

2.0 Review of Related Literature

This chapter discusses the concepts related to ICT and project management, the project management systems that were reviewed to serve as a basis for comparison for the proposed system, and the methodologies considered in developing the system.

2.1 Review of Related Concepts

This section provides further discussion on concepts related to the capstone project, specifically a detailed discussion on the ICT trends mentioned in the previous chapter, projects and project management, and project management phases, inputs, outputs, tools, and techniques.

2.1.1 ICT Trends in Business Management

Digital Transformation

Digital Transformation, also known as Digital Business Transformation, is transforming the business and the organization, including their processes, to optimize the opportunities that digital technologies present. This entails the organization to be more agile, people-oriented, both internal and external customers, and innovative. Digital business transformation areas are points where digital transformation can be done to achieve the goal of the company. Among these areas are business activities/functions and business processes. This is where automation of processes come in as processes are digitized (i-Scoop, 2018). As businesses embrace the digital revolution, the only challenge they face is how fast and how far they can go to the path of digital transformation.

Digital transformation started in the late 1990's with the increase in digital products, such as music and entertainment, and infrastructure such as telecommunications and software. However, these products were seen only in selected industries, music, entertainment and electronics to be specific. The 2000's brought empowerment to users as they had more access to more information as digital distribution and web strategies, such as e-commerce, were increasing. As 2010 came, the digital transformation zeroed in on transforming business models using

mobile revolution, social media and analytics as the main staples to drive the transformation.

When transforming the business, organizations have to reconfigure key areas such as what they deliver to their customers and how they deliver these products or services. In order to do that, organizations need to reshape their products and services and realign their operational model to customer preferences by integrating business activities with how data relating to these activities would be managed (Berman & Bell, 2011).

Cloud Computing

Cloud computing as a service provides networked storage space and computer resources. They stated Email services like GMail and Yahoo! as examples, as it hosts your mail on a server which users can access through the Internet, anywhere and anytime. The only difference being that the cloud allows you to access any information of your choice as long as it is within the cloud. There are three cloud computing models that cloud providers offer, mainly, Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). These differ in how you can control your information (Huth & Cebula, 2011).

Software as a Service (SaaS)

SaaS allows subscribers access to both resources and applications. As multiple users are serviced by a single instance of the service that runs on the cloud. Costs for cloud providers are lowered as they only need to host and maintain one application. An example of this would be software licenses such as Microsoft and Google (Torry Harris Business Solutions, n.d.).

Platform as a Service (PaaS)

PaaS provides the subscriber with an integrated platform for development of web-applications (ESDS, 2014). With this model, subscribers are given the freedom to develop applications with the predefined combination of OS and

application servers, an example of this would be the LAMP (Linux, Apache, MySQL, PHP) platform. An example of PaaS would be Google's App Engine.

Infrastructure as a Service (IaaS)

IaaS gives subscribers basic storage and computing capabilities. All hardware needed would be provided such as servers, networking equipment and data center spaces. Subscribers would deploy their application or software to the infrastructure to reach their desired customers. An IaaS example would be Amazon.

Aside from the models mentioned, there are also different kinds of clouds wherein you can deploy your softwares, specifically, Public Cloud, Private Cloud, and Hybrid Cloud. These depend on the business type, whether the subscriber is a home user or a small business owner. Public Cloud are accessible by any subscriber who has access to the cloud, these are owned and operated by third-parties. Private Clouds are exclusively for a single organization. Private Clouds have two (2) variations, On-Premise Private Cloud, which is hosted within one's own data center, and Externally Hosted Private Cloud, which is hosted externally by a cloud provider. The Hybrid Cloud combines both the Public and Private Cloud into one (Torry Harris Business Solutions, n.d.).

Analytics

Data Analytics is said to be the “*extensive use of data, statistical and quantitative analysis, explanatory and predictive models, and fact-based management to drive decisions and actions*” (Davenport & Harris, 2007). It uses analyzed data to support decision-making. It is getting information and deriving what to do with the information at hand (National Academies of Sciences, Engineering, & And Medicine (U.S.), 2017, p. 61). Web 2.0 has allowed users to be content providers thus making it data-driven. This helps analytics as it heavily relies on data. There are four types of data analytics, mainly, Descriptive, which points out what is actually happening, Predictive, which figures out what is likely

to happen, and Prescriptive, which provides insight on what should be done depending on the scenario. These all attribute to better decision making as the decision to be made would have supporting evidence that the decision maker is making the right choice (Corcoran, n.d.).

Descriptive

This is the most common form of data analytics as it aims to compile and understand data that already exists. It uses historical data to identify patterns and trends. Going side-by-side with Descriptive analytics is Exploratory data analytics, as it goes further than Descriptive analytics. It searches through the data for correlations and relationships to generate a hypothesis. Data to be used in this type of analytics are discrete and continuous data. Discrete data are data that are finite or countable, may it be numerical or categorical, while continuous data is taken through observations within an interval of time. These data are then summarized, either by frequencies, distributions, or tabulations to make calculations of occurrent values, and central tendencies, such as mean, median, and mode. Presenting these data are usually done in graphs, such as bar graphs and scatter plots (National Academies of Sciences, Engineering, & And Medicine (U.S.), 2017, p. 65).

