system, making it reputable today (DCI, 2015). They managed to take care of their excellent track record, which is visible in their portfolio. They were also able to build trusted partnerships with clients from various industries.

The founder, Arch. Oscar Salvacion, graduated with a BS in Architecture from the University of Santo Tomas. He ranked 9th place in the licensure examination for architects during his time. As an achiever and wholesome professional, his local and international experiences in the industry have driven DCI to become the leading Construction Project Manager in the Philippines (DCI, 2015). Today, his legacy remains to be the propelling force in the company's commitment to providing the highest standards in the field of Construction Project Management as can be seen in their vision in which they pledged to "...consistently be the trusted Construction Project Manager and partner in nation-building by providing quality service exceeding expectations" (DCI, 2015).



DCI's mission "...to provide the highest quality construction project management service that meets cost, time and quality objectives in all phases of project delivery" (DCI, 2015) enabled them to address the need for professional Construction Project Managers in the country. Their policy also ensures meeting expectations reliably and aware of the importance of a natural, healthy, and safe environment while managing and delivering every construction project in a timely and economical manner.

From a small company of around 30 employees in the '70s, DCI expanded its company with more than 400 professionals even after the untimely demise of its pioneer in 2011 (DCI, 2015). This was made possible because of the unceasing improvement of their system, which was proven effective throughout the years.

DCI's latest system and approach in project management broken down into five subprocesses: Initiating (Start), Planning (Plan), Executing (Do), Monitoring and Controlling (Check and Act), and Closing (End). These widely acclaimed process groups of DCI adapted in PMBok's Project Management Framework (DCI, 2015).

The Project Management Body of Knowledge (PMBok) framework is one of the various project management frameworks. However, the most popular one is the most popular one since most project management professionals are certified by the Project Management Professional (PMP) certification. This type of certificate was sponsored by the Project Management Institute (PMI.org), which produced the PMBok (Hassib, 2018). Architect Salvacion adapted this into DCI's methodology, introducing in the Philippines an exceptional project management framework.

The first process group of DCI's system is initiating. In this subprocess, high-level planning is done considering the numerous constraints of the project. Some of these are scope and nature of work, the time required to finish the project, cost and budget, quality, risk and hazards, available resources, and client satisfaction (DCI, 2015). All the foreseeable situations that may affect the construction and project delivery are being identified from the start to ensure the project's success.

After initiating, detailed planning is being conducted so that all the considerations will be worked out, and potential problems will be solved throughout the





construction. Plans on performing, monitoring, controlling, and closing the project completed in this phase (DCI, 2015). The next subprocess is executing, wherein the project team, composed of relevant professionals, completes the tasks following the plans prepared.

The execution itself is not enough to ensure the project deliverables' quality and timeliness thus, monitoring and controlling is part of DCI's process groups. While work is being performed, the team tracks and directs the project concerning the baselines. Lastly, the project team oversees closing the project. This is the concluding phase wherein the project's works, including procurement, are finalized (DCI, 2015).

## **1.2 Objectives of the Practicum**

This practicum will focus on the review of the existing manual document management system used in submission and approval of shop drawings in which the following specific objectives would be attained:

1. To identify the gaps and weaknesses of the existing manual document management system specifically those related to submission, routing, consolidating and inventory of the shop drawings used for construction;
2. To propose a procedural workflow and controls in preparation for the development of a Web-based Document Management System for Shop Drawings; and
3. To integrate the use of this document workflow database in all stakeholders involved in the project once the system is fully developed.

This paper is limited to the preparation of detailed guidelines in developing a web-based document management system as it is not the intern's expertise to create such a system.



### **1.3 Significance of the Practicum**

The rapid digitalization of our world has led to exponential growth in data and content. Every day the company is creating and managing massive amounts of documents, shop drawings, queries, inspection checklist, methodologies, testing plans, and other construction documents.

These documents are often scattered all over the place on the filing cabinets, desks, boxes, etc. The late transmittal of data causes disturbance to progress, and outmoded data can give rise to abortive working. Both involve unnecessary and avoidable costs. A Document Management System provides efficient and effective control, management, and storage of large volumes of information. It ensures that staff can quickly and easily access up-to-date information.

The proposed web-based document management system for shop drawings can help reduce the reliance on paper and save additional costs for printing, storing, maintenance, filing, etc. It can also improve overall efficiency and easy information access for the employees since it provides a central location for all files.

This study will show what is possible when document management is taken online. While the system implemented here is raw and far from being a done work, it gives an excellent place to start developing Web-based Document Management Systems.



## Chapter Two

### PRACTICUM PROGRAM

#### 2.1 Practicum Schedule

The practicum was undertaken at the SOLAIRE Metro North Project Site located at Vertis North, Brgy. Bagong Pagasa, Quezon City, scheduled along with the prescribed work hours, 8:00 AM to 5:00 PM during weekdays (Monday to Friday), and 8:00 AM to 12:00 NN during weekends (Saturday). However, due to the pandemic, the staff was advised to work from home starting from March 17, 2020, until the Enhance Community Quarantine. The Practicum Program commenced on Term 2, AY 2019-2020, in January 2020 and was completed by the end of Term 2, AY 2018-2019, in April 2020 with a total number of 500 hours.

#### 2.2 About the Project



*Figure 2.2.1 Organizational Chart showing Major Players in the Project*

Blossberry Resorts Cooperation, together with Sureste Properties Inc., its project management department, plans to open a second Solaire Casino in Quezon City as part of a strategy to capture the base mass segment in the north. DCI took part as the construction project manager under the management team of Sureste Properties Inc. Together with the major players of the project, PBD Joint Venture as the General



Contractor, AEDAS and CASAS as the Architect, SY^2 as Structural Consultant, FORSSPAC as the MEPFS Consultant and Habitus as the Interior Designer the project is slated for completion by 2022.

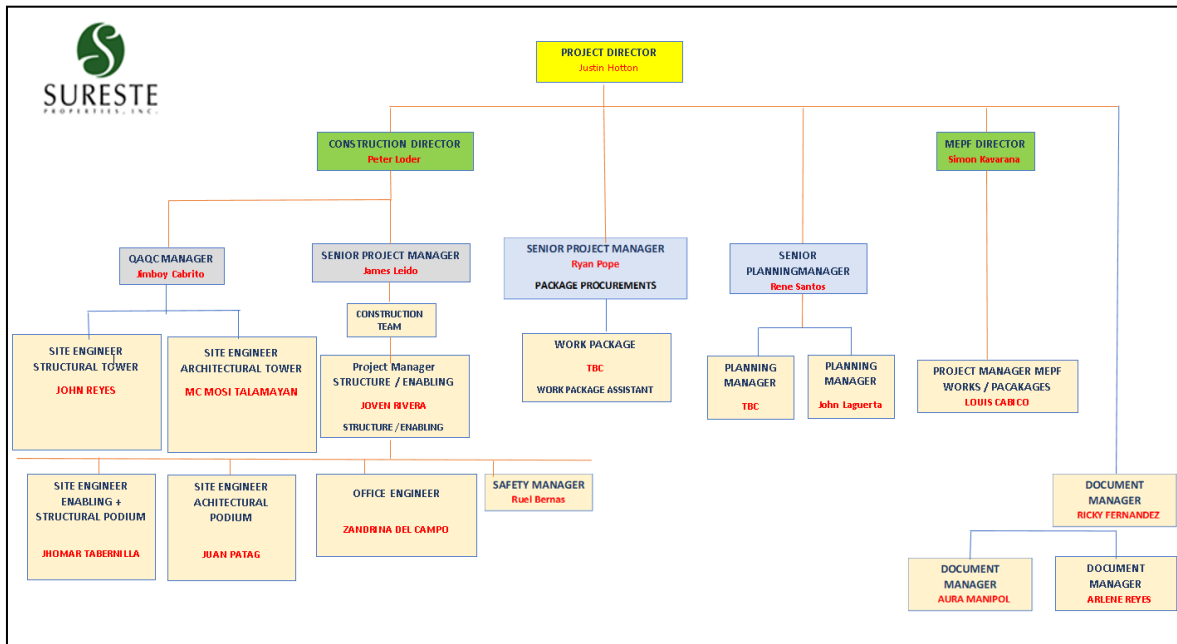


Figure 2.2.2 Organizational Chart of the Project Management Team for Solaire Metro North Project

This project consists of a forty-one (41) storey hotel and casino with five (5) basement levels, six (6) storey podium, helipad, and others. The basement level consists of parking, fire exits, driver's lounge, smoking lounge, BOH, vehicular ramp, fan room, storage room, fire tank, fire pump room, fuel oil storage, and STP Plant Room. Also include VIP lobby and drop off, engineering/workshop/storage room, main transportation office, offices, clinics, bakery, kitchen, laundry area, admin office, male/female dormitory, and staff and employees' area. For ground floor area includes drop off area, lift lobby (function, VIP, podium, hotel service), main lobby (function, VIP, hotel), reception area, retail, public toilets, BOH rooms, and offices. Podium area includes Casino, Retails, swimming pool, restaurant, food court, meeting rooms, storage, ballroom, Spa, Salon, Gym, and executive offices. Tower area includes hotel rooms and



suites, karaoke rooms, VIP lounge, bar, sky bar and restaurant, outdoor sky bar, cooling tower, chiller room, and MEP rooms.

