CHAPTER II

LITERATURE REVIEW

2.1. Construction

Construction is an activity to construct a certain facility or infrastructure. Construction basically is different with manufacture. Manufacture mostly consist of activities that require a mass production of similar item, while construction produce an unique item as a result of environment concern, codes and purpose of the facility or infrastructure itself. Basically construction is categorized into one package of work, but in practice it is consists of several other jobs.

Trianto (2001) define that construction is an activity to build facilities and infrastructures including buildings and electrical installations. While construction is known as a job, but in fact construction is an activity that consist of several other job that are assembled into a single unit building.

Commonly, construction activity being supervised by a project manager, design engineer and project architect. These people are responsible for the condition of project life cycle such as financial condition, delays, equipment, and monitoring the progress of the work.

In order to ensure a successful construction work, effective planning is fundamental. It is also required supported by several aspects, such as; good planning schedule, workplace safety, availability of building material, logistics and etc. (Chrisna, 2013).

2.2. Construction Project

According to Dipohusodo (1996), project can be defined as a process to obtain complete infrastructure that match to its purpose and initial goal by using available budget and resource within a certain period of time.

Definition of construction project according to Kerzner (2001) stated that a project could be treated as a chain of work and should consist of:

a. Specific goal and done in a certain specification
b. The start and finish date is already decided
c. Have a budget limitation (if required)
d. Consumption of human and non-human resources (money, tools and equipment)
e. Multifunction (shorten several functional way)

In general public assumption, construction project is defined limited only as a physical construction that supported and executed by contractor. While actually a construction project has started since the initiative from the owner to build, in which in the next stage will involve and affect the behavior several parties such as consultant, contractor and the owner itself (Liang, 2015).

Successfulness of a construction project not only seen from the physical result, but also the functional goal achievement after the construction has finished. Therefore, the relationship between parties which are involved in the construction project is important.

In competitive environments, where construction and infrastructure project are taking place, planning and scheduling are vital in order to understand

regarding the project performance (De Snoo, Van Wezel & Jorna, 2011). More specifically, both process have to be addressed correctly and efficiently to ensure that project meet their main objectives (Demculemeester & Herroclen, 2002; Laslo, 2010). These process are fundamental in the life cycle of construction project as they involve the selection of the most appropriate techniques, tools and equipment, definition and organizingvarious activities, and the estimation and allocation of the most economical usage of resources.

Haughan (2002) assume that planning and scheduling are time-cost oriented process in which becoming a challenge to project managers and planners when managing their project (Oglietti, 2005). Scheduling represent a significant task within construction project management. Scheduling must take into account the trade-offs between time cost based on the consumption of the resources and also minimizing project duration (Yang, 2007). Planning for resources must ensure the development of reliable schedule. Project manager and scheduler are responsible for planning and perform sufficient management coordination in a correct sequence (Winch & Kesley, 2005). Scheduling cannot succeed without knowledge of work being planned. Even more, an incompetence planning process might disturb the schedule and lead to uncontrolled flow of construction project progress. According to Oberlender (2000), tracking of project schedule cannot be achieved properly unless effective control are implemented. Chua and Godinot (2006) noted that a well-defined work break-down structure (WBS) in the planning phase improve the interface between parties, as the result more dynamic work, functional and schedule achieved.

2.3. Construction Management

Project Management Institute (2001) defines project or construction management as the application of knowledge, skill, tools and techniques to a broad range of activities in order to achieve the requirement of a particular project. The project being directed and controlled by five basic phases;

1. Project concept and initiation

   An idea for a project that being carefully examined to determine whether it is beneficial or not toward the owner or organization. During this phase, a decision making team will identify if the project can realistically be completed.

2. Project definition and planning

   A project plan, charter and scope may be put in writing, outlining the work to be performed. During this phase, a team should have prioritized the project, calculate a budget and schedule, and determine what resources are required.

