APPLICATION OF PROJECT MANAGEMENT PRINCIPLES IN UniMAP's SOLAR SHADE DEVELOPMENT & IMPLEMENTATION PROGRAM (SSDIP)

058437
rb
fT56.8
H198
2016

by

SUHA IBRAHEEM HAMAD
(1532421567)

A dissertation proposal submitted for EPT 504 Research Methodology
Master in Manufacturing Engineering (Mixed Mode)

School of Manufacturing Engineering
UNIVERSITI MALAYSIA PERLIS

2016

ACKNOWLEDGEMENT

First and foremost, I would like to express my utmost gratitude to my supervisor, Prof. DR. ZURAIDAH MOHD ZAIN for providing the assistance and guidance in completing my dissertation. Her immense knowledge and practical aid have given me the motivation to complete my work. I would also like to thank my husband Qusay Adnan for his constant support and encouragement. Without him, I would not have been able to complete the project. To my family (especially my mother, my brother Bariq Ibraheem Hamad, and my sons Abdullah Qusay Adnan and Yusof Qusay Adnan), I must express my love and appreciation for the affection that they show, which has inspired me to no end. Thanks are also due to all my friends and the staff of the School of Manufacturing Engineering, for backing me up as I work towards finishing this thesis. May Allah bless you all.

©This item is protected by original copyright

TABLE OF CONTENTS

© This item is protected by original copyright

CHAPTER 2 LITERATURE REVIEW

©This item is protected by original copyright

©This item is protected by original copyright

©This item is protected by original copyright

CHAPTER 5 DESIGN AND DEVELOPMENT OF UNIMAP'S SOLAR SHADES

©This item is protected by original copyright

©This item is protected by original copyright

LIST OF FIGURES

©This item is protected by original copyright

LIST OF TABLES

©This item is protected by original copyright

LIST OF ABBREVIATIONS

SSDIP	Solar Shade Development & Implementation Program
PM	Project management
PERT	Program evaluation review technique
WBS	Work Breakdown Structure
CPM	Critical Path Method
PDSA	Plan-Do-Study-Act
W	Watt
MW	Megawatt
MWh	Megawatt per hour
PV	photovoltaic
CPV	Concentrated Photovoltaics
VS	Solar power versus start
BIPV	building integrated –photovoltaic
ES	Earliest Start time
EF	Earliest Finish time
LS	Latest Start time
LF	Latest Finish time
FMEA	Failure Mode and Effects Analysis
REC	Renewable Energy Credits
SOW	statement of work

©This item is protected by original copyright

Penggunaan prinsip pengurusan projek (PM) Prinsipdalam program Solar shade

Pembangunan UniMAP (SSDIP)

ABSTRAK

Kajian ini menggunakan asas Pengurusan Proses (PM) yang sesuai dalam Program Rekabentuk dan Pelaksanaan Teduhan Solar UniMAP (SSDIP), agar SSDIP dapat dilaksanakan dengan berkesan dalam aspek masa, kos, dan kualiti, dan bagi memastikan kemampanan projek ini di masa akan datang. Dalam menjalankan kajian ini, proses sebenar merancang dan merekabentuk teduhan solar dijalankan. Alat-alat PM yang digunakan adalah Plan-Do-Check-Act (PDCA), Work Breakdown Structure (WBS), Program Evaluation Review Technique (PERT), Carta Gantt, Penilaian Ketidak-pastian dan Risiko, Perancangan Komunikasi, Penjadualan, Rajah Scheduling, Analisis Fishbone, Rajah Jaringan, dan Pembajetan. Lokasi teduhan solar ini ialah di kawasan letak kereta Perpustakaan Universiti. Bagi rekabentuk dan teduhan solar, tiga rekabentuk yang berasingan dibangunkan dan dicadangkan. Setiap rekabentuk mempunyai kekuatan dan kelemahan masing-masing. Setelah menjalani proses pemilihan yang mengambilkira keperluan universiti ke atas SSDIP, rekabentuk teduhan solar yang terbaik dipilih.