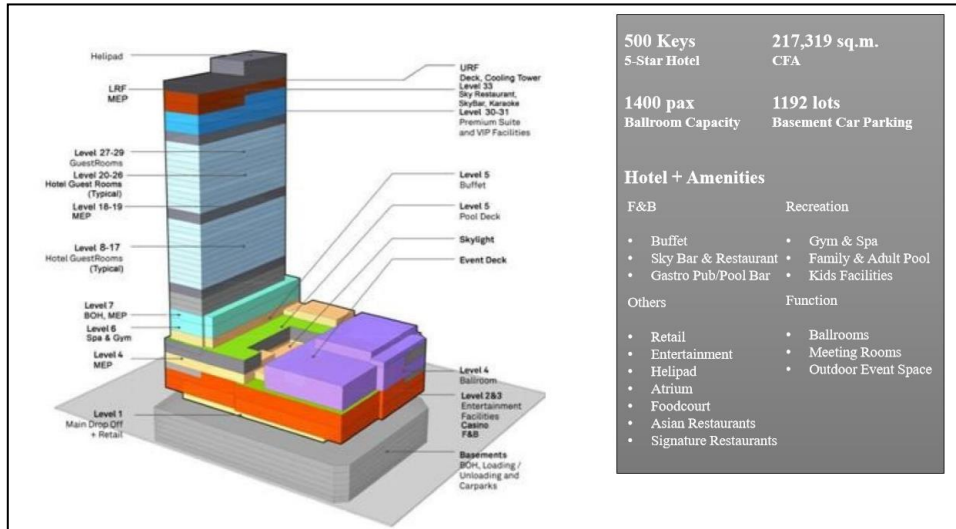


Figure 2.2.3 Project Programs and Function

The construction floor area of the project has an estimated total of almost 220square meters. Unfortunately, the project's total cost cannot be disclosed and cannot reveal for any purpose due to a non-disclosure agreement or confidentiality agreement.

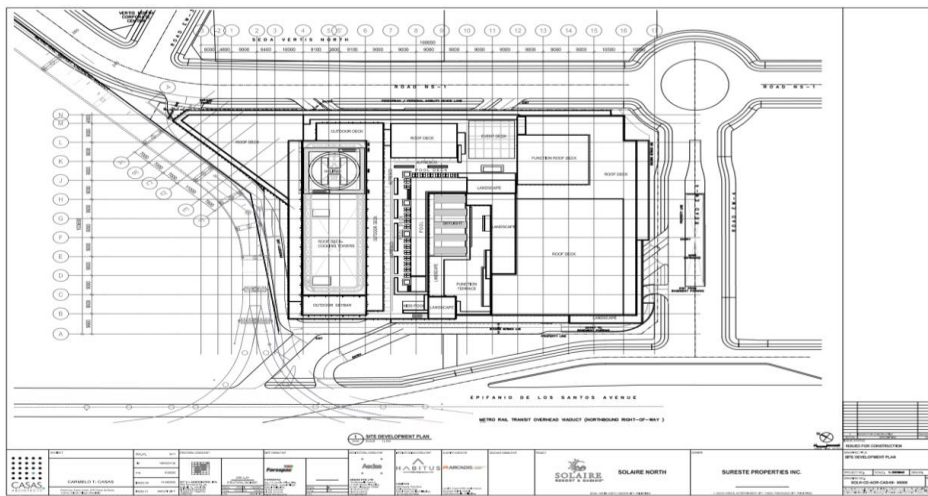


Figure 2.2.4 Site Development Plan



Figure 2.2.5 Site Vicinity Map



Figure 2.2.6 Project Perspective



## **2.3 Practicum Program Activities**

During the practicum program, the intern was given duties and responsibilities for their daily work routine. The intern was responsible for the quality inspection and monitoring of enabling works (excavation and soil protection) and structural works for the Podium Area and concreting works while ensuring strict compliance of plans and specifications. The intern was also responsible for collecting and reviewing approved Shop Drawing / For Construction Drawings of Architectural and/or Structural for Podium Area and updating Daily Photos on-site and daily activities of the contractor and reporting it to the owner. Lastly, the intern should ensure that the contractor complies with approved work methodologies and inspection testing plans.

The intern focuses on enabling works and the structural trade for the podium area and directly reporting to Engr. Joven Rivera, the project manager for Structural/Enabling Works and the Industry Adviser during the practicum.

## **2.4 Problems and Issues Encountered**

One of the biggest challenges in the project is undefined goals. Sometimes the stakeholders do not know what exactly they want; other times, they cannot agree. Another issue that creates challenges in the project is a lack of accountability. There are times when the contractor is not laying out the project's goals and assigning them to ensure all parties are held accountable for their tasks.

There are times when the subcontractors are unreliable, sometimes scheduling conflicts, or most of the time, the changing tastes of stakeholders, are the ones that derail the project. That is why the management team always makes sure the contractor has a contingency plan, but they do not in many cases.

Sometimes the stakeholders have unrealistic expectations. Whether it's from impossible deadlines or lack of resources, these unrealistic expectations create



management challenges because they can hurt morale and productivity. With impossible deadlines looming or a lack of resources, the team sometimes becomes less productive. In some cases, the team would not make the deadline regardless of their high productivity—some of these expectations are set due to the contractor's lousy forecasting.

Stakeholder indifference also sometimes kill the project, and the lack of stakeholder participation poses a challenge in the construction project management team. When the stakeholders are indifferent to the activity at the site, it resulted in rework and delays. There are times when the management and the contractor are not communicating well, which resulted in slippages and the team sometimes remain unaware of the issue.

The biggest problems that the intern encountered during the practicum is the documentation and its traditional methods. As shown in Table 2.3, the existing manual document management system's weaknesses outdo its strengths, which the intern still sees as a weakness. Digitized records have risks with cybersecurity; however, should an office caught on fire, paper records burn. Computers may burn, but if documents stored in an off-site server or cloud environment, the information is still safe.

Table 2.3 – Strength and Weaknesses of the Existing Document Management System

<b>Strengths</b>	<b>Weaknesses</b>
<ol style="list-style-type: none"><li>1. Data Security</li><li>2. A traditional filing approach is less complex</li></ol>	<ol style="list-style-type: none"><li>1. Cannot track shop drawings according to version, author, document number, and status.</li><li>2. Document workflow is confusing</li><li>3. Cannot assign different attributes to documents(type, significance, urgency, status, etc.)</li><li>4. There is a possibility of Lost Files</li><li>5. Time-Consuming in retrieving files</li><li>6. Increase in Budget Needs</li></ol>





Based on the data gathered, the effectiveness of the existing system shows that in terms of duration in the number of days, the review and approval of shop drawings, which should have been set only to twenty (20) days based on the plan, have reached an average of twenty-five to thirty (25-30) days on the actual. These delays because of resubmitting and rechecking resulted in other delayed activities on-site, which makes it inefficient.

Since the proposed web-based system will be introduced to the staff already used to the existing manual system, capacity building is needed to train staff and require young engineers to understand and operate the web-based system. Resistance is a common factor with the introduction of new processes and applications into any organization. Private Contractors, Management, and Consultants are no different, except that it can mitigate this issue by drawing upon the vast amount of experience from the successful implementation of the other applications such as AutoCADD, Primavera, STAAD, ETABS, BIM, etc. It will require at least months or a year for other construction companies to accept the proposed system since this will need financial resources and IT expertise.

## **2.5 Lessons Learned**

As construction project management team of the Solaire Metro North Project, the team has several processes like administrative submittals, progress photos, product data, product samples, daily construction reports, shop drawings order, etc. During the practicum program, the intern learned that there is a need to better the existing documentation system not to lessen the team's productivity and focus on their actual work and not wasting their time checking and reviewing papers or filing them.

Usually, a drawing must be internally reviewed and signed-off before distributed for approval. The approval process can involve various parties, such as construction companies, consultants, sub-contractors, and external clients. The revisions can be done in series - meaning that the drawing can only be reviewed by one engineer/authority at a



time, which would mean that review and approval of shop drawings or other queries would take longer and affect the activities on-site. Considering that the management does not have a centralized system for submitting drawings, the intern intended to help develop a web-based document workflow that would bring order to these independent processes transparent to make it a vital part of the drawing cycle. To focus on enhancing document and drawing management delivery from time to time, all involved trades, consultant managers, and project contractor engineers can access the file. They can be reviewed by several users simultaneously.

All the uploaded documents and other important information shall automatically stored in one place. The proposed web-based system takes way less space compared to using a physical location. Project participants must be able to access documents quickly instead of wasting time searching manually. The proposed web-based system should also implement coding systems that let project participants know which version of a file they are looking at since shop drawings mostly have many revisions during the project's construction.

Document management, though vital for business success, is only the beginning. If managing certain documents within a specific repository cannot gain the full benefits of actual efficiency. It's a phase that never really has a finite end — just a transition. It's going to take time. It needs some training to get rid of old habits. In the end, benefits far outweigh the discomfort of breaking away from the status quo.



## Chapter Three

### PRACTICUM PROJECT

#### 3.1 Review of Related Web-based Programs

Concerning all the management team's problems in handling, tracking, and managing all project documents, especially shop drawings, the most probable information system that would best fit their needs would be the Web-based document management system.

The intern's main focus was to search for information to help create a system that will solve the management team's problem in handling their documents. In researching related concepts/systems, the intern aims to gather and understand concepts and methods needed to pursue and accomplish the project.

##### 3.1.1 Yahoo! Briefcase

Yahoo! Briefcase is the web-based file storage system by Yahoo!Inc. It supports folders' creation for grouping files, and Premium Service users can share their select folders. Yahoo! Briefcase features remote access. Still, it's not entirely scalable as it doesn't give users many tools for management when the number of files uploaded becomes extremely large. The user also cannot define new features or functions, so there's the danger that the system might not meet future requirements and demands. Lastly, the system doesn't have any database search functionality for quick accessing of files.



### **3.1.2 Apple iDisk**

iDisk is the online file-storage system by Apple Computers, Inc., as part of its' I-Mac package of Internet services. It supports the creation of folders for grouping files and a public folder for making files available online. Rather than being a web-based system, it uses the WebDAV protocol for deployment. Accessing it requires a Mac-OS X computer built-in iDisk WebDAV support or the iDisk Utility for Windows XP. A significant feature of iDisk, at least on Apple computers, is its integration with Mac OS X. iDisk is scalable, allows for remote access, and has integrated search functionalities with Mac OS X. However, the user isn't able to edit or create new functionalities and actions so it might not meet future requirements for document management.