3. Project launch or execution

   Resources task are distributed and teams are informed of responsibilities. Activities related to any information updated may delivered during this phase.

4. Project performance control

   Project managers will compare the project status and progress to the actual plan, as resources perform the scheduled work. During this phase, project

managers may need to adjust schedules or do what is necessary to keep the project on track.

5. Project close

After project tasks are completed and the client has approved the outcome, an evaluation is necessary to highlight the project successfulness.

The concept of project management according to PMI is a concept to develop a model of project management known as Project Management Body of Knowledge (PMBOK) which consists of eight components: 4 basic components or core function including; managing project scope, time/schedule, cost and quality, also 4 supporting function including: management of human resources, risk, contract and communication.

According to Kerzner (2001) the potential benefits of project management implementation are:

1. The functional responsibility could be identified to ensure every activities and profit are noted
2. Minimalized the needs of continuity report
3. Able to identified time limit of time in scheduling activity
4. Able to identified the methodology for trade-off analysis
5. Able to identified the progress of planning
6. The initial problem could be identified in order to perform early corrective action
7. Support the ability to predict the future planning
8. Know when the objective either fulfilled or not fulfilled.

2.4. Building Information Modeling (BIM)

The Technical Marketing Manager of Autodesk. Inc., Governati (2012), express that BIM is not just a tool, but a process that support virtual designing construction methodology. Point all stakeholder together throughout entire design in construction process and beyond to the operation and maintenance of the building.

According to BIM Handbook, it give three definition of BIM which are: (1)"design and process of construction that more integrated than its traditional way which provide an infrastructure in a better quality at a lower cost also shorter duration of project"; (2)"a model that include a precise geometry and data required to support progress of fabrication and construction itself" and (3) "accommodate the required functions to support the project life cycle, provide a fundamental aspect to the new design, construction ability and relation toward the team member" (Eastman et al. 2007).

Eastman et al (2011) defines BIM as a "verb or adjective phrase to describe tools, process, and technologies that are facilitated by digital machine-readable documentation about a building, its performance, planning construction and operation. The result of BIM activity a 'Building Information Model'. BIM software tools are characterized by the ability to compile virtual models of the buildings using machine-readable parametric object that exhibit behavior commensurate with the need to design, analyze and test a building design (Sacks et al, 2004). As such, 3D computer-aided drafting (CAD) models that are not

expressed as objects that exhibit form, function and behavior (Tolman, 1999) cannot considered BIM.

However, BIM also provides "the basis for new construction capabilities and changes in the roles and relationships among a project team. BIM also facilitates a more integrated design and construction process that results in better quality buildings at a lower cost and reduce the project duration" (Eastman et al, 2011). In this sense, BIM is expected to provide the foundation for some of the result that Lean construction is expected to be deliver.

The UK Government has set up a special BIM Task Group to help a roadmap for implementation of BIM in UK. To help with a gradual adoption they have specified levels of BIM that will have to be adopted by construction projects, with a mandate that all project achieve level 2 BIM by 2016.

The maturity levels (from the Government Construction Client Group, 2011):

Level 0: unmanaged CAD, information is exchanged as text or 2D drawings on paper (or as electronic document)

Level 1: managed CAD in 2D or 3D format using BS1192: 2007 with a collaboration tool providing a common data environment, possibly some standard data structures and formats. Commercial data managed by standalone finance and cost management packages without integration.

Level 2:coordinated 3D BIM environment. Separate discipline models consisting of objects with attached data. Commercial data managed by an ERP (enterprise resource planning) system. Level 2 may use 4D scheduling data and 5D cost

elements. This is the current typical, advance use of BIM and also the level that UK governments Construction Strategy requires as the minimum by 2016.