Predictive

Predictive analytics goes deeper than both descriptive and exploratory as it uses the data to determine patterns and predicts what will happen in the future. It is used to test certain hypotheses. Tools that can be used in Predictive analytics are machine learning, linear regression, and nonlinear regression.

Machine Learning

This method is used for out-of-sample predictions and addresses dealing with a huge set of data. It basically involves developing techniques to teach computers to learn without putting it into code. There are three (3) types of classes, Supervised, a teacher gives examples to the computer, Unsupervised, the computer itself finds patterns without examples, and Reinforcement, where a software agent finds a way how to optimize without giving examples (National Academies of Sciences, Engineering, & And Medicine (U.S.), 2017, p. 66).

Linear Regression

Linear regression summarizes relationships between two (2) quantitative variables. This is usually used for predicting, forecasting, reducing errors, and quantifying the relationship between data (National Academies of Sciences, Engineering, & And Medicine (U.S.), 2017, p. 66).

Nonlinear Regression

Nonlinear regression uses observational data that are modeled using nonlinear combinations of parameters that depend on independent variables. This requires a lot of computation and should be iteratively done (National Academies of Sciences, Engineering, & And Medicine (U.S.), 2017, p. 67).

Prescriptive

This is the analytics that answers the question of what to do with your data. It provides recommendations to support decision-makers with the best results based on the trends found within the data sets. This is also known as decision making under certainty which is based on the methods of Stochastic modeling and mathematical optimization.

Prescriptive analytics has two (2) key areas, Stochastic Models of Uncertainty and Mathematical Optimization Under Uncertainty (National Academies of Sciences, Engineering, & And Medicine (U.S.), 2017, p. 71).

Stochastic Models of Uncertainty

This area is done before optimization as it determines the best set of decisions through the Stochastic models and the processes associated with the problem. It provides context in formulating a solution to the problem by capturing the relationships between the actions done and its outcome (National Academies of Sciences, Engineering, & And Medicine (U.S.), 2017, p. 73).

Mathematical Optimization Under Uncertainty

Mathematical optimization determines which among the set of decisions would generate the best result with context given by the Stochastic model (National Academies of Sciences, Engineering, & And Medicine (U.S.), 2017, p. 74).

2.1.2 Project Management

According to the Project Management Institute (n.d.), the application of knowledge, tools, skills, and techniques is basically the definition of project management. Project management is applied to project activities to meet the project requirements. Certain steps and tools and techniques are used to have a successful implementation of project management.

2.1.2.1 Project

A project as defined by the Project Management Institute (n.d.), “is a temporary endeavor undertaken to create a unique product, service, or result.” Most of the time projects are made to take advantage of an opportunity, or to solve a problem. Certain attributes help define a project. A project can be large or small and

can take a short or long time to complete depending on the scope. A project will end when the objectives have been met or it has been terminated. There are six attributes to further help define a project are discussed as follows:

- A project has a unique purpose. Having a specific objective or goal is expected of every project. The objective can serve as a basis for further discussion about a project.
- A project is temporary. As mentioned earlier, all projects are temporary endeavors, meaning, each project has a definite beginning and end.
- A project is developed using progressive elaboration. In the beginning, projects have broad definitions, however, as it progresses, the definition of the project and specific details become more understandable.
- A project requires resources, often from various areas. Employees, software, hardware, and other assets are considered as resources. Often times, the employees involved in a project are not just from one department, and resources will constantly be used to achieve project objectives.
- A project should have a primary customer or sponsor. A project sponsor most of the time is the customer. A project sponsor provides the funding and budgeting, and also the direction to where the project will lead.
- A project involves uncertainty. There are risks involved in every project, and also unforeseen external factors.

2.1.2.2 Processes/Phases

There are five (5) phases in the project management life cycle, Initiate, Plan, Execute, Control, and Close.

Initiate

Project management starts with the initiation process wherein the project is to be defined. During this process, the senior managers are to determine the scope, time and cost constraints of the project as well as selecting the project sponsor and project manager (Schwalbe, 2011). The main goal of this process is to formally

select and start projects. It is to be noted that the initiation process does not involve any work to be started on the product of the project but rather it focuses solely on the project's objectives and what is needed to achieve it (Newton, 2015).

Plan

The main goal of this process is to estimate the time, cost and resources needed for the project to avoid risks and issues down the road. Within this process, the deliverables are identified as well as the activities to produce these deliverables. The planning process includes developing the schedule of the project and the budget needed. This process is used to develop an understanding of the project, how the project will be executed and where to get resources to execute the project (Newton, 2015).

Execute

This process puts into action the project plan that was developed in the planning process. This process includes performing the necessary activities to meet the objectives stated in the project plan as well as managing resources and the project team. Changes to the scope are to be made as the project execution moves farther along as unexpected internal and external factors arise. Within the execution process these changes are to be documented as Change Management (Newton, 2015).

Control

The controlling process is where actual results taken from the execution process are compared to the expected results stated in the project plan and the variances are then controlled by taking corrective action to keep the project on time and on budget (Newton, 2015).

Close

The closure process is the formal completion of the project deliverables as well as turning them over to the customers after getting the final approval from project sponsors and the customers.

This also marks the termination of any activities done by the project team and the completion of the documentation of the project and archiving these documents (Newton, 2015).