©This item is protected by original copyright

Application of Project Management (PM)Principle in UniMAP's Solar shade

Development program (SSDIP)

ABSTRACT

This study applies the appropriate Project Management (PM) principles in UniMAP's Solar Shade Design and Implementation Program (SSDIP) so that the SSDIP can be implemented efficiently in terms of time, cost, and quality, and to ensure the continuity of the project in the future. In the course of the study, the actual planning and designing of the solar shade is carried out. The PM tools used are Plan-Do-Check-Act (PDCA), Work Breakdown Structure (WBS), Program Evaluation Review Technique (PERT), Gantt Chart, Uncertainties and Risk Assessment, Communication Planning, Scheduling, Fishbone Analysis, Network Diagram, and Budgeting. The location of the solar shade is on the car park of the University Library. As for the design and development of the solar shades, three design options are developed and proposed. Each design has its own strengths and weaknesses. After a process of selection, which takes into account the requirements that the university imposes on the SSDIP, the best solar shade design is selected.

©This item is protected by original copyright

CHAPTER 1

INTRODUCTION

1.1 Background

Around the globe, concern is mounting over conventional carbon-based energy production. The issues at hand are numerous. They include increasing atmospheric carbon dioxide concentration from greenhouse gas emissions, environmental safety of energy production techniques, fluctuating cost of energy, and depleting carbon-based fuel, to name a few (Nguyen and Pearce 2010; Choi et al. 2011). Following this, countries all over the world are facing an increasing challenge to diversify energy sources and bringing renewable energy generation. In the United States, a rise in renewable energy generation has been supported by taxation programs Many states are implementing renewable energy standards that aim to increase electricity generation from renewable sources (U.S. Energy Information Administration 2013a).

In line with these developments, solar energy is now being looked at with much interest. Solar radiation can be harnessed and converted to electricity by photovoltaic (PV) technologies. Photovoltaic cells produce electricity by absorbing photons and releasing electrons that can be captured in the form of an electric current (Knier 2011). Cells can be used individually to power small electronics or grouped together into modules and arrays to generate larger amount of power (U.S. Energy Information Administration 2013b).

PV array systems are becoming an increasingly popular means for powering residential and commercial buildings (Loudat 2013). The photovoltaic market in the United States has grown tremendously in the last decade (U.S. Energy Information Administration 2013a). PV is a robust technology that possesses a great deal of potential because it is both scalable and geographically dispersed (Pearce 2002; Zekai 2004; Nguyen and Pearce 2010; Choi et al. 2011). Herbst (2009) reports that PV production doubles every two years, increasing by an average of 48 percent each year since 2002, making it the world's fastest growing energy technology. In 2012, PV

©This item is protected by original copyright

technology consisted of 12 percent of all new U.S. electricity generation (Interstate Renewable Energy Council (IREC, 2013).

Despite much encouragement to take advantage of solar technologies in 2012, it only comprises 0.11 percent of the overall electricity generation in the U.S. Many barriers to the wide scale adoption of photovoltaic production still exist (U.S. Energy Information Administration 2013c). Its initial cost is a major barrier to implementation of PV systems (Súri and Hofierka 2004). Even with falling prices, renewable sources of energy are still expensive compared to the traditional fossil fuel source. The expense of installation and lack of information to calculate PV technology return on investment are a few of the barriers facing the industry today (Choi et al. 2011; Herbst 2012). Beyond financial factors, there are a number of social and regulatory factors that influence a consumer's decision to purchase solar panels.

In addition to existing renewable portfolio standards and tax credits, many governments have implemented GIS-based modeling and decision support tools (Voivontas, Assima copolous and Mourelatos 1998). Online solar potential maps are one type of decision support tool that is becoming increasingly popular throughout cities in the U.S. These allow users to evaluate the geographical, technological and financial factors that affect system performance and then predict the costs and benefits associated with installing solar PV panels for both residential and commercial buildings.