Level 3: fully open process and data integration enabled by open standards and managed by a collaborative model server. Can be regarded as iBIM (integrated BIM) and potentially employ concurrent engineering process. Difficult to achieve with current technologies

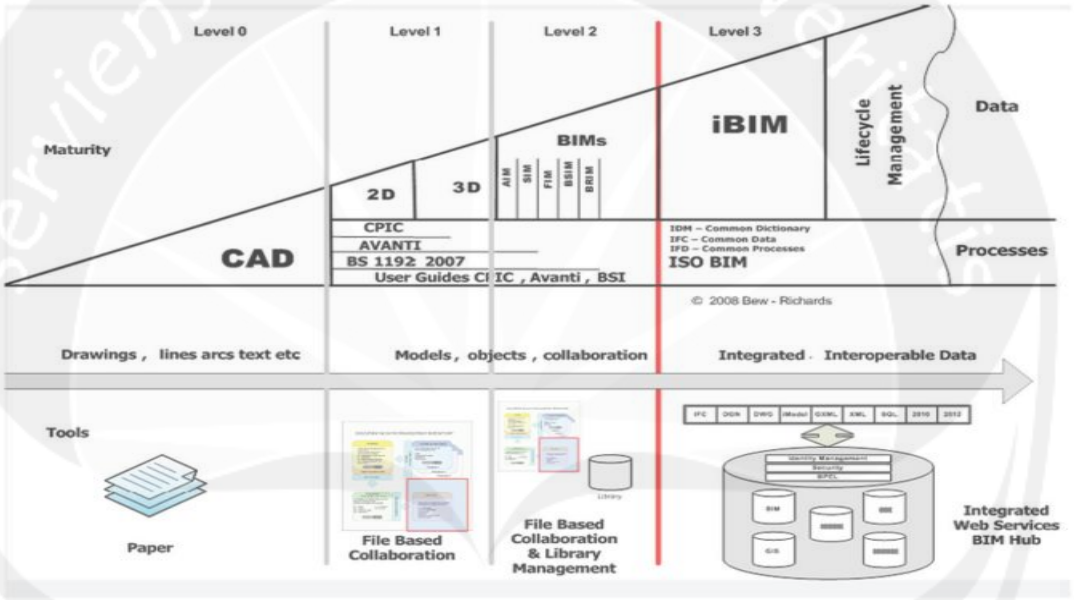

Figure 2.1. UK Government BIM roadmap

2.5. BIM Implementation in Construction Management

The Building Information Modeling are used is various construction activities for each project, as shown in Figure 2.2.