2.1.2.3 Inputs and Outputs

Initiate

The initiation process produces a business case that entails the reason of why the project was initiated as well as what problem it seeks to solve, the cost-benefit analysis that will aid top management in deciding whether to go through with the project or not and what resources the project will consume. Aside from the business case, the project charter is also another output of this process. The project charter describes the project in detail, this includes the requirements needed for the project as well as the scope of the project. The project charter defines the objectives and the budget (Newton, 2015).

Plan

The main inputs of the planning phase are the project charter and business case completed from the initiation process. The planning phase produces the scope statement, work breakdown structure (WBS) and the project management plan. The scope statement basically describes what the project encompasses, what work would be done and what work is not to be done for the duration of the project. The WBS helps decide how to do the work needed in the project and also aids in making the project schedule (Schwalbe, 2011). The WBS would further be discussed in the Tools and Techniques section of this chapter. The main output of the planning process is the project management plan which helps guide the execution of the project and project control. It documents the plans, scope, cost and schedules that have been approved by top management (Newton, 2015).

Execute

The main input of this process is the project plan and the main output of the execution process are the project deliverables that

were specified in the project plan. Aside from the project deliverables, change management documents, which entails changes done to the original project plan as external and internal factors that were unforeseen during the planning process, are also expected outputs of this process (Newton, 2015).

Control

The controlling process requires the project plan and progress reports to see the variances between the expected results from the actual results taken from project execution. The controlling process produces updated progress reports, project plan updates and change requests as well as the deliverables stated in the project plan (Newton, 2015).

Close

The closure process produces the final deliverables as well as their respective documentations. These documents and deliverables are archived as reference for future projects as well as lessons learned by the project team (Newton, 2015). The final output of the project is the final report that entails all details of the project which is to be presented to top management and project sponsors (Schwalbe, 2011).

2.1.2.4 Project Metrics

Key Performance Indicators (KPI) are present to monitor, evaluate, and provide insight to the project's performance, as well as, project team member's. According to Denley (2015), KPI is a method to measure a performance against an identified objective. In making KPIs, it is important to understand what KPI should or should not be measured. KPIs should be quantifiable metrics to be measured accurately. There are four (4) common metric categories, namely: Timeliness, Budget, Quality, and Effectiveness. The following are more specific KPIs under each category:

- Timeliness
 - Cycle Time. The time required to accomplish a particular task or activity.

- On-time Completion Percentage. Checks the number of projects wherein the projects were finished given a deadline.
- Time Spent. The amount of time you spent in completing a project, task, or activity.
- Number of Adjustments to the Schedule. Counts the number of times the completion date of the project was adjusted.
- Budget
 - Budget Variance. Difference between the actual and proposed budget for a certain project.
 - Budget Creation Cycle Time. Measures the time it took to finish formulating the project's budget.
 - Line Items in Budget. Tracks the individual expenses of a project team member.
 - Number of Budget Iterations. Counts the number of times the budget was revised before final approval.
- Quality
 - Customer Satisfaction. Measures the number of customers that are coming back. This is essential to projects dealing directly with its customers.
 - Number of Errors. Number of times things were needed to be redone during the project development.
 - Complaints. Tracks the number of complaints coming from customers, stakeholders, or project team members.
- Effectiveness
 - Number of Project Milestones Completed On Time with Sign Off. Measures the number of activities that were completed on-time and was approved by the project owner.
 - Number of Returns. Counts the number of times certain product, material, or equipment was returned to you due to some reasons.
 - Training Needed For Project. Tracks the number of hours, days it takes to finish training.

2.1.2.5 Tools and Techniques

Tools and techniques are used to assist project managers in the overall planning, executing, monitoring, controlling, and closing phases of any project or program. The main reasons for using certain tools and techniques range from brainstorming ideas, organizing and/or summarizing an array of data and information, visualizing the project flow, formulation/initiation of contingency plans, and proper project documentation. There is not an existing tool that captures everything needed in managing a project and with this, there is a long list of tools and techniques to be discussed, but it would be more viable to discuss at least five important tools and techniques that may be applicable in every project, namely the Work Breakdown Structure (WBS), Gantt Chart, Program Evaluation Review Technique (PERT), Responsible-Accountable-Consulted-Informed (RACI) Accountability Matrix, Progress Reports, and Project Management Software.

Work Breakdown Structure (WBS)

A deliverable-oriented grouping of activities involved in a project is a Work Breakdown Structure (WBS). The WBS helps in organizing and dividing deliverables between the people involved in the project. It is a basis for planning and managing project schedules, resources, changes, and cost. A good WBS includes the scope of the project, therefore, all activities not in the WBS should not be done. Often times, the WBS is organized by the project's phases and the project management process group - initiating, planning, executing, monitoring and controlling, and closing. WBS can be in form of chart or in a list depending on the preference of the user. There are five (5) different approaches in making the WBS namely, Using Guidelines, Analogy Approach, Top-down Approach, Bottom-up Approach, and Mind-mapping Approach. WBS alone is insufficient, and a WBS dictionary is required to support the WBS. WBS Dictionary describes in detail the deliverables in the WBS, it includes the responsible organization, resource requirements, estimated costs, and other information (*Refer to Appendix B for Sample Work Breakdown Structure*).