Parking lots offer ideal spaces for solar energy systems. For years, solar photovoltaics (PV) have proven to be a smart choice for parking facilities. With increasing energy usage and operating expenses, solar PV parking lots offer a solution for facility owners looking to counteract the increase in energy demand. Shade structures can be a great addition to any parking lot, as they provide numerous benefits as well as the potential to carry solar panels. Adding shade structures to a parking lot can reduce lighting costs through the installation of energy-efficient LED lighting under the structures in place of the often low-efficiency light poles in many lots. Additionally, elevated shade structures - sometimes called carports - help keep cars dry, provide security from sun and rain, and keep cars generally cooler.

©This item is protected by original copyright

Given the advantages of both PV cell energy generation, and having solar shades in car parks, it is only reasonable that UniMAP should have its very own solar shade car parks. The University Library is the most appropriate location to build the solar shades. Hence, the Solar Shade Development and Implementation Project (SSDIP) is incepted. To make the SSDIP truly successful, it should be carried out using project management (PM) principles. If performed well, the SSDIP is envisioned to be a model for the application of PM fundamentals in any green projects in the future.

Project Management (PM) is an organized and systematic process and activity of planning, organizing, motivating, and controlling resources, proceduresand protocols to achieve specific goals. A project has a beginning and an end and is designed to produce a product or a service. It comprises many elements which, when executed in a systematic and orderly fashion, will give results that are in line with what are originally planned for the particular project. However, PM implementation is not without challenges. The primary challenge of PM is to achieve all of the project goals and objectives within set constraints.

©This item is protected by original copyright

1.2 Problem Statement

The university's electricity bill is very high, and hence there is a need to find ways to reduce it.To add, at the moment, there is no proper shade for cars that are parked in the University Library parking space. Given the advantages of solar shades, and the need to have a comfortable parking space at the University Library vicinity, the Solar Shade Development and Implementation Program (SSDIP) is incepted. It serves as a model for project management (PM) principles to be used in other green-related campus projects that are currently carried out. If PM principles do not underlie the execution of gree-based campus projects, the chances of success of the projects are reduced.

1.3 Objectives of Study

The objectives of the study are given below:

1.3.1 To design a solar shade structure to be used in the University Library car park.

1.3.2 To develop an implementation action plan to run the project

1.3.3 To use project management (PM) tools in the planning and implementation of the project.

1.4 Scope of Study

The study is limited to:

1.4.1 Theoretical planning and implementation only.

1.4.2 The use of simulated / extrapolated data only.

1.4.3 Calculations of electricity cost savings in UniMAP Pauh Putra campus only.

The work is focused on developing a solar shade system in the vicinity ofUniMAP's Pauh Putra Library campus. Due to time and financial constraints, the work is theoretical in nature, and does not involve an actual construction of a solar shade.

1.5 Significance of Study

This study represents an opportunity for UniMAP's many green-related projects that are currently carried out to learn the use of project management principles in the planning and execution of the projects. To add, the complete documentation of the SSDIP can be used as the basis for actual implementation of the project in the future. This will help in the reduction of electricity bill, and the increase of comfort of the University Library users.

1.6 Project Deliverables

The deliverables of the project are:

- A full solar shade plan, designed specifically to meet UniMAP's unique requirements of cost, location, and energy efficiency.
- A relatively comprehensive 'blueprint' of a solar shade project proposal that can be used by UniMAP in the future.

©This item is protected by original copyright

- A complete project management (PM) documentation of the proposal and its simulated implementation.

1.7 Methodology

The work essentially comprises two main parts, namely the design of the solar shades, and the development of PM documentation. The design work comprises developing the appropriate solar shade specifications and the actual drawing up of the shades. Three designs are completed, and a selection process is carried out to choose the most suitable design. As for development of PM documentation, all relevant PM tools are studied, and the ones most suitable for UniMAP's SSDIP are selected and developed appropriately.