### **3.1.3 FileNet Content Manager**

FileNet Content Manager is a high-end content managing platform geared more towards big enterprises. It is scalable, and it has advanced search capabilities for helping the user find specific files and documents. It cannot modify functionalities to meet future requirements and specifications as they arrive.

### **3.1.4 Pinpoint**

Pinpoint document management system can run as a self-hosted or cloud-based solution, compatible with both "Mac and Windows computers. It also has a wealth of valuable features and offers outstanding user support (Brroks C, 2016). The Pinpoint document management system is such a good fit for small businesses because it can be hosted on-premises or in the cloud and works with all computer types. The interface is spotless and isn't cluttered with the features and tools we don't use daily, which allows us to maneuver through the system easily.



### **3.1.5 Absence and Leave Management Software – Employee Tracking System**

It is a leave management system that automatically tracks employee absences; the route leaves requests to appropriate offices and records employee's time work. It notifies the affected department of the future absences of the employee. Also, the system has an integrated document management system and electronic forms for record-keeping purposes. The system is capable of accepting a leave application. Leave application forms can be customized according to the needs of the institution. It keeps all documentation in the right files and proper references for easy retrieval. The employee can view how much leave credits he has and monitor the leave application's real-time status.

### **3.1.6 MaxxVault**

It is an electronic document management system and cloud document management solutions to small, medium, and large companies in over 25 vertical industries (Bohemia NY, 2016). It reduces costs by automating tasks and improving productivity. Every company has document records and other digital content that gets created. Whether paper-based or electronic files, It helps organize, secure, and manage them. It can access the correct and current version of a document or record.

### **3.1.7 Web-based Enrollment System**

Centered on the local setting report, a web-based enrolment system for Veritas Parochial School (VPS), Manila, has been established to help its students enroll more effectively without the difficulties of waiting for long hours to fill out forms that often become obsolete or to stand in line and pay in the cashier. It is through the VPS Web-based Enrollment Framework that this new form of enrollment can be accomplished.



This new model of system gives students new opportunities for enrolling in the VPS system. By signing in to the VPS website, you can register and enroll subjects for a school year. For these, all students must fill out some forms that do not require longer than a few minutes to complete. The device retains its records for possible references in the school library. Confirmation of the students' transaction needs to be verified, the payment of tuition fees must be made in the school's registrar. The students may also browse the website of VPS, and he can check his current account. It may also refer to new school fees (Pascual & Riceo, 2008). According to Lopez (2005), the registration system supports and delivers effective and secure resources to applicants, enrollment staff, and administration. Also, this method enhanced enrolment in terms of quest, retrieval, and topic schedules.

Research conducted by Cayabyab (2007) described several challenges and difficulties in the Dagupan City National High School (DCNHS). These big issues impact the effective student enrolment scheme. The protection of student records is at high risk. The new scheme may not cover any important records. It also has an untimely and wasteful generation of studies. The computerized framework for DCNHS would result in a substantial rise in the number of enrollees of the network-based enrollment framework Conde (2007), in his study entitled "Network-based Enrollment System of Paete National High School" cited the fact that the manual method of enrollment and manual handling of students' information and records is a very difficult one. The proponents developed a network-based system enrollment system for the said school to solve many tasks. Garcia (2002) created the "LSCP Enrollment Method;" the analysis can be of great benefit to the persons involved during the enrollment phase, the registrar, the teacher of the students as they collect the required information as needed and minimize the burden of manually browsing over-enrollment slips for record purposes Saayo et al. ( 2008) designed the method "Network-based automatic enrollment and grading." Due to the growing population of the university and the school currently adopting the manual method, each pupil spends a lot of time during the enrollment



period, such as paying school fees and processing school requirements. Valina et al. (2009), in this work entitled "Network-based pupil permanent record-keeping and registration method of Bali's National High School." This system was built to minimize the time and commitment of both student and school personnel. It can also give accurate reports and keep records of every student and an easy and fast way of enrollment.

### 3.2 Comparison of Existing Document Management System vs the Proposed Web-based System

There are various office types for different departments at business world. Therefore, there are many document management products in the market. These document management systems can be used for both individual paper management and business process management. Six different widely used document management systems are chosen from the internet and their features are compared with the proposed web-based document management system for shop drawings thru a comparison table.

Table 3.2 – Comparison Table of Widely used Document Management System vs the Proposed Web-based System

Product Features	Zoho Docs	Logical Docs	Sharepoint Online	M-Files	Ascensio System	Evernote Business	Proposed DMS
System Support	Desktop & Web	Web-based	Web-based , Android & IOS	Windows, Mac, Android, IOS	Winows, Mac, Linux	Web-based, Windows, Mac, Android, IOS	Web-based
Cloud Storage	✓	✓	✓	✓	✓	✓	✓
Mobile	✓	✓	✓	✓	✓	✓	✓
OCR Featured	x	✓	x	✓	✓	✓	✓



<b>Files Encryption</b>	✓	✓	x	✓	✓	✓	✓
<b>Real Time collaboration</b>	x	x	x	x	x	x	✓
<b>Workflow</b>	✓	✓	x	✓	✓	x	✓

Note: ✓ means that the document management system has the listed product feature and x means that the listed product feature is not available.

As seen from the comparison table, the proposed web-based document management system has all the functions needed for better and effective documentation. It also provides organizations general insights on the functions of the proposed web-based document management system. As stated earlier, it will focus on shop drawings and if developed further, it will broaden its scope to all construction documents which will be an advantage and ease of use to construction related companies.

There are also other document management system that caters to construction industry, however, they are much like the six (6) examples from the table that can be suitable but not exactly for the construction industry. The main difference that sets apart the proposed web-based document management system from all other existing document management system is its special feature which is the role-based menus (See Annex C).

For an external user company such as a design consultant or contractor, tasks may involve delivering communications by letter or email and uploading new drawings plus responding to Technical Queries. Whereas a document controller for the Client/Project Manager will be managing all incoming communications from all external parties, ensuring all drawings submitted are reviewed and responded to and monitoring commercial instructions to contractors and consultants within acceptable time frames. Therefore, on any project or site, a role determines the functions available and the reviews and actions one must take.





## **3.3 Identification of Critical Areas in the Proposed Web-Based Document Management System**

### **3.3.1 Database**

According to Coronel C. and Morris S. (2016), efficient data management typically requires the use of a computer database. A database is a shared, integrated computer structure that stores a collection of the following:

- a. End-user data – raw facts of interest to the end-user
- b. Metadata – Data about data, through which the end-user data is integrated and managed

The metadata describes the data characteristics and relationships that link the data found within the database. The metadata component stores information such as each data element's name, the type of values (numeric, dates, or text) stored on each data element, and whether the data element can be left empty. The metadata provides information that expands and complements the value and use of data, which presents a complete picture of the data in the database. The database might be described as well as a collection of self-describing data.

### **3.3.2 Database Management**

The Database Management System (DBMS) serves as the intermediary between the user and the database. DBMS is collecting programs that manage the database structure and controls access to the data stored in the database. The DBMS hides much of the internal database complexity from the application programs and users. The application program is probably written by a computer programmer using Visual Basic, NET, Java, or C#, or it probably created through a DBMS utility program.



When DBMS is used, the database structures can be modified even more easily as the organization's information needs differ. New types of data may be applied to the database without disrupting the current structure. Organizations may use one form of DBMS for day-to-day transaction processing and then transfer the data to another machine that uses another DBMS that is best suited for random queries and analysis.

Database servers are specially designed computers that hold the actual databases and run only the DBMS and related software. Database servers are usually multiprocessor computers, with RAID disk arrays used for stable storage. Connected to one or more servers via a high-speed channel, hardware database accelerators are also used in large volume transaction processing environments.

#### Advantages of DBMS

- Improved strategic use of corporate data
- Reduced complexity of the organization's information systems environment
- Reduced data redundancy and inconsistency
- Enhanced data integrity
- Application-data independence
- Improved security
- Reduced application development and maintenance costs
- Improved flexibility of information systems
- Increased access and availability of data and information
- Logical & Physical data independence
- Concurrent access anomalies.
- Facilitate the atomicity problem.
- Provides central control on the system through DBA.



Business process interoperability is necessary for achieving operational efficiency in any organization. Interoperability defined as systems' ability to exchange information and use the information that has exchanged. Without interoperability, units will have to perform redundant tasks. It will waste time, workforce, and resources, which could be utilized more efficiently. Allowing different units to share the business process's workload will allow each unit to move more efficiently at a reduced overall cost to the organization. An example of this in the Philippine government is that each agency asks the citizens to supply their personal information during the application or require them to supply documents provided by other agencies. Through business process interoperability, agencies can quickly check their customers' identity and acquire the details they need for the transaction. This will mean less time, effort, and money, particularly on the part of people. Having the business process more effective would make government transactions a more rewarding activity for people.

### **3.3.3 Integrated Information System**

Today, business firms are replacing traditional ways of performing business processes by investing heavily in information systems and adopting various information systems to their different departments. Variety of problems of the conventional system such as data redundancy resulting from task duplication and related data stored in various functional areas. The convergence of information systems has become an essential topic to address these issues, demonstrating the need to merge multiple systems across functional areas to provide a fast and reliable query for data sources. There are two ( 2) key forms of convergence of the knowledge structure, according to Al-Hashem, A.O., and Al-Ma'aitah M.A. (2019). The first internal integration focuses on integrating information technologies within a business firm and the extent to which different systems interconnect in the business and can communicate with each other to facilitate information sharing within the organization. The second external integration looks at integrating two or more independent business information systems linked through



telecommunication technologies to better control activities to provide real-time and consistent connectivity with partners across supply chains. Information system integration techniques include both internal and external integration.

Internal integration, also known as cross-functional integration, refers to the extent of cooperation and collaboration, knowledge exchange, the degree of cooperation, and the extent of mutual participation through roles. Internal alignment may help a closer interaction between data and knowledge sharing and cooperation between functional fields. In cross-functional integrated organizations, there is typically thorough collaboration and interaction with all business units and established cross-functional teams that promote an effective approach to establishing close relationships between individuals and divisions. It encourages structural relations between entities or functional areas of business and supports structural capital with external stakeholders at about the same period.