Gantt Chart

In 1917, Henry Gantt devised a horizontal time chart which is mainly used for project scheduling. It is a standard graphic representation of all tasks to be performed in a project plotted in days, weeks, or months whilst showing the start, end, elapsed, and completion time of each task. It provides an overview of the flow of tasks of the project and its dependencies to one another. It can also show the comparison between the actual task/s completion from the planned task/s completion. It is not just a simple scheduling tool, but it can also be used in estimating resources and costs within a project. The information gathered from a Gantt Chart are that of tracking project progress, success and failure points, and comparison between actual and planned schedules and costs (*Refer to Appendix B for Sample Gantt Chart*).

Program Evaluation Review Technique (PERT)

PERT was developed by the United States Navy in the late 1950's to administer the Polaris submarine missile program. It is used to define and address risks by defining, planning, and analyzing tasks involved in a project with proper scheduling, organizing, and coordinating of tasks with one another. This technique makes use of the critical path method, or sometimes called the PERT charts, as foundation for schedule estimates and task dependencies. A critical path method simply illustrates the activities in a project in chronological order, activities that can be done in parallel, and individual activity durations. Analyzing the critical path method is the essence of PERT, as it is used to formulate the optimistic, most likely, and pessimistic time for completion, or better known as the Three-Point Estimate or probabilistic time estimates (*Refer to Appendix B for Sample PERT Chart*).

Responsible-Accountable-Consulted-Informed (RACI) Accountability Matrix

The RACI Accountability Matrix is used to identify the roles and responsibilities of project stakeholders by assigning specific tasks to the rightfully skilled members. It is a helpful tool in task management and control in knowing what each stakeholder's

involvement in the project is and what are their key deliverables. In constructing the matrix/diagram, there are three components – the leftmost column being the list of tasks/deliverables, the topmost row being the role or a specific member's name, and the rest of the areas is for cross-referencing the responsibility of each member to each task. The RACI acronym is further defined as follows (*Refer to Appendix B for Sample RACI Accountability Matrix*):

- Responsible. Stakeholders who are highly involved in each activity and is committed in accomplishing each activity and managing its resources.
- Accountable. An individual whose main role is to take credit for the success or take blame for the failure. It is sometimes called the activity manager.
- Consulted. Stakeholders whose opinions are deeply taken into consideration in the decision-making process.
- Informed. Stakeholders who are always updated with the progress of a certain activity.

Progress Reports

Progress Reports are regular or routine documentation of updates and information regarding the current status of the project, planned activities, activity accomplishments, issues, and comments or notes that provide relevant information to stakeholders in a timely manner. These reports are used to identify and address the potential and current problems regarding cost, schedule, and quality. There are five types of progress reports and are discussed as follows (*Refer to Appendix B for Sample Progress Reports*):

- Current Period Reports. It is the status of the project at the present time.
- Cumulative Reports. It is the report history of the project at a specific duration of time in order to identify trends and patterns.
- Exception Reports. It is a report that is only produced when there are issues and/or problems that have risen. Consequently, it summarizes these issues and problems and suggests the corrective action towards each concern.

- Stoplight Reports. It is more like a tool for reports in which it makes use of the colors of the stoplight to indicate status. Green indicates that the project is completely controlled. Yellow means there is a problem or two that needs to be addressed or is being addressed. Red means that the project is experiencing more problems than accomplishments and is currently uncontrolled.
- Variance Reports. It is a report that indicates the project's overall pace as it is compared to the initial agreed schedule; it may be ahead or behind of schedule. Aside from schedule, it may also compare costs, resources, and quality.

Project Management Software

Project Management Software and Systems may be the most helpful tool in administering project management. It cuts processing time by automating processes which include project scheduling, cost management, communication and coordination, activity management, risk management, and reports management. It also has the ability to instruct collaboration and synergy among the project team members as it provides transparency and a sense of urgency by prioritizing near deadlines on certain tasks (*Refer to Appendix C for Sample Project Management Systems*).

2.1.3 Project Management Systems

Project management systems aid organizations with their projects by providing them ease of access and use to what used to be a manual task and process to a digital and convenient application (Hoebler, 2015). These systems provide visuals for project managers and project stakeholders to align timelines. Gantt charts are the most common visual representation that project management uses for project planning and scheduling and is used by most PMSs today. PMS also has dashboards that present the progress of projects, visual metrics and key performance indicators (KPI) of ongoing projects to be able to provide a quick overview that may lead to well-informed decisions (Karlson, 2015).

2.1.3.1 Benefits of Using Project Management Systems

Today, applications and software help people finish their tasks properly and on time. Software make it easy for people to lessen human errors and provides platforms that show important information to help make important decisions. Moreover, there are a number of benefits that a project management system can provide. According to Windsor (2018), PMS offers a centralized project reporting platform for the project stakeholders. This provides up to date progress to everyone involved in the project. In addition, PMS presents improved task management and visibility that provides the project team what tasks they are responsible for and how it will affect other tasks within the project. Another benefit is the assistance with monitoring the project. This helps a project stay on schedule and presents an idea how an individual task can influence the overall schedule of the project (Collins, 2016). Lastly, PMS presents various information that will help optimize decision making. It allows the project stakeholders to make necessary adjustments based on all the data captured by the PMS (Hurst, 2017).

2.2 Review of Related Systems

Leading project management systems were studied and compared as a reference for the conceptualization of the project. The project management systems that were considered were, Asana, Basecamp, Jira, Microsoft Project, Smartsheet, Trello, Wrike, and Zoho Project.