1.8 Thesis Structure

The thesis comprises (1,2,3,4,5,6) chapters, with each chapter containing the following:

- Chapter1 — • An overall introduction to the thesis.
- Chapter2 — • Literature review of project management and solar PV projects around the world, especially in the USA.
- Chapter 3 — • The research methodology. There are two parts of the work – (1) project management, and (2) designing of solar shades. Both are carried out almost simultaneously.
- Chapter 4 — • Results and discussion of work on the project management component.
- Chapter 5 — • Results and discussion of work on the design of solar shades
- Chapter6 — • An overall discussion of both project management and design of solar shades.
- Chapter 7 — • An overall conclusion and future work.

©This item is protected by original copyright

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of literature related to project management (PM), and the PM tools and techniques involved. In addition, green-related projects, particularly solar PVs from around the world, are reviewed. Case studies of green projects in a few selected universities abroad are also given.

2.2 Project Management

Project management (PM), as a discipline, is an organized way of carrying out a huge task that requires a series of steps and processes to be taken. In terms of definition, project management is "a temporary endeavour undertaken to create a unique product or service or result" (American National Standard ANSI/PMI 99-001-2004). Another way of putting it is that, it is "a unique process, consists of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements, including the constraints of time, cost and resources" (ISO 10006). It can also be seen as "a high-value, time-bound, special mission of creating a product/facility, with pre-determined performance objectives, generally stated in terms of quality specifications, completion time, resources constraints and budgeted cost" (UddeshKohli, 2007).

According to Juran (2008), a project is a "problem scheduled for solution. As in any organization, every department has specific functions set up to perform specific tasks. According to Duncan (2000), works that are performed in an organization are usually categorized into two, and they are operations or projects. Both are quite similar, in that they must be planned and executed by the staff of the organization. Because of this similarity, operations and projects are usually used interchangeably. However, they are actually fundamentally different in terms of their nature and time. Operations are repetitive and usually pre-defined, and their existence goes along with the existence of

©This item is protected by original copyright

the organization. On the other hand, projects are temporary in nature. They have a definite start and end dates, and they are uniquely different for every product or service.

Projects play important roles in an organization's business strategy. They can be based on correction, problem solving, developing, campaigning, and so forth. Each step of the project is normally very detailed. The Plan-Do-Study-Act (PDSA) frame is quite popularly used in any project execution (Kotnour, 1999).The elements of planning, doing, studying, and acting are discrete, but they are performed interactively. More often than not, each of these project management processes overlap and they are revised constantly, despite the dissimilarity in the scope and nature of the different projects.

Every project is managed and implemented differently due to the diversity of every factor which may impact on the processes and outcome of the projects. These factors can be any aspects related to the project: size, complexity level of the project; experience, professional level of project team; access to resources; project management organization structure and so forth.