External integration refers to the centralized management of business-wide operating areas and procedures. This partner involves the integration of all distribution operations with vendors and client operations in the supply chain. External integration with business associates is perceived to be a significant challenge for the company's attempts to reduce supplier issues on company operations. Opportunities for improving the quality of the details that decrease the product life cycle, manufacturing preparation time and inventory level costs by helping firms be more sensitive to the consumer are due to the close relationship among companies and their stakeholders.

### **3.3.4 Management Information System**

According to the journal of Murti, G.T (2016) regarding the Management Information System (MIS) and Accounting Information System (AIS), MIS is a group of connected and harmoniously cooperating sub-system to achieve one goal-processing data needed by management in the process of decision making on conducting its



function. MIS is the transaction of processing, recording, using electronic data processing application that focuses on the development of business application development providing reports for the management in the form of useful information for decision making and a particular category of the information system for the middle-level management applied to control business and predict working performances MIS consists of a large number of interrelated data and knowledge structure that is structured in such a manner that it relates to the needs and structure of the entity and can be used by more than one person with more than one use. The attributes of MIS are the following:

1. It supports recording keeping and data processing functions.
2. Same databases can be shared for all functions of the organization
3. Every manager from the different levels of the organization can reach easily to the data.
4. All data and information can be used only by authorized personnel. Thus, the system's security is provided.

Organizations need MIS for a variety of particular reasons. There are the following causes:

1. The difficulty of data transfer and communication challenges is due to this difficulty.
2. Work and force repetitions, creation of same data, and storing them in many different places.
3. Applying many kinds of operations and information flows when obtaining the same data.
4. Impossibility of working with data. It's hard to get useful and necessary information because their form and positions aren't proper.
5. Insufficient data source.
6. Limited information support.



### **3.3.5 Data Security and Privacy Issues in Organizational Context**

Organizational context also described as characteristics representing an organization, such as company strategies, culture, structure, and policies. These characteristics may describe organizational security practices and culture, security planning, security policy, and risk mitigation strategies from an information security view. After a thorough review of all the selected articles, the authors' security and privacy issues can classify as organizational-related.

Organizational culture and awareness of big data's security and privacy issues are an essential factor to consider in safeguarding data from human-related breaches. In their article, Philips-Wren et al. revealed that addressing organizational culture in the context of big data is highly important. This importance highlighted by the fact that "attitudes on ethics, privacy, and security can vary significantly across organizations." In another article that presents a paradigm shift in computational social science in the big data era, best practices in the safe handling of big data are said to come from the way organization provided encouragement and work structure to all of their employees instead of relying on individual's way of working with data. Thus, for organizations to derive the intended benefit of big data and protect data from security breaches, organizations are required to make alterations and enhancement in terms of its business processes and applications and make an incremental change in its business model.

To avoid catastrophic consequences, should there be a data breach, organizations must have the right protection mechanisms prepared – the outcomes of wrongful treatment of customers or employee data must be made known throughout the organization. To make the changes in culture and awareness a successful effort, the top management role is vital in promoting security culture and providing necessary support and security technology resources. Lack of full management support may deter the



efforts made by IS security professionals in protecting and securing organizational data and systems from functioning at an optimum level.

Another organizational-related issue derived from the review is organizational learning capacity and employee competencies in implementing necessary big data protection mechanisms. Chang et al. asserted that implementation of protection required for a big data environment could be expensive and challenging. This process requires several necessary steps, such as designing the data handling process and identifying suitable employees' suitable training and procedures. Other steps include periodic auditing of the protection mechanisms and problem identification of security issues that may arise.

### **3.3.6 Data Governance**

NCHRP Report 666 (Cambridge Systematics, Inc., et al. 2010) describes data management as "the creation, implementation, and monitoring of architectures, strategies, practices, and procedures for handling an enterprise 's information lifecycle needs efficiently as they relate to data acquisition, storage, security, data inventory, analysis, quality control, reporting, and visualization." Although data management as defined by the International Organisation for Standardization (2003 ) refers to "activities of identifying, developing, preserving, maintaining and providing access to data and related processes in one or more information systems." which presents a more concise definition.

Data governance is concerned with ensuring that the data is handled properly. It is the creation, implementation, and compliance of data assets authority (Cambridge Systematics, Inc., et al. 2010; Ladley 2012). The phrases "data governance," "data management," and "data business planning" are frequently used interchangeably or as components of each other (Stickel and Vandervalk 2017). Ladley (2012) suggested there



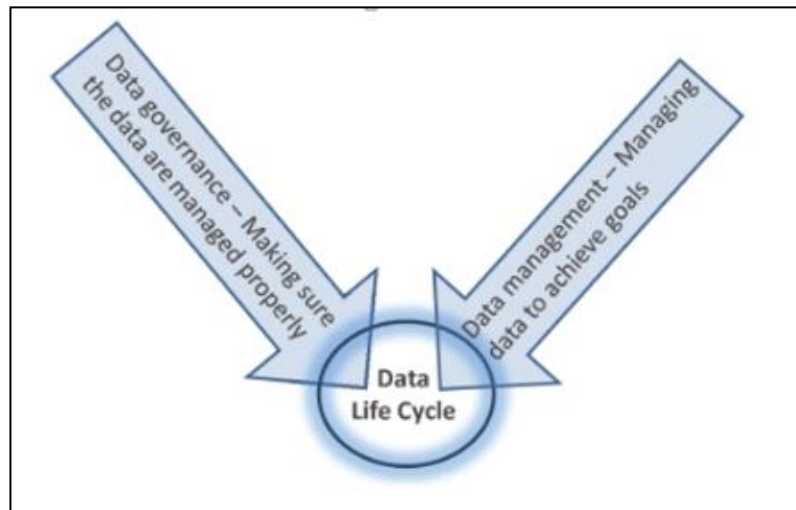
should be a distinction between managing data (i.e., data management) and ensuring that data are appropriately managed (i.e., data governance) (Figure 3.3.6)

Transportation data managed by different business divisions (often referred to as "data processing areas") within transport departments. NCHRP Study 814 (Spy Pond Partners, LLC, and Iteris, Inc. 2015a) uses the terms "data management area" and "data program" interchangeably, describing them as an operational role that is responsible for scoping, gathering, handling, and distributing a certain type of data sort. NCHRP Project 08-36 (Task 100) suggested a structure and conceptual design-build a resource to support transport data into seven categories in the framework development: travel data, system inventory data, system status data, protection data, operating data, financial data, and customer relationship data. NCHRP Study 814 (Spy Pond Partners, LLC and Iteris, Inc. 2015a) provides a roadmap for transport agencies to perform a self-inspection process, providing self-assessment case studies of the Michigan DOT and Utah DOT data management systems for particular business areas: mobility/congestion, facility management, repairs, project scoping and design. That guidebook can help evaluate and improve the value of data for decision making and data-management practices.

In most cases, data governance has not been assessed in the early stages of implementation; thus, the long-term benefits have not been assessed. However, interviews undertaken as part of this analysis with a sample of transport agencies revealed that the main reasons and ear advantages of introducing data governance include:

1. Improved accountability to produce high-quality and reliable data (sources of truth)
2. Ensuring that the data are accessible and integrated using a standard linear referencing system
3. Engaging business areas within transportation agencies in their data, rather than viewing data as strictly an information technology (IT) issue.





*Source: Adapted from Ladley (2012)*

Figure 3.3.6 V-shaped illustration is used to distinguish between data governance and data management.

Several state DOTs have developed data business strategies that detail the processes, functions, and duties for data governance. A recent peer exchange RB stressed that data governance models should be tested and tested periodically (Hall, 2015).

### **3.3.7 Data Integration and Warehousing**

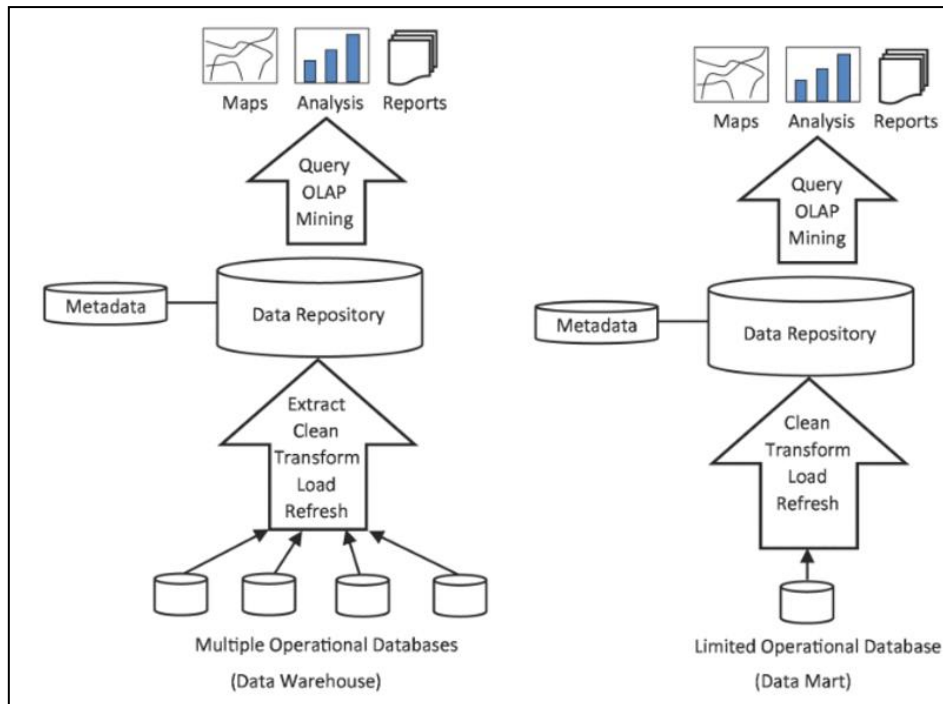
The words "data center," "data mart," and "operational database" are related but apply to various types of structures. Since most readers are familiar with the word "database," the first business item is the contrast of data warehouses and data marts with running databases.