Asana

Asana is one of the most popular project management systems in the market. Asana mixes project management with task management into their system that pushes communication and collaboration within the project team. Aside from creating projects, users can make tasks within the project. As Asana is a web-based project management system, it makes following the progress of your project easier as well as communicating with your project team as Asana provides real-time communication between project members. Asana has no built-in feature of producing Gantt Charts however it allows users to integrate their project management system with various established applications such as Gmail, Microsoft Office 365, Google Calendar, Jira, Salesforce and Instagram, which

provides Gantt Charts. As for pricing, Asana has three (3) categories; a free version which caters to teams of fifteen (15) members that allows users use of basic features such as basic searches and dashboards. The premium category costs \$9.99 (roughly PHP 500) per member per month to be billed annually and \$11.99 (roughly PHP 600) per member per month when billed monthly. The premium package consists of the free package features plus advanced searches and reporting, custom fields, task dependencies and priority support among others. The premium package also has no team member limit. Lastly, the enterprise package consists everything that the premium package has with the addition of advanced admin controls, custom branding and same day support. In order to find out the price of the enterprise package, users must contact Asana directly as it is priced by quote. Asana has been tried and tested by Uber, Airbnb, Dropbox and Tesla (*Refer to Appendix C for System Screenshots*).

Basecamp

Basecamp is one of the first products of Basecamp, formerly known as 37signals. Basecamp began its production in 2003 and was launched in 2004 as a web-based project management tool. The system is for all types of businesses, may it be freelancers to even big enterprises. Basecamp, as all project management system, only has the basic functions like to-dos to track activities, message boards to make announcements, campfire to chat with project members, schedule to mark deadlines and milestones, docs and files for easy sharing of documents, and automatic check-in to get updates from project members. As a project management system, Basecamp could be lacking for some, compared to big project management software names out there, Basecamp offers minimal customization, limited integration of developer's API, and also Basecamp is not really mobile friendly. However, Basecamp has been trying to improve and a number of third party tools can be integrated with the system, these third-party tools includes, but not limited to, Zapier for mobile and desktop applications, Timeneye for time tracking, AssessTEAM for feedback of employees, Ganttify for creating Gantt Charts, Instabug for software development, and SupportBee for customer service and support. Some of the major clients of Basecamp are NASA, WWF, Adidas, and Twitter (*Refer to Appendix C for System Screenshots*).

Jira

Jira is a web-based project management software that allows users to manage projects from the moment of conceptualization to project launching. Jira allows users to plan and track projects as well as create user stories, plan sprints and

assigning of tasks to team members. It is flexible in terms of planning, it can accommodate mixed methodologies. Prioritizing tasks to be done and releasing of reports that are real-time and easily understandable for users to analyze. Jira does not have their own generation of Gantt Charts however they are capable of integrations with over 3,000 established applications such as Salesforce, Github, Gantt-Chart for Jira and a lot more applications from the Atlassian Marketplace. As for pricing, Jira has two (2) categories, cloud based and self-hosted. For Cloud based, a team up to ten (10) users would cost \$10 (roughly PHP 500) monthly flat fee and a team up to 11-100 users would cost \$7 (roughly PHP 350) per user per month. If a team exceeds 100 members, price is to be quoted. For self-hosted, prices range from a server of 10 users costs \$10 (roughly PHP500) one-time payment to a server for more than 10,000 users costs \$39,000 (roughly PHP 2,000,000) one-time payment. For data centers, prices range from 500 users at \$12,000 (roughly PHP 600,000) per year to 50,001 users at \$450,000 (roughly PHP 23,000,000) per year. Jira currently has over 51,000 customers such as eBay, Spotify and Cisco (*Refer to Appendix C for System Screenshots*).

Microsoft Project

Microsoft Project (MS Project) developed by Microsoft, the same company who made the known Microsoft Office, an office suite that provides a word-processing application, spreadsheet application and presentation application namely - Word, Excel and PowerPoint respectively. MS Project was designed by Microsoft to be used by business professionals. MS Project is meant to be installed locally to a machine and is intended to be used by the project manager to monitor a project. MS Project, as many will say, is an optimized spreadsheet or Excel application that focuses mainly on project management. It makes capturing data and input from the project manager easy and convenient. MS Project also provides instant visualization of the data that the project manager has provided. Project timelines, assigning resources to tasks, tracking the project progress and many more. MS Project offers extensive data capture but should be manually encoded by the project manager. It then uses this information to provide visual representations and basis for decisions for the project manager. The user experience of MS Project is very similar to a spreadsheet. Numbered cells are used to capture and present encoded information to the user. MS Project is very dynamic to a point that most of the features are not customized to an industry or organization. In addition to that, MS Project offers little to no customization. The organization will have to adapt and learn how to operate and fully utilize this software.

A single license of Microsoft Project Standard 2016 for a single user will cost \$560.00 (roughly PHP 28,000.00) while a single license of Microsoft Project Professional, which adds a number of useful features, will cost \$940.00 (roughly PHP 57,000.00) for a single user. Although there is an option to avail access to this software through Microsoft's online service - Project Online Professional, it will cost \$30.00 (roughly PHP 1,500.00) per user, per month which is just a fully installed, desktop application and not cloud-based. This just opens the availability of the software to multiple devices of a single user. MS Project currently has over 20 million users from multiple companies like British Airways, Kraft, BMW, Toyota and Intel to name a few (*Refer to Appendix C for System Screenshots*).