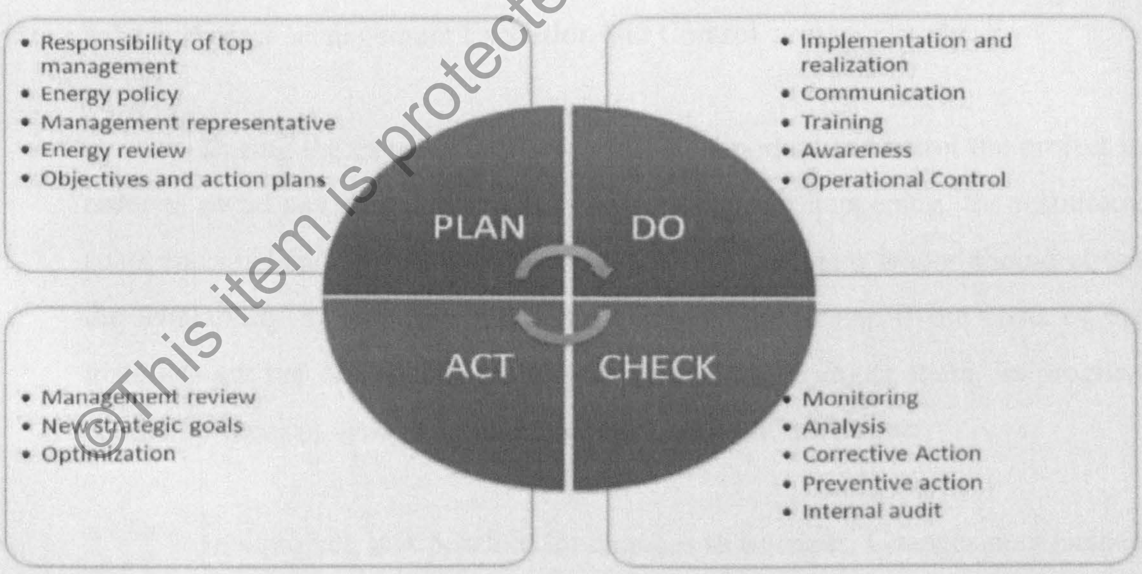

Figure2.1: The Plan – Do – Act – Check Cycle

The project management process (Figure 2.1) diagram is a continual improvement process to achieve the objectives related basic PDCA diagram that is found in many text books. It is more complex, and applies the interrelationship among

©This item is protected by original copyright

and the processes in the group. As can be seen, there are still four elements (plan, do, check/study, and act), but each one of the elements is described further. More detailed description of the elements in the diagram means more guidance for the user.

Project management is a challenging task with many complex responsibilities. Fortunately, there are many tools available to assist with accomplishing the tasks and executing the responsibilities. Some require a computer with supporting software, while others can be used manually. Project managers should choose a project management tool that best suits their management style.

Of the many tools and techniques in the project management body of knowledge, Work Breakdown Structure (WBS), Gantt Charts, Pert Diagram (or Critical Path Analysis Flow Diagrams), and Network Diagrams are the most popular. In addition, there are numerous considerations that make their way in different forms and formats that can make it simpler to execute a project successfully. Some commonly used PM tools will be discussed later in this chapter.

©This item is protected by original copyright

2.2.1 Project Management Execution and Control

During the execution of project, it is important to control the project in order to avoid any mistakes. To minimize risks from happening, the resources, costs and quality of work should be monitored. The team leader should check the availability of materials, and at the same time to see if the costs of the materials are not different from the planning. As the project starts, its progress should be checked always to guarantee the quality of the project.

In a project, it is possible for changes to be made. Changes may happen either from the customers or they can be internally driven. If changes are to happen, they must happen early project to save the overall cost of the project. Figure2.2shows the graph of cost of change against project life cycle (Dennis, 2013).

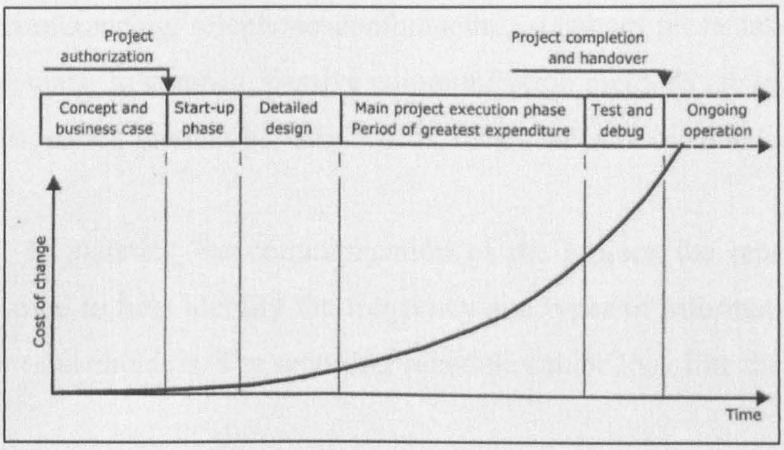

Figure 2.2: Cost of change against project life cycle

Changes in a project can affect the quality of the project. That is why changes are seriously taken into consideration. Making changes involve many aspects such as cost, activity sequences, and also resources. Therefore, it is necessary to have a formal change control process to ensure that the issues and the project budget can be controlled effectively.