An operational database refers to the support of a particular application's day-to-day operations and has limited or no analytical capabilities. Also, a data warehouse is stored that integrates data from various sources and time frames. Integrated data is structured in a cohesive scheme and remains in a single region. Both data centers and data marts provide data collection and decision-making capability.



Figure 3.3.7 displays typical architectures for data warehouses and data marts. The bottom line consists of corporate reports providing statistics on the department's day-to-day tasks and procedures, such as inventory and state of equipment, accident reports, and traffic counts. The data in these databases are too comprehensive and raw to be used for decision-making purposes. The data warehouse combines data from various operating databases and time frames. The data mart is connected to a single or small set of running databases and has less data integration and computational capability. Data repository in a warehouse or mart (Middle Level) built by the process of data washing, convergence, transformation, loading, and periodic refresh (Han et al. 2012). These processes shall be described as follows (Han et al. 2012):

- Data extraction: gathering data from multiple, heterogeneous, and external sources.
- Data cleaning: detection of errors in the data and rectifying them when possible.
- Data transformation: conversion of data from legacy or host format to warehouse format.
- Data loading: sorting, summarizing, consolidating, checking the integrity, and organizing the data in a unified schema.
- Refreshing: propagation of updates from the data sources to the warehouse repository.



Source: Gharaibeh, N., Oti, I., Schrank, D., & Zmud, J. (2017) *Data Management and Governance Practices*

Figure 3.3.7 Architecture for data warehouses (left) and data marts (right)

The top tier of this architecture consists of data processing and analysis tools, including:

- Information processing: The warehouse or mart processes the data through querying, basic statistical analysis, and presentation (e.g., tables, graphs).
- Analytical processing: The warehouse or mart processes the data through online analytical processing – that is, analysis techniques with functionalities such as summarization and drilling down. For instance, one can drill down on yearly weather data to obtain data summarized by country, district, or state.
- Data mining: The warehouse or mart equipped with in-depth capabilities, such as data clustering, outlier detection, and prediction.

Transportation data warehouses and marts are also fitted with GIS capabilities for visualization and spatial analysis. For example, Utah DOT (UDOT) uses the ArcGIS



Web network to view and exchange transport data through the Agency's open data gateway (UGATE) and mapping framework(UPlan) (<http://uplan.maps.arcgis.com/home/index.html>). UPlan covers several types of statistics, including safety and collision, road traffic technical designation, entry types, maintenance stations, structure and bridge sites, proposed and ongoing construction projects, mileposts, roadway control, transportation and decentralized financing, fibre optic networks, and data on freight and operating preparation. Other state DOTs have followed this strategy to view and exchange data ( e.g., Arizona, Florida, Kansas, Idaho, Montana, Pennsylvania).

### **3.4 Database Architecture: The Hierarchial Data Model**

The hierarchical data model is defined as the data model which organizes data logically according to the structural relationships of hierarchical definition trees. The level of a record type in the hierarchical definition tree is a measure of its distance from the root of the tree. The root record type is the highest level record type in the tree (level 1). The General Contractor record type in Figure (3.4) is an example of root record type. The other record types, called dependent record types, are at a lower level in the tree (level 2, 3, etc.).

From the workflow of the shopdrawing approval, it can be similar to a hierarchial database management system where in the data are organized into a tree-like structure. The hierarchical database model mandates that each child record has only one parent, whereas each parent record can have one or more child records. As seen from Figure (3.4), The General Contractor is the parent record for they are the one who uploads the shopdrawing for approval and the one to receive the issued shopdrawing regardless of the status if it is approved or rejected.

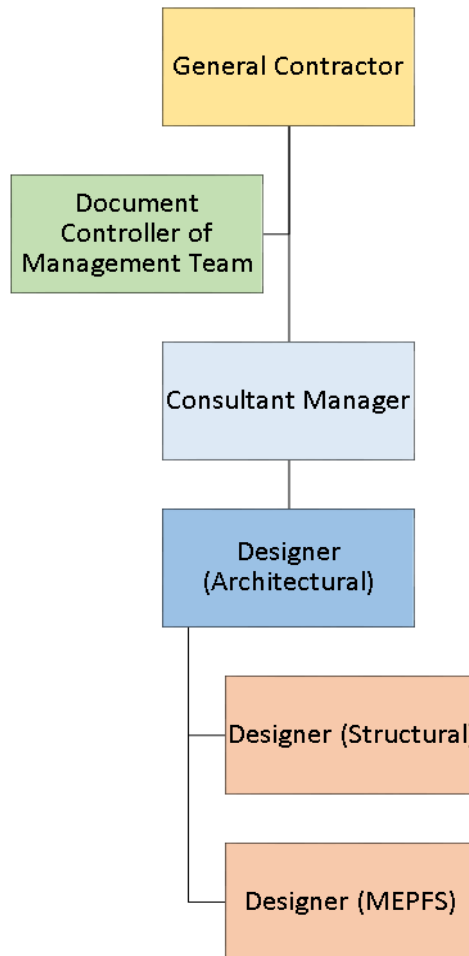


Fig. 3.4 The Hierarchical Data Model of the Workflow of the Proposed Web-based Document Management System

After uploading the shopdrawing, the Document Controller will check and review the document and then forward it down to level 2 to the Consultant Manager. Once reviewed and approved, the Consultant Manager will forward it down to level 3 to the Designer (Architect) and distributes the shopdrawing to the other designer consultant (Structural and MEPFS). After the review of all child record, the shopdrawing will then be returned to the single parent record, the General Contractor.



## 3.5 Conceptual Framework of the Proposed System

Conventionally, workflows in the document management system were done manually on a document by document basis, hard copies. The drawing document management system can automate this manual process for a specific document outline and workflow template to initiate the workflow automatically. As the intern researching information systems related to this study, DeLone and McLean Model commonly cited. With this, the intern will improve controlling, accessing, storing, receiving, and sending of drawing easier than the current traditional document drawing management in his company by using a model from DeLone and McLean (2003).

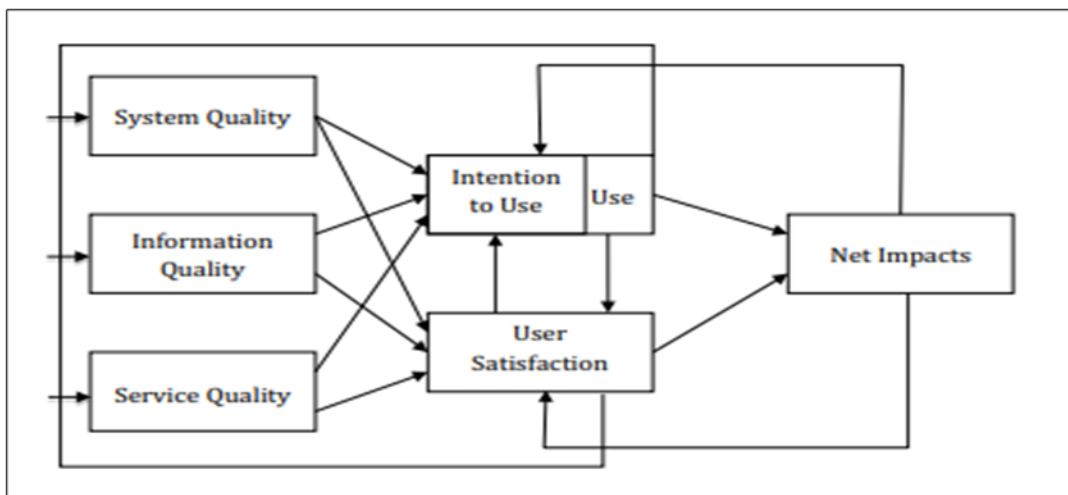


Fig. 3.5 DeLone and McLean 2003 IS Success Model (Modified)

DeLone and McLean 2003 describe the above six variables in the model.

- a. *System Quality* - the desirable characteristics of an information system (DeLone and McLean, 2003). Instead of the old traditional way of receiving and sending drawings, a software workflow process is to develop. It allows all users to know the status of a specific drawing.
- b. *Information Quality* - the desirable characteristics of the system outputs, i.e., management reports, and Web pages (DeLone and McLean 2003). The



workflow can be initiated manually or automatically, especially the reference number of the drawing. Once initiated, the first user's step-by-step activity will be recorded in the system, the date, action, uploaded drawing, issued drawing, signed drawing, or rejection.

- c. *Service Quality* - the quality of the support system users, receive from the information systems organization and IT support personnel (DeLone and McLean 2003). A notification will be received by all involved users that are part of completing the initiated workflow. They will receive a notification every time each user has completed its activity.
- d. *Use* — the degree and way employees and customers utilize an information system (DeLone and McLean 2003). Unlike the traditional way of keeping records of drawing, you can search or monitor drawings by getting the list and hard copies to document controller or getting it from the higher position who has the hard copies of the drawing. In this develop document drawing system, any one or all users can view and monitor the drawings. They can download this anytime.
- e. *User Satisfaction* — users' level of satisfaction with reports, Web sites, and support services (DeLone and McLean 2003). Since construction has a target date to complete, this study aims to review and approved the drawing swiftly. Of the traditional way, a document controller needs to stamp and sign and record first the drawing in an excel file for his record before distributing it to the Consultant Manager and Designer for review. An expediter sometimes is used by the document controller to transmit the hard copy drawing from consultant manager to designer, which sometimes causing a delay if offices are far and time-consuming. Herein, a notification will receive as soon as the workflow is initiated. All participants are notified.
- f. *Net Impacts* — the extent to which information systems are contributing (or not contributing) to the success of individuals, groups, organizations, industries, and nations. (DeLone and McLean, 2003). The intern's target impact is to let



individuals know all the drawings' status to have a pro-active action on-site to meet the target schedule on time.