Smartsheet

Spreadsheets are widely present in any organization, and adapting a similar interface allows users to easily adapt and learn the software, but the only difference in Smartsheet is that it has more capabilities and is more customizable than regular spreadsheets. It is a web-based project management software designed for any sized business to initiate collaboration with the use of project templates, Gantt Charts, task and sub-task lists, budget variance, resource management, change notifications, custom reports, file sharing, customizable dashboard, and version control, which can all be viewed real-time in any device. The key functions of Smartsheet are planning, tracking, automating, and reporting work. These functions can cater to the majority of the departments in an organization. Smartsheet can be integrated with more or less fifty-seven (57) applications; Google Apps, Salesforce, AppSheet, and Microsoft are only some of the biggest integrations it is able to do. There are four pricing packages which are all billed annually and are charged per user and per month except for one - An individual plan at \$14 (roughly PHP 700), team plan at \$15 (roughly PHP 750), business plan at \$25 (roughly PHP 1, 250) and the enterprise plan with a customized quote. It now claims that it has over 3 million users in 70,000 organizations across 190 countries. Some of its clients are Cisco, Aramark, World Vision, Colliers International, Netflix, and Hilton (*Refer to Appendix C for System Screenshots*).

Trello

Trello is a web-based PMS made by Fog Creek Software. On the surface, Trello is fairly easy to use. Navigation is straightforward and action buttons are displayed where a user will expect them to be. Trello's implementation of a project management software is very modern. They opted not to use the

traditional Gantt Charts, but instead use what they call Boards. These boards are similar to projects and those can contain, what they call, cards. Cards are similar to tasks in a project where you can set who is responsible for that card, when the task should start and end, and so on. Trello also takes pride of its user experience which is much similar to social media platforms - Facebook to be exact. The way Trello implemented its notification feature, tagging, and project activity log is close to how Facebook implements theirs. This way, users who are familiar with using the platform will not have difficulty using Trello. Trello can handle any kind of projects but is not optimized for business use. What Trello lacks the most is the capacity to generate reports and KPIs. Trello is offered for free with no limitations on its main features. Upgrading a user to Business Class will cost \$9.99 (roughly PHP 500.00) per user per month which enables more features most notably the capability to be integrated with other software such as Jira, Salesforce, Dropbox, etc. (*Refer to Appendix C for System Screenshots*).

Wrike

Wrike is an online project management software for any sized businesses that aims to speed up and improve efficiency of work. It has a 3-pane layout interface that allows users to view project operations and other important data in one screen. Within this view, users can collaborate with their team members through updates, file sharing, monitoring and controlling work progress, and standardized change requests/proposals. Other tools for collaboration include an interactive Gantt Chart, performance charts, task discussions, report generation and auditing, and integration with other applications. Wrike can easily integrate with Dropbox, Salesforce, MS Project, Google Apps, and many more. Wrike prides itself in being able to produce extra time by cutting time in certain work processes including meetings, emailing, reporting, and data gathering. There are five pricing packages which are all billed annually and are charged per user and per month except for two – A free plan with absolutely no cost for up to 5 users, professional plan starting from \$9.80 (roughly PHP 490) for 5-15 users, business plan at \$24.80 (roughly PHP 1, 240) for 5-200 users, marketers plan at \$34.60 (roughly PHP 1, 730) for unlimited marketing/creative users, and the enterprise plan with a customized quote for unlimited users. Some of its clients are EA Sports, Stanford University, HTC, Google, Adobe, and Hawaiian Airlines (*Refer to Appendix C for System Screenshots*).

Zoho Project

Zoho Projects is an online project management application for various types of businesses like freelancers, small and medium-sized businesses, and enterprises. Zoho Projects was developed by Zoho Corporation, which is home to almost 35 more web-based applications. Some of the features that are included in Zoho Projects are dashboards, task dependency, Gantt Chart, project templates, document sharing, calendar, project custom fields, and email integration. Zoho Projects can also be integrated with most, if not all, the products of Zoho Corp. like Zoho Mail, Zoho Docs, and Zoho Reports. Also, the application is open to other APIs, and can be integrated with third party softwares to have a more customized and personal application that may suit your business needs. Zoho Projects has 4 business plans to choose from. First, is the Free version which includes 1 project, 10 MB of storage, maximum of 5 users, and limited features of IssueTracker. Next, is the Express for \$25 (roughly PHP 1200) it includes 20 projects, 10 GB of storage, and unlimited number of users. Third, is the Premium which costs \$50 (roughly PHP 2500) wherein a customer can have a maximum of 50 projects, 100 GB of storage, unlimited number of users, and pages and chat is also included. Lastly, the Enterprise, for \$100 (roughly PHP 5000) and it includes unlimited number of projects and users, 100 GB of storage, and pages and chat is also included. Some of the biggest clients of Zoho Projects are Raw Engineering, Cloud Camper, and Abacus Concepts (*Refer to Appendix C for System Screenshots*).