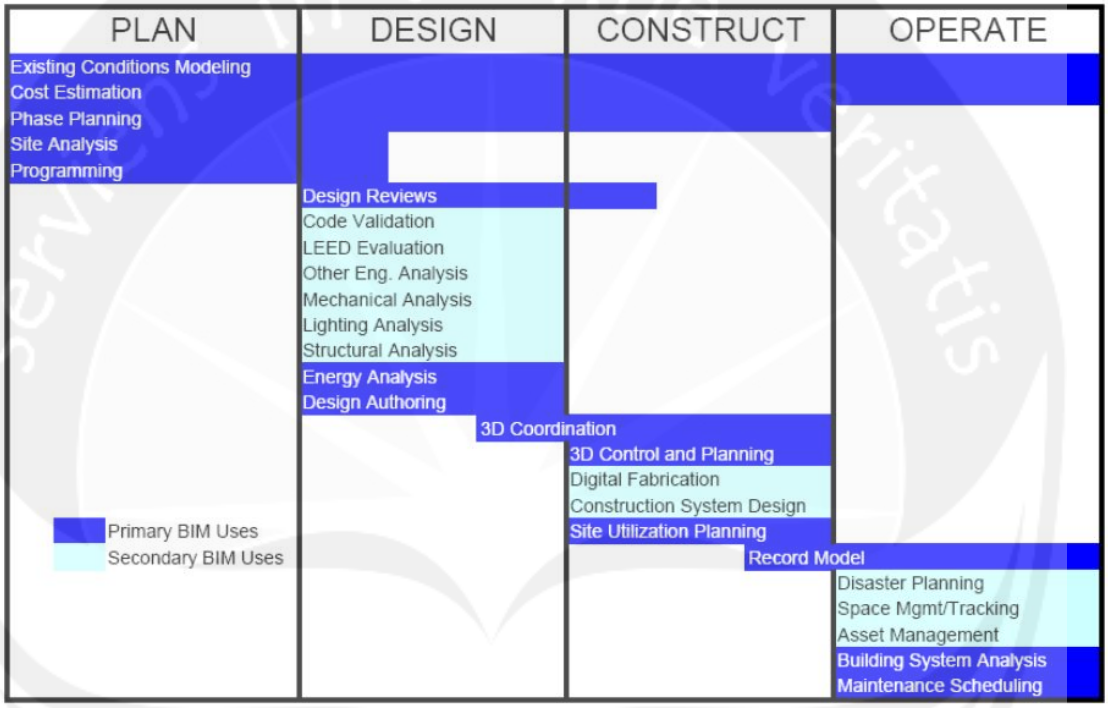

Figure 2.2. The use of BIM in construction project (Mehmet, 2011).

During the design phase, the use of Building Information Modeling could reduce the negative impact due to its ability to calculate precisely. BIM offer a solution to the potential problem that might impacts the cost of the project. This action occurred as a result of teamwork and coordination from the parties involved in the project, therefore, it is fundamental to have a solid collaboration. The use of BIM enhanced the collaborative effort toward the team of the project. Architect and engineer can test their design ideas as well as energy analysis. The

construction manager could deliver a constructability, sequencing, value and engineering report properly. BIM can also become a pilot action to the 3D coordinator between sub-contractor and vendors during early stages of planning phase. The owner able to visually notice the design that they expected. Overall, BIM promote collaborative action of all project participants.

Kusayanagi (2015) during the seminar of Jakarta Mass Rapid Transit mentioned that the concept of BIM would enhanced the collaborative between the owner, contractors and consultants. It also provides a benefit in the form of knowledge and technology to the construction industry as well as academic sector. The planning ability, human resources quality and engineering technology will be lifted up by implement this concept. It also supports the idea to realizing a sustainable infrastructure development scheme as shown in the Figure 2.3.

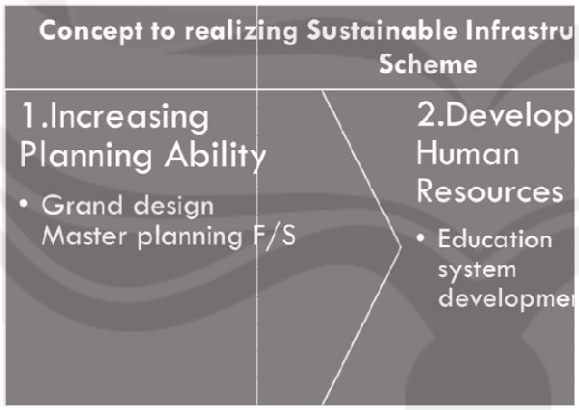

Figure 2.3. Sustainable Infrastructure Development Scheme

Kusayanagi (2015) explained that in the execution of construction project in the present time, the responsibilities of work are spread into two part. Consultant will discuss with the owner of the project regarding the planning of the

project up to giving the basic design to the contractor who win the tendering process. Later on the contrator will proceed the basic design into detail design that will be used as reference of constructio execution. By these scheme, chance of missunderstanding between contractor, consultant and the owner is big to be occurs. Therefore, BIM is required to imprrove the quality of working scheme of a construction project. as the collaboration between division (Figure 2.4) is bounded together in a real-time database that can be accessed by each division . the reisk of missunderstanding will significantly reduce.