### 3.6 Detailed Procedure in the Preparation of a Web-Based Document Management System

The proposed system started to study the existing system on how a typical construction company routes their shop drawings that need trade consultants' approval. The details on the manual system have been died to come up with the specific data required that is needed in the integration of the proposed web-based system.

The following diagram shows the step by step procedure that the intern undertook to conduct the practicum project:

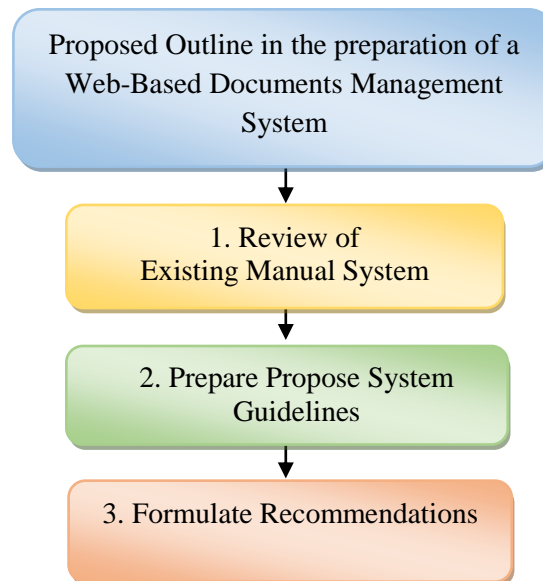


Figure 3.6 – Step by step procedure undertaken for the preparation of developing the web-based document management system





To enhance the workflow management system for shop drawings that would be used during the construction phase of the project, the intern conducted the following data collection tool/method:

1. Review of existing manual workflow system when it comes to routing the shop drawings for approval – reviewing these systems provided insight into how the involved parties organize and manage the drawings' approval and how much time it would take for the whole process to finish.
2. Interviews with staff from each party – the intern conducted a series of interviews with the contractor, management, and consultants regarding the actual average review time and routing of the shop drawings.

### **3.6.1 Data Collection**

The intern gathered data through the conduct of interviews and document analysis. A review of the documents that have gone through the existing workflow system has been done to obtain information regarding reviews of each consultant's trade and their approval speed.

The data collection tools and techniques that were used are as follows:

#### **3.6.1.1 Interview**

An interview is a powerful tool for data gathering since it allows the interviewer to probe and clarify several issues, according to Alshenqeeti, H. (2014). Face-to-face interviews were used to interact with the staff from managers and designers of each company involved in the workflow to obtain the necessary information for the existing system as the practicum project's sampling population. The participants from the owner side's project management consisted of one (1)



Senior Project Manager, one (1) Quality Manager. There were three (3) Design Consultants that were part of the workflow, and from the construction management side, one (1) Document Control Manager and (1) Project Manager. In summary, there were 7 participants interviewed, 2 participants from the Project Management of the Owner of the building constructed, 2 participants from the Construction Management that the owner hired to oversee the project, and 3 participants from the Design Consultants.

### **3.6.1.2 Review of Manual Existing System**

Construction plan drawing plays an important role in the construction field; its purpose is to illustrate what to be built. It provides exact measurements, shapes, and inside and outside detail of house/building. There are drawing, naming, architectural drawing, structural, electrical, plumbing, and finishing drawing in the construction industry. Based on the intern's experience, there are three kinds of construction drawings: For Construction Drawing (FCD), Shop Drawing (SD), and As-built Drawing.

In this practicum, Shop Drawing (SD) will mainly discuss. Shop Drawings are sets of drawings prepared by the Project Contractor and the relevant sub-contractors to be issued to the designer for approval in adherence to the issued FCD drawings.

As the intern currently working in a construction company, the traditional way of transmitting, documenting, and recording shop drawing is observed, and the process is identified hereunder.

### **Manual Workflow Management System (Shopdrawing)**

#### **SHOP DRAWINGS**

- A. Send newly prepared information on an accurate scale. Highlight, encircle, or otherwise imply a departure from the Contract Papers. Do not replicate Contract



Papers or copy traditional material as the basis for Shop Sketches. Standard information prepared without precise regard to the project shall not be called Shop Drawings.

- B. Shop drawings involve production and assembly drawings, setting plans, calendars, patterns, models, and similar drawings. Include the following details as follows:
1. Dimensions
  2. Identification of products, materials, equipment, classified item numbers included, and installation locations.
  3. Compliance with specified standards
  4. Notation of coordination requirements
  5. Notation of dimensions established by field measurement
  6. Name of the project
  7. Reference drawing sheet numbers and/or specifications item numbers as shown on Contract Documents wherever possible
- C. Sheet size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings using any of the following sheets: 210 x 297 mm (A4), 297 x 420 mm (A2) but no longer than 841 x 1189 mm (A0).
- D. Coordination drawings are a specific form of shop drawing that displays the relationship and alignment of various building elements that involve careful coordination during production or installation to fit into the space offered or to work as expected. Submit coordination Drawings for the incorporation of numerous building components. Show sequences and interactions with different components to prevent space utilization disputes.
1. Submit the above items to Consultants through the Construction Manager as follows:
    - a. One reproducible transparency print.
    - b. Two blue line prints



c. After the Consultant's review, approval, and return, the Contractor shall make blue line prints from reproducible as follows:

c.1 One copy to Owner, or its duly authorized representative

c. 2 One copy to Consultant

c.3 Copies as required for Contractor's office and field use

c.4 Copies as required for subcontractors, suppliers, and/or installers.

d. Drawings returned to Contractor requiring re-submission shall be corrected as required by redrawing/correcting the original and resubmitting as initial shop drawing submittal as indicated above.

e. Drawings submitted without the Contractor's review, corrections (if required), and stamp will be returned without the Consultant's review.

**1. Coordination.** Coordinate the planning and processing of submissions with the success of building operations. Transmit each submission in advance of the results of the relevant building activities to prevent delays.

1.1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

1.2. Coordinate transmittal of different types of submittals for related elements of the work so processing will not be delayed by reviewing submittals concurrently for coordination.

1.2.1 The Architect reserves the right to withhold on a submittal requiring coordination with other submittals until related submittals are received.

1.3. Processing. Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for re-submittals.

1.3.1 Allow two weeks for the initial review. Allow additional time if processing must be delayed to permit coordination with subsequent



submittals. The Architect will promptly advise the Contractor when a submittal being processed must be delayed for coordination.

1.3.2 If an intermediate submittal is necessary, process the same as the initial submittal.

1.3.3 Allow two weeks for reprocessing each submittal.

1.3.4 No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit processing.

1.4 Submittal Preparation. Place a permanent label or title block in a format approved by the Architect and Project Manager on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1.4.1 Include the following information on the label for processing and recording action taken.

1.4.1.1 Project Title

1.4.1.2 Date

1.4.1.3 Name, address and telephone no. or fax no. of supplier

1.4.1.4 Name of manufacturer

1.4.1.5 Number and title of appropriate specification

1.4.1.6 Drawing number and detail references, as appropriate

1.4.1.7 Other pertinent data

1.5 Transmittal Submittal. A kit of each request in an appropriate manner for delivery and handling. Transmit each submission from Contractor to Architect via the Project Manager using the appropriate transmission type. Submittals obtained from sources other than the Contractor shall be returned without intervention.

1.5.1 Accompany all submittals with transmittal letter (5 copies) containing.

**2. Submittal Schedule.** The General Contractor must submit to the Project Manager a Submittal Schedule 20 calendar days after award of contract or notice



to proceed. The submittal schedule, which shall be subject to the Architect and the Project Manager's approval, must identify each required submittal and include a submission date that supports the project CPM Schedule. Advance submissions of the approved dates are accepted; however, it will be the Architect's prerogative whether or not to act immediately on the said submittal as long as he acts on the same within the approved submittal schedule.

- 3. Submittal Number:** The Contractor will assign the Submittal Number for each submittal as follows;

3.1 Each submittal shall be assigned a twelve (12) character number:

Example: AR-160500-031-1

Re-submittal Number

Submittal Number within

Specification Section

Specification Section

Trade Concern

i.e.: AR-ARCHITECTURAL

ST-STRUCTURAL

ME-MECHANICAL

EE-ELECTRICAL

SE-SANITARY/PLUMBING

FP-FIRE PROTECTION

The first two (2) letters or combinations of letters and numbers identify the particular trade concern. The next six (6) digits identify the specific specification section that the submittal applies. These six (6) digits shall be followed by three (3) digit extension. These three (3) digit extensions represent the cumulative submittal number. The last digit of the entire submittal number represents a re-



submittal number within that specification section. For example, AR-160500-032-0 would pertain to the Architectural Trade Concern, Specification Section 160500, and is the 32<sup>nd</sup> submittal in this specification section. If it were rejected, the subsequent re-submittal would be numbered AR-160500-032-1. Place the submittal number on all sheets or pieces of the submittal.

#### **4. Submittal Quantities \*Required:**

4.1 Shop Drawings – CADD files .....	1
Prints .....	5
4.2 Manufacturer's literature or brochure for approval .....	5
4.3 Mechanical, Electrical, Plumbing (MEP) Product Data .....	5
4.4 Samples .....	5
4.5 Manufacturer's instruction and/or Specifications .....	5
4.6 Detailed and descriptive transmittal letter covering each submission ... (Original).....	1
(Copies).....	4
4.7 Certification and inspection reports.....	5
4.8 As-Built drawings .....	1
4.9 Prints of As-Built drawings.....	5
4.10 CADD File of As-Built Drawings in CD ROMS .....	1
4.11 Warranties .....	5
4.12 Operating Instruction .....	5

This quantity allows only one (1) copy or sample to be returned to the Contractor. If the Contractor desires more copies or samples to be returned, the Contractor should transmit the additional copies/samples and note his request on their transmittal letter.