Synthesis

The systems mentioned above each have their own strengths and weaknesses. Asana, Basecamp, and Trello have strong team collaboration, although, they cannot visually display the created schedules. Jira, Microsoft Project, and Zoho Project are both highly customizable, however the former is very complicated to understand and master, while the latter has an overwhelming need for third-party applications. Smartsheet and Wrike have detailed reporting schemes, however, they are unable to measure performance with a customized formula. In reviewing project management systems, the developers have created an image of a system that will cater to TEI-specific needs (*Refer to Appendix C for Project Management Systems Comparison Table*).

2.3 Review of Related Methodologies

Agile Software Development is one of the methodology umbrellas in developing a software. It is composed of methods with an iterative workflow, gradual delivery of software units/modules in short iterations, continuous stakeholder engagement, and quality software outcome. Agile is defined to be active, responsive, and alert, which are all factors that are reflected in each methodology. In February 2001, the Agile Software Development Manifesto was developed and included four sets of values in describing the true essence of what agile meant. The four agile values are, team interactions over processes and tools, quality and working software over adequate documentation, customer involvement over contract negotiation, and responsive to changes over following the initial plan. Some of the methodologies classified under agile software development are Dynamic Systems Development Method, Extreme Programming, Feature-Driven Development, and Scrum.

Dynamic Systems Development Method

The first version of Dynamic Systems Development Method (DSDM) was developed due to the lack of discipline in the Rapid Application Development Method. In 2007, DSDM released its latest version which is known as DSDM Atern. DSDM puts emphasis on time and quality over the actual functions of the system. DSDM implements the MoSCow method in prioritizing the requirements of a project. Must have (M), should have (S), could have (C) and won't have (W). This methodology may be used in all project sizes with any sized teams as well. DSDM sets itself apart from other agile methodologies due to the fact that reports are formalized, and requirements are tracked.

DSDM is made up of seven (7) phases; the pre-project phase wherein projects are suggested and selected. This phase determines whether or not to go through with the project. The second phase is the feasibility study where the problem is defined as well as its proposed solutions. Assessing of costs whether it is feasible for the company to achieve is done in this phase. The third phase is the business study where the basis for all work that would be done is stated. The fourth phase is the functional model iteration (FMI). This focuses on designing the business aspects of the system. The fifth phase is the design and build iteration (DBI) where the system is actually developed. The iteration phase follows the 80%/20% principle wherein 80% of the solution should be resulted from 20% of the total time. DSDM practices having early deliverables in order to make time for more thorough testing. The sixth phase is the implementation where the

system is turned over to the client. The last phase is the post-project phase wherein the deployed system's performance is measured. Additional enhancements are also measured, this usually takes place six (6) months after project completion (*Refer to Appendix D for DSDM Framework*).

Extreme Programming

Extreme Programming (XP) is an agile development process, it focuses on collaboration between managers, customers, and developers, and it also gives emphasis on teamwork. Change is inevitable in software development, and these changes can sometimes have big impact on wasted resources, therefore, one of the main purpose of XP is to minimize wasted resources through having multiple short development life cycles instead of long ones. This methodology is fit for small projects with a team of less than twenty (20). XP is done according to values, and rules and practices. The five values to follow when implementing XP are simplicity - what needs to be done will be done, no more, no less. Also, in XP they believe in minimalistic and clean design; communication - as mentioned earlier, XP emphasizes on teamwork, therefore, communication is key. It is important that constant communication happens between the customer and the developers, to lessen misunderstanding as well; feedback - in the early stages of development, testing is already done and giving feedback or critic is highly encouraged by XP; respect - everyone is expected to respect the opinion of different people with the software that is being developed; and lastly, courage - changes can be scary at times especially with how fast technology is moving right now, however, everyone should have the courage to embrace those changes. Now, the five (5) rules to follow when practicing XP are the following (*Refer to Appendix D for Extreme Programming Framework*):

- Planning. Users stories are made in the planning stage. User stories are used to make time estimates for meetings, planning, and releases.
- Managing. Managing bottlenecks and having control measures are key in this rule. Avoiding bottlenecks, and over workload by managing requirements and the people is part of managing.
- Designing. It is believed that complex designs take more time than simple ones, therefore, it is expected that the design model is simple and follows one (1) of the values of XP. Spike solutions - a program to explore potential solutions, are required by this rule.
- Coding. For coding, this rule states that customers are expected to be part of the development team as a consultant, or similar, the customer is always

expected to be available for consultation. Coding standards should also be agreed by everyone involved in the project.

- Testing. A rule stating that all codes must undergo testing, especially, unit testing. Acceptance testing is also required to be accomplished.

The following are thirteen (13) standard practices that best describe Extreme Programming:

- Customer Team Management. The customer is part of the development team and is responsible for defining and prioritizing features.
- User Stories. Scenarios that will show the different requirements of the system. Based from these stories, the priority and estimated cost of each function will be determined.
- Short Cycles. Iteration is the core practice of XP. Ideally, the system should have small releases every two (2) weeks. At the end of each release, feedback is collected, and a release plan is made. Each iteration lasts from one (1) to six (6) weeks.
- Acceptance Tests. Acceptance testing should always be done from different users to further enhance the user interface and user experience of the system.
- Pair Programming. As the name suggests is done by pair in one development effort on one workstation.
- Test-Driven Development. Test cases should be prepared before coding. In result, a completed test case will be the guide in system development.
- Collective Ownership. All codes, modules, and features of the system are never owned by a single developer, but rather the whole team, therefore, anyone from the team can make changes if necessary.
- Continuous Integration. Developers who made an improvement or added a new code should always integrate it into the larger system at all times.
- Sustainable Pace. It is a rule of XP that a team is only allowed to work for forty (40) hours a week and no overtime is allowed. XP thinks that developers are less productive when tired.
- Open Workspace. XP believes that information dissemination can be made easier and more accessible when everyone on the team works together in an open room and are within earshot of each other.
- Planning Game. In this practice, customers rate the importance of a feature, while the developers, decide how much that feature will cost.
- Simple Design. The system is designed to be as simple but expressive as it can be, and the XP team encourages a minimalistic design.