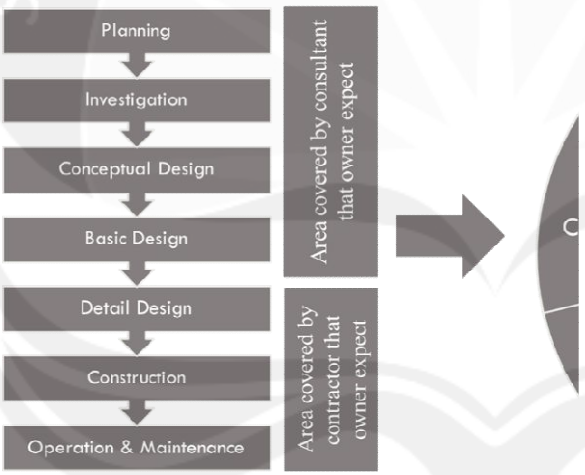

Figure 2.4. The Comparison between traditional and modern construction

2.6. BIM Software

Various software of Building Information Modeling is available nowadays, the following table listed the BIM software and the main function which cover MEP, Structural, Architects and 3D Software (Mehmet, 2011).

Table 2.1. Type of BIM Software (Mehmet, 2011)

Product Name	Manufacturer	Primary Function
Cadpipe HVAC	AEC Design Group	3D HVAC Modeling
Revit Architecture	Autodesk	3D Architectural Modeling and parametric design
AutoCAD Architecture	Autodesk	3D Architectural Modeling and parametric design
Revit Structure	Autodesk	3D Architectural Modeling and parametric design
Revit MEP	Autodesk	3D Detailed MEP Modeling
AutoCAD MEP	Autodesk	3D Detailed MEP Modeling
AutoCAD Civil 3D	Autodesk	Site Development
Cadpipe Commercial Pipe	AEC Design Group	3D Pipe Modeling
DProfiler	Beck Technology	3D Conceptual modeling with real-time cost estimating
Bentley BIM Suite (Microstation, Bentley Architecture, Structural, Mechanical, Electrical, Generative Design)	Bentley Systems	3D Architectural, Structural, Mechanical, Electrical, and Generative Components Modeling
Fastrak	CSC (UK)	3D Structural Modeling
SDS/2	Design Data	3D Detailed Structural Modeling
Fabrication for AutoCAD MEP	East Coast CAD/CAM	3D Detailed MEP Modeling
Digital Project	Gehry Technologies	CATIA Based BIM System for Architectural, Design, Engineering and Construction Modeling
Digital Project MEP Systems Routing	Gehry Technologies	MEP Design
ArchiCAD	Graphisoft	3D Architectural Modeling
MEP Modeler	Graphisoft	3D MEP Modeling
HydraCAD	Hydratec	3D Fire Sprinkler Design and Modeling

Product Name	Manufacturer	Primary Function
AutoSPRINK VR	M.E.P CAD	3D Fire Sprinkler Design and Modeling
FireCad	Mc4 Software	Fire Piping Network Design and Modeling
CAD-Duct	Micro Application	3D Detailed MEP Modeling
Vectorworks Designer	Nemetschek	3D Architectural Modeling
Duct Designer 3D, Pipe Designer 3D	QuickPen International	3D Detailed MEP Modeling
RISA	RISA Technologies	3D Architectural MEP Modeling
Tekla Structures	Tekla	3D Detailed MEP Modeling
Affinity	Trelligence	Full suite of 2D and 3D Structural Design Applications
Vico Ofice	Vico Software	3D Detailed Structural Modeling
PowerCivil	Bentley Systems	Site Development
Site Design, Site Planning	Eagle Point	Site Development

2.7. Benefit of Building Information Modeling

There are beneficial uses of BIM during construction phase. According to Biemo (2014) several overall benefit of BIM implementation namely;

1. Minimalized lifecycle design by improve the collaboration between owner, consultant and contractor
2. Produce high quality and accuracy of report during construction stage
3. BIM technology used to design the lifecycle of a certain infrastructure, including operation and maintenance.
4. High quality product with less conflict possibilities
5. Reduce the construction cost and construction waste
6. Improve the level of construction management