Furnish the complete bound sets to the Owner, typewritten, or blueprinted instructions to operate and maintain all systems and equipment. All instructions



for operating and maintaining all systems and equipment. All instructions shall be submitted in the draft, for approval, before the final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instructions. The bound sets shall include the following:

- a. Maintenance Manuals and Instructions for operating and servicing all electrical systems.
- b. Characteristics curves of all equipment.
- c. Data on all the electrical equipment includes the item, make, model, capacity, electrical characteristics, and maintenance schedule.

**5. Forwarding Procedure:** The Contractor shall submit the required number of copies of each submittal to the Project Manager. The Project Manager will forward the correct number of copies to the Architect of Record for review and approval.

**6. Formal Action:** Submittals must be formally processed with action by the Architect of Record. Each submittal must be marked by the Architect with the following action codes:

A – "Approved"

B – "Approved as noted."

C – "Revise and resubmit."

D – "Disapproved"

**7. Distribution after Action by Architect:** After review, the Architect and the Engineers shall retain two (2) prints of shop drawings and two sets each of product data and sample and return all other marked-up copies to the Project Manager Team. The Project Manager will keep three (3) prints of shop drawings and two sets each of product data and sample (one print / set for client/owner records) and return the rest of the submittals to the Contractor for action with copies as follows:





1 Print sepia / 1 set each of Product Data and Sample.

**8. Submittal Log:** The General Contractor and the Project Manager will maintain a submittal log. The logbook shall contain a copy of the most recent updated submittal log and copies of all incoming and returning transmittals. Specification Section shall arrange it. The submittal log shall be updated weekly.

**9. Time Allotment:**

9.1 Time allowed for processing shop drawings shall be 20 working days from the appropriate consultant's date of receipt. \*\*Review time will vary depending upon the type of submittal. Each submittal will be allowed a maximum of two numbers of re-submission for Architects review. In any case that a re-submittal exceed the numbers allowed, a corresponding fee on a man-hour basis shall be chargeable to the contractor at a rate as follows and the number of Consultants responsible for the review.\*\*

9.2 Re-submissions that result from "revise and resubmit" or the incorrect number of submittals sent shall be processed according to the same procedure and time frame as any original submittal.

### **3.6.2 Guidelines of the Proposed System**

Companies or Construction projects have several processes like administrative submittals, progress photos, product data, product samples, daily construction reports, shop drawings order, etc. The electronic drawing document workflow brings order to these independent processes transparent to make it a key part of the drawing cycle.

This study will enhance the delivery of drawing document management from time to time, wherein all involved designer trades, consultant managers, and project contractor engineers can access the file. Each role has a key part and determines the function in the system.



Standard roles in this system are Designer, Manager, and Contractor. Each role determines the function available and reviews and actions that must take. Also, there are different workflows in each role. A workflow is a sequence of steps involved in moving from the beginning to the end of a working process.

Once a workflow is commenced, the process starts. All users will receive notifications that a workflow is initiated. Once the first user completed the first activity, the workflow moves to the rest of the activities defined in the workflow. A project contractor to upload a drawing of which purpose is for review and approval of the designer and consultant manager based on the FCD and if there will be an impact on the project schedule and cost.

In submitting SD by Contractor, a transmittal is to be created wherein the following are filled out.

- a. Reference Drawing No.
- b. Company From
- c. Company To
- d. Drawing Type
- e. Latest Revision
- f. Discipline
- g. Document Status
- h. Purpose (REVIEW, APPROVED, APPROVED WC and REJECTED)
- i. Sequence number
- j. Subject
- k. Issued Date and Due date
- l. And remarks

Once filled out, the contractor is to upload the drawing in the system and initiate a workflow.



## Comparison of Shopdrawing approval workflow of Paper-Based Document Management System vs Web-Based Document Management System

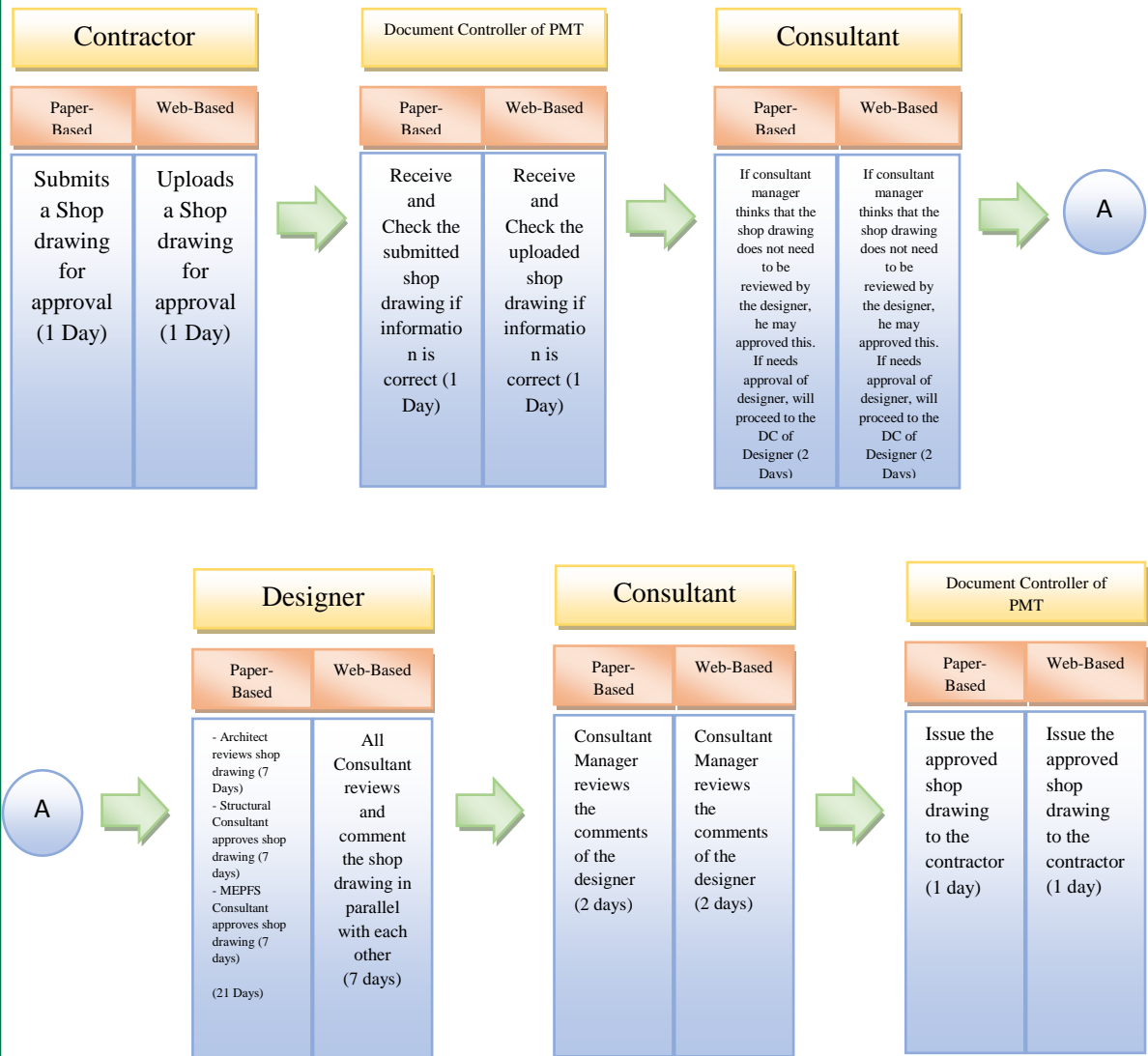


Figure 3.6.2.1 Shopdrawing Workflow with responsibilities of involved parties

**Note: Routing Time for Paper-Based Document Management System may be longer depending on different causes/situations. (i.e. traffic, distance of offices, type of transportation, etc.).**