If the changes are requested, the outcome may be one of the following: the change is authorized, the change is given limited approval, the request is returned for clarification or alternative course of action, and finally, the change request is rejected. If the changes will be made or in the project, the communication is one of the main in order to ensure that project run efficiently. Communication is also to avoid any misunderstanding during the project. As the project manager, it is important to have good skill in communication and leadership.

Communication in a project is another important aspect(Harper&Douglas,2013). Communication is not only telling workers what the project manager expects on the worker. Successful communication is about being there for all team members, and to always keep in touch with the real challenges of the project.

There are some methods that can be used in communication, and they are either active orpassive ways. Active methods are likes face to face meetings,

©This item is protected by original copyright

video conferencing, telephone conferencing, stand up presentations in person, and webinars. In contrast, passive communication methods are include pod cast, web cast, email, intranet bulletin boards, blogs, website or table top presentation.

In planning the communication of the project, the reporting schedule can be used to help identify the frequency and types of information required by different stakeholders. The reporting schedule can be look like the Table 2.1

Table 2.1: An example of reporting schedule

Stakeholder	Reporting needs	Format	Preferred medium	When	Person responsible
Sponsor	Status report - including schedule, budget, variances, issues	Spreadsheet for schedule and budget status, table for scope status and issues plus a one page summary	Email attach. 24 hours prior to face to face meeting	Meeting last Mon. of each month prior to Board meeting	Project Manager

©This item is protected by original copyright

2.2.2 Work Breakdown Structure

Dividing complex projects to simpler and manageable tasks is the process identified as Work Breakdown Structure (WBS). Project managers use this method to simplify project execution. In WBS, much larger tasks are broken down to manageable chunks of work. These chunks can be easily supervised and estimated .WBS is not restricted to a specific field when it comes to application (Gelbard et al., 2002) This methodology can be used for any type of project. The following are a few reasons for creating a WBS in a project:

- To have an accurate and readable project organization
- To have a more specific assignment of responsibilities to the project team
- To indicate more clearly project milestones and control points
- To facilitate in estimating the cost, time and risk of the project

- To show the project scope, so that stakeholders can have a better understanding of the overall project structure.

2.2.3 PERT Diagram

PERT means 'program evaluation review technique'. It is essentially a planning and control tool used for defining and controlling the tasks in a project. PERT is sometimes called Critical Path Method (CPM). Hence, they are often used interchangeably. A PERT diagram comprises numbered nodes that represent events or milestones of the project. The nodes are linked by vectors (or directional lines), whereby the direction of the vector represents the sequence of the tasks to be carried out to complete the project. Some tasks must be performed before other tasks are performed. These tasks are called dependent or serial tasks. As for tasks that are not dependent, they can be performed simultaneously, and hence they are called parallel or concurrent tasks (McIntosha & Mc Cable, 2003).

In some projects, there are tasks that must be performed in sequence, but they do not need resources or a fixed completion time. These tasks are considered to have 'event dependency'. In short, PERT charts portray graphically the interrelationships of the elements of a project and the sequence the activities must be performed. PERT planning involves the following steps:

- Identify the specific activities and milestones. The activities are the tasks of the project, while milestones are the events that mark the beginning and the end of one or more activities.
- Determine the proper sequence of activities. This step may be combined with the point above because the activity sequence is evident for some tasks. Other tasks may require some analysis to determine the exact order in which they should be performed.
- Construct a network diagram. Using the activity sequence information, a network diagram is drawn showing the sequence of the successive and parallel

©This item is protected by original copyright