- Refactoring. Constantly, every hour, XP team always try to improve using refactoring techniques, such as, improving codes, to simplify codes.

Feature-Driven Development

Feature-driven Development is an agile software development model that focuses on quality of the entire project by conducting frequent quality checks for each step and delivery of results to prevent late discovery of errors and change in requirements. It provides insights to the client by continuously producing results for the clients to see. This model can cater to more complex projects with it being highly iterative with each iteration taking up two weeks. By catering to complex projects, the methodology requires multiple teams composed of a large group. FDD is divided into five steps - Develop an overall model, build a features list, plan by feature, design by feature and build by feature (*Refer to Appendix D for Feature-Driven Development Framework*).

The process starts with the client and the developers discuss the overall domain of the project then generates models that will focus on one problem and later on combining all models to create the overall model that they will use for the project. Following that, the next step would be for the developers to break down a functionality and identify the necessary features for that functionality. A feature will also entail activities for it to be properly developed in which the team will also discuss. After which, they proceed to the next process, they conduct planning on which order the features will be developed. They identify which is the priority and usually, these are the features that are most relevant and important to the clients. Tasks are also divided among the team for them to identify which feature they will be working on. Right after that, the developers then proceed to designing the domain classes that will be used for the feature of a certain iteration they are working on. Method and class prologues are produced in this step and a design inspection is conducted. Lastly, the developers begin to code and test their assigned features. The codes are inspected and would require the approval of their Chief Programmer before they can finally be compiled to the main build. After which, another iteration will begin starting on the fourth step until they finish the project.

Scrum

In 1993, Jeff Sutherland developed the Scrum methodology which is designed to quickly deliver value and project deliverables in an iterative process. The project deliverables or list of tasks are subdivided into smaller units in order to easily

monitor each task, or more commonly known as a “Divide and Conquer” approach. It ensures an environment where the team members are well-informed and have a platform for disseminating information on the overall progress of the project. All kinds of projects are suited for this methodology. There are three main roles involved in this methodology namely, the product owner, the scrum master, and the team. As the names imply, the product owner is an individual responsible for defining the scope of the project and coordinates with the stakeholders, the scrum master is responsible for all activities and decisions that take place in an iteration, and the team is responsible for accomplishing the actual work within each iteration that contributes to the entirety of the project.

The first step in a Scrum framework is to define the scope of the project by closely coordinating with the project sponsors in gathering all necessary requirements in order to provide direction for all stakeholders. The scope is now translated into the product backlog wherein all the project specifications are listed in the form of user stories. After the product owner designs the project using information found on the product backlog, the project now enters into the first cycle of iterations, or better known as a sprint. To formally enter a sprint, the team must go through sprint planning which would not exceed two (2) hours. During sprint planning, the team plans a list of tasks to be done and deliverables to be accomplished at the end of the sprint. Everything that was discussed in each sprint planning is documented in a sprint backlog, specifically the product backlog items chosen to be accomplished and how they are supposed to be accomplished during the sprint. The sprint is then executed while being guided by the sprint backlog. There will be a fifteen-minute meeting every day to synchronize and plan activities to do within twenty-four hours, which would be coined as a daily scrum. Each team member explains three points during the daily scrum – what he/she did the previous day to help the team meet the goal, what he/she will do today to meet the goal, and possible issues that may prevent the team from meeting the goal. At the end of each sprint, a sprint review is done to gather feedback and apply changes to the product backlog if necessary. After the sprint review, a sprint retrospective is done to evaluate the team and their performance to adapt improvements on the next sprint. Once the team executes its last sprint and is accepted by the stakeholders, it then releases a usable software to be delivered to the client.

One of the advantages of scrum is that it can produce value to the stakeholders after each sprint rather than during the end of the entire project. It also eliminates risk and enhances team collaboration with the use of repetitive team meetings in sprint planning, daily scrums, sprint reviews, and sprint

retrospectives. Scrum is simple to understand, yet difficult to master. One of the down sides of scrum is that, it requires a high level of commitment from the team in order for it to be a success and one of the key issues in project management is the individual culture within a team which may imply that not everyone has the same practices and preferences (*Refer to Appendix D for Scrum Framework*).

Synthesis

Reviewing other agile methodologies shined a brighter light on the researchers' chosen methodology to be applied in the project. Although Scrum is the most popular methodology, the researchers found it unfit for the project due to the complexity of the sprint, or also referred to as the iteration. The FDD had familiar practices, but it requires generally a large team, which is inapplicable to the researchers' group of four (4). DSDM and XP are also good frameworks to follow because of the practices and principles involved such as, the MoScow method, user stories, and having an open workspace (*Refer to Appendix D for Methodologies Comparison Table*).