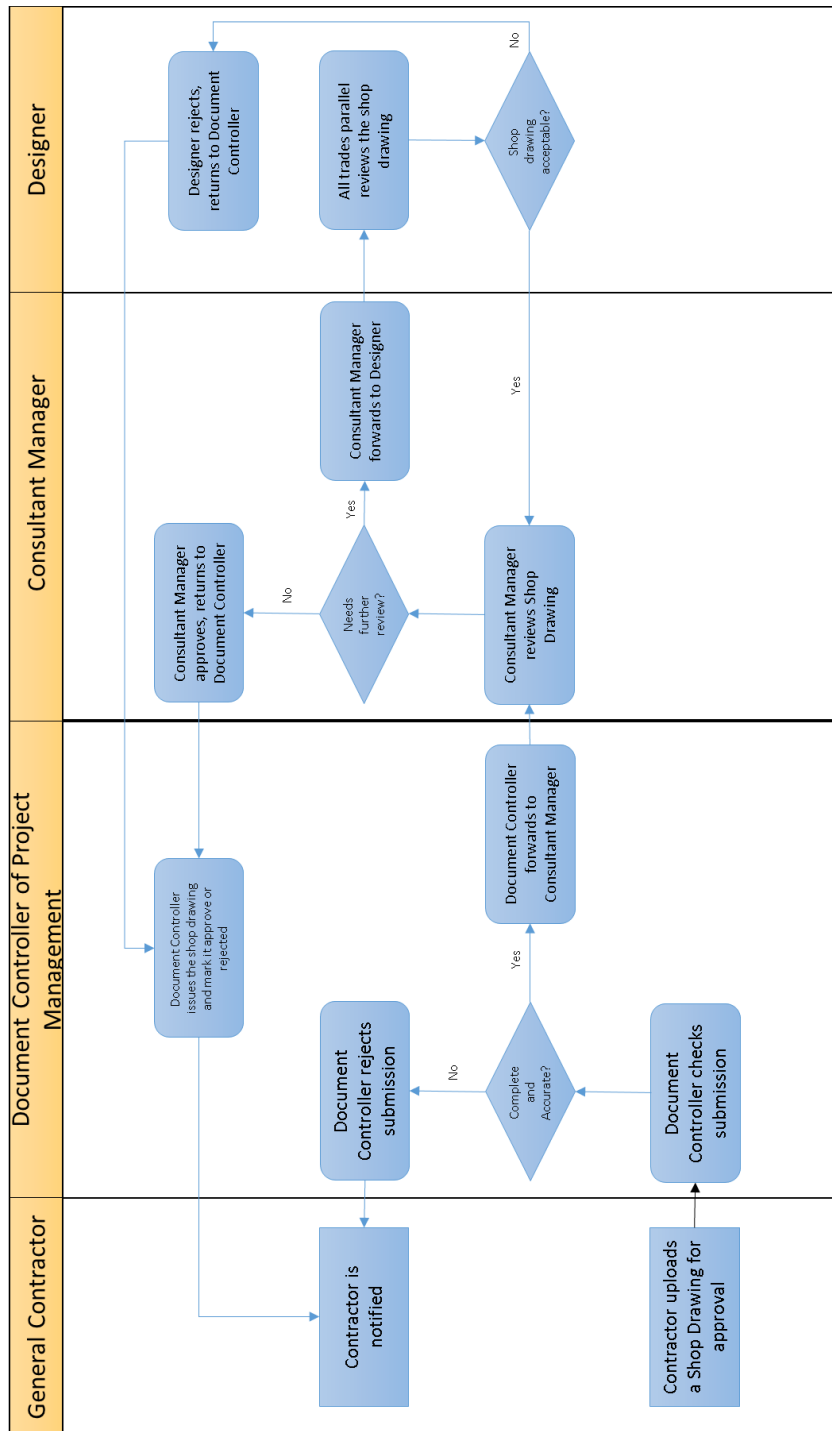


Figure 3.6.2.2 Swimlane Diagram of the Shopdrawing Approval Workflow of Web-based Document Management System



## **A. Document Controller of Manager Side – DC (Manager) receives and checks the uploaded shopdrawing’s transmittal workflow**

Consultant Manager's document controller to receive and check the created workflow from the Contractor's document controller. DC (Manager) to check specifically the filled-out items on the database/transmittal, to wit;

- a. The transmittal has the same reference number in the database and in the drawing itself.
- b. The Contractor’s document controller inputted the correct name of Originator by checking the drawing trade.
- c. The Contractor’s document controller inputted the correct name of the company receiver.
- d. The drawing type and revision number are correct and updated.
- e. The Document status of the transmittal must be "ISSUED".
- f. The purpose of the workflow should be "REVIEW".
- g. Also, ensures no missing page on the submitted drawing.
- h. Also, ensures signatories from the Project-in charge or Project Manager of the Contractor are completed.

The checking process of DC (manager) should be done in a day only. If all the mentioned items above have complied, DC (manager) will transmit the drawing to the Consultant Manager for review. If not, this will be returned to DC of Contractor for re-submission

## **B. Consultant Manager reviews and checks the drawing**

Once the Consultant Manager receives the notifications of the Shop Drawing from his Document Controller, he has two days to review. If the Consultant Manager thinks that shop drawing does not need to be reviewed by the Designer, he may approve this and can now be sent back to DC (Manager) for issuance to the Contractor. If the Consultant Manager needs the Designer's



approval, this shop drawing will proceed to the Designer's Document Controller.

**C. Designer (Architectural, Structural, MEPFS) reviews the shop drawing for technical comments**

All trades shall review, comment, and approve the submitted shop drawing. They are given seven days in total to review the shop drawing. The Architectural Designer's Document controller will receive the shop drawing forwarded by the Consultant Manager. DC (Arch, Designer) creates routing within the designers of other trades (structural, MEPFS, etc.) for their final review. If anyone of the designer rejected the shop drawing, this would consider as rejected, and the workflow will automatically go to DC (Manager) likewise if shop drawing is approved and commented.

**D. DC (Manager) distributes/issues the shop drawing to Contractor**

Before sending out the approved or rejected shop drawing, DC (Manager) to notify the Consultant Manager that the shop drawing was approved or rejected – this needs to do in 2 days. Once the Consultant Manager agreed to it, DC (Manager) distributes or issues the shop drawing to the Contractor. But if the Consultant Manager does not agree to it, DC (Manager) reverts the shop drawing to DC (Arch. Designer) with the corresponding comment made by the Consultant Manager.

This workflow in reviewing and approving shop drawing has time allotted 15 working days to revert or issue to the Contractor as to not delay the project. If the deadline or due date is not met, the workflow will mark a red flag on the workflows list.

Drawing documents can be canceled out, updated, and checked back in during the workflow process. The database/transmittal can also be updated while drawing



documents are in the ongoing workflow. This can be edited not to make a new database or metadata since it needs to update only the drawing attachments and the workflow process to continue. Workflows can also be restarted on the discussion between the Consultant Manager and Contractor.

All users can see shop drawing status while it is under workflow. Users can monitor who is reviewing the shop drawing. History of the shop drawing metadata and workflow are also recorded. It shows the date, user, action made by the user, and remarks.

### **3.6.3 Research and Development**

As a competent construction management company, DCI will be the target market of the intern to capitalize and spearhead the development of the web-based document management system. This proposed system will serve as a special offer during the negotiation of contract with the client. The integration of the web-based document management system will increase the cost of the budget for IT services since administration and maintenance services will be handled by DCI and will decrease the cost of the budget for office supplies since the documentation will not be paper-based and will less likely the need for file storages. At the end of the project, all documents and information will be surrendered to the client thru cloud-storage.



## Chapter Four

### SUMMARY AND CONCLUSION

#### 4.1 Conclusion and Recommendations

The practicum project investigated the effectiveness of the existing system in terms of the number of days of the routing and approval of a typical shop drawing and the file's storage efficiency. The existing system's efficiency shows that it is slow in terms of routing and approval since it is done manually and not in parallel. In contrast, the proposed system can route instantly and check the drawings parallel with each designer/consultant. In the proposed system, effectiveness was achieved since data quality in terms of timeliness and currency were addressed. The proposed system utilizes chat boxes for communication of each user involved, storage of the file uploaded, and approval and revision of the files; hence, it would make the submission paperless.

In terms of the information generation of the file uploaded in the web-based system, consistency would be achieved since what has been inputted in is the same data would be used in the transmittal of the file. Hence, there would be no need for the administrative assistant to check if the transmittal is the same as the file's information in the web-based system.

It is recommended that if the proposed system is implemented, training should be conducted for the staff from the project's involved companies. Capacity building is needed so that there would be an awareness of how the proposed system works.

Most construction firms stay deeply anchored in the world of hardcopy, fax, and e-mail. But the time has arrived when building companies can no longer rely on these





outmoded paper exchange formats. There will continue to be an eventual difference for those companies who use these technologies and do not purchase knowledge exchange through the evolving process. It can be noted that this is a web-based system and implementation of this kind of system requires a considerable amount of financial resources and an IT expert who is knowledgeable in this type of programming language. Once implemented, this system can ease the workload of document controllers, admin assistants, or even engineers who are having a hard time with internal audits and safekeeping of hundreds and hundreds of construction files and folders.



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## APPENDIX A: INTERVIEW QUESTIONS AND ANSWERS

What are the problems you encountered when it comes to the existing documentation system?

Did it somehow affect your work?

**Senior Project Manager:** As a Senior Project Manager, I deal with paper works every day, from making and updating reports to be presented to the owner to reviewing any kind of drawings. I find it really hard to keep track of it all and sometimes you lose important documents and have to start all over again.

Yes, it affects my daily work because documentation takes over a lot of time, instead of doing reports or reviewing files, I first need to keep track of documents from other days before doing anything else.

**Quality Manager:** Documents are a part of my work. Every day I file Inspection reports, Non-Conformities, and review methodologies and testing plans. There are times when I need to find the files in a filing cabinet because I need to check whether the inspection reports are already due or the non-conformities are already repaired.

All of this tracking, checking, and reviewing of documents keeps me from doing my actual job which is to monitor the quality of the structures at site.

**All Design Consultant:** As designers, we need to consolidate each other's review of the shop drawings or any kind of design related queries. However, workshops are not always possible due to different schedules. So the only thing that we could do is wait for the other to finish and if there are questions or design conflicts, we'll have to send it back for the other to revise it.

It affects the time of the reviewing of documents which can affect the work onsite since they are waiting for the queries they need to solve the ongoing problem.

**Document Controller Manager:** As a document controller, I make sure that all information regarding a specific document are correct. Every day there are times when documents submitted have wrong information or reference number. When that happens, I immediately return it to the owner. Another problem is tracking and filing of files since there are many documents in a construction, it's really hard to keep track.



Yes, it always affects my work since I am responsible in documentation and if one of the documents is lost or not correct then it will affect all the work of the management.

**Project Manager:** As Project Manager, I deal with reports and review of schedule, specifications and methodologies. I also delegate reports to my direct reports so I also need to track the documents that were routed to me for review.

The existing system makes it hard to track documents because it will take time and cannot guarantee that all documents are secured and no mistakes. I also delays work in all aspects of the construction thru design and onsite work.



## APPENDIX B: INTERFACE OF WEB-BASED DOCUMENT MANAGEMENT SYSTEM

Reference No.					Search Bar
Project Drawing No. (System Generated)					Document Status
Company From					Date Submitted
Consultant to Review					Latest Revision
Title					Discipline
Remarks					
Created By					Date Last Updated

Reference No.					Search Bar
File Name	Status	File Size	Date Uploaded	Created By	Comments

Reference No.					Search Bar
+ New Conversation		Show All Threads			
From:					Reply
To:					Reply All
Cc:					
Subject:					
Date/Time:					

Reference No.					Search Bar
Initiated By	Time Allowed	Deadline			
Activity	Outcome	Remarks	Owner	Actioned By	Date



## APPENDIX C: SPECIAL FEATURE: ROLE-BASED MENUS





