MALAYSIAN BUILDING INFORMATION MODELLING (BIM) IMPLEMENTATION ROADMAP: IDENTIFYING STAKEHOLDERS INTEREST

NOR AINI BINTI ABDUL

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UNIVERSITI MALAYSIA PAHANG

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ABSTRACT

Building Information Modelling (BIM) is an approach in which utilise a 3D parametric modelling as a primary technology. The approach brings many advantages and has attracted many players in Malaysian Construction industry and has led the industry to develop a roadmap to strategize the implementation. The roadmap is important to coordinate many activities amongst the industry groups working with adopters of BIM in Malaysia. The aim of the study is to support the development of BIM national roadmap by providing the data of the stakeholders' Interest of BIM implementation at the industrial level. Research methodology used in this research is qualitative in nature by engaging a workshop. The workshop was organised by Construction Industry Development Board (CIDB) Malaysia. In the workshop, six groups of stakeholders were formed to provide data and information regarding to the stakeholders' interest for BIM implementation. The stakeholders were academics, vendor & BIM consultant, facilities management, contractor & quantity surveyor, design consultant and public agency. Result from the workshop shows that the stakeholders interest basically tied to the three main objectives of construction delivery which are the quality, cost and time. Combining all the interests, 47 factors of interests were identified with some of them are overlapped between one stakeholders to another. Based on the occurrence that takes place during the discussion, the most discussed factors are the accuracy of BIM data, reduction of delivery time and improve understanding of the project information.

ABSTRAK

Permodelan Bangunan Bermaklumat (BIM) merupakan satu pendekatan yang menggunakan model parametrik 3D sebagai teknologi utama. Pendekatan ini membawa banyak kebaikan dan telah menarik ramai golongan professional dalam industri pembinaan Malaysia dan ini sekaligus telah membawa industri untuk membangunkan pelan tindakan bagi menyusun strategi pelaksanaan. Pelan hala tuju adalah penting untuk menyelaras pelbagai aktiviti di kalangan kumpulan industri pembinaan di dalam pelaksanaan BIM di Malaysia. Tujuan kajian ini adalah untuk menyokong pembangunan pelan hala tuju BIM negara dengan menyediakan data berkaitan faktor galakan yang menarik minat pemain industri pembinaan untuk melaksanakan BIM. Kajian ini menggunakan metodologi kualitatif bengkel industri bagi mendapatkan data. Bengkel ini dianjurkan oleh Lembaga Pembangunan Industri Pembinaan (CIDB) Malaysia. Dalam bengkel tersebut, sebanyak enam kumpulan telah dibentuk untuk berbincang dan menyediakan maklumat mengenai matlamat dan minat terhadap pelaksanaan BIM. Kumpulan yang dibentuk ialah akademik, vendor & perunding BIM, pengurusan fasiliti, kontraktor & ukur bahan, perunding reka bentuk dan agensi awam. Keputusan daripada bengkel tersebut menunjukkan bahawa minat dan matlamat pemain industri pada dasarnya terikat kepada tiga objektif utama pembinaan iaitu kualiti, kos dan masa. Sebanyak 47 faktor minat telah dikenal pasti dengan sebahagian daripada factor berkenaan adalah bertindih antara satu sama lain. Berdasarkan kepada perbincangan berkenaan, faktor ketepatan data BIM, pengurangan masa penghantaran dan meningkatkan pemahaman mengenai maklumat projek merupakan faktor utama pelaksanaan BIM dalam industri pembinaan.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATION

2D	2 dimensional
3D	3 dimensional
4D	4 dimensional
5D	5 dimensional
BEM	Board of Engineers Malaysia
BIM	Building Information Modelling
CAD	Computer Aided Design
CIDB	Construction Industry Development Board
CIMP	Construction Industry Master Plan
EPU	Economic Planning Unit
FM	Facilities Management
JKR	Jabatan Kerja Raya
KPI	Key Performance Indicator
LOD	Level of Development
MEP	Mechanical, Electrical, Plumbing
M&E	Mechanical & Electrical
PDM	Project Document Management
PR1MA	Perbadanan Rumah 1 Malaysia
QS	Quantity Surveyor
RFI	Request For Inspection
RISM	Royal Institute of Surveying Malaysia
ROA	Return of Assets
SMM	Standard Measurement Method
VO	Verification Order

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF RESEARCH

Building Information Modelling (BIM) is now become natural phenomenon in construction industry in Malaysia. BIM utilize 3D parametric object tools which give more advantages to the user. In order to maximise the benefit of BIM, at the national level a roadmap is important as one of the strategies to implement BIM. The importance lies on the need to coordinate many activities amongst the industry stakeholders working with BIM adopters in Malaysia.

On July 24th, 2013 at CIDB Malaysia headquarters in Putra World Trade Centre, Kuala Lumpur the first meeting was held to establish BIM Steering Committee at the national level, which was officiated by the Chief Executive Officer of CIDB Malaysia, Dato' Sri Ir. Dr. Judin Abdul Karim .The meeting was chaired by Dato' Ir. Hj Salehudin Bin Mohd Isa, Senior Director of Cawangan Pengurusan Projek Kompleks, Jabatan Kerja Raya (JKR) Malaysia and attended by industrial participants representing Persatuan Arkitek Malaysia, Board of Engineers Malaysia (BEM), Royal Institute of Surveying Malaysia (RISM), PR1MA, Sime Darby Properties, Economic Planning Unit (EPU), Academician from Local Universities etc. The establishment of the steering committee is to undertake a huge and critical task to oversee and manage the adoption and implementation of BIM in Malaysia.

1.2 PROBLEM STATEMENT

The key objective of the roadmap is to coordinate the many activities amongst the industry groups working with adopters of BIM in Malaysia, which unless coordinated, have the potential to be overlapping, or a duplication of resources, technically different and incompatible, and not comprising a complete enough solution that will benefit the Malaysian Construction sector. Many private organisations and government agencies have interests in the National BIM Roadmap and will identify stakeholders to ensure a representative position is taken across the industry in Malaysia. This will not only include direct BIM users, but also take into account Local Government, the need for coordination with the Infrastructure sector, government agencies such as major facility procurers – PR1MA, Health, EPU - and agencies responsible for Geo-spatial data, land information etc.

The roadmap consists of four major elements which are Stakeholders' Interest, Stakeholders' Objectives, Key milestone and KPI platform. The Stakeholders' Interest are crucial in the development of the roadmap as all the motivation, expectation and problems associated with the construction industry and BIM are tied to it. Therefore, a study must be conducted to explore and identify the stakeholders' Interest and was set as the main.

1.3 AIM & OBJECTIVE OF RESEARCH

The aim of the study is to support the development of BIM national roadmap by providing the data of the stakeholders' Interest and Objectives of BIM implementation at the industrial level. The objectives of the study are:

1. To explore, appraise and systhesise relevant literature related to BIM with specific focus on the concept, usage, implementation requirement and success factors
2. To explore, appraise and systhesise relevant literature related to roadmap development with specific focus on the stakeholders' interest.
3. To explore and identify the stakeholders' interest'.

1.4 SCOPE OF STUDY

The scope of the study is important as a guidance to minimize the area to focus on the research. For this research there are three main scope of study need to focus on.

1. Phase of Lifecycle - Construction Lifecycle
2. Level of Implementation - Operational Level
3. Stakeholders' Interest - Industrial Level

1.5 THESIS OUTLINE

This thesis consists of five chapters. Every chapter consists of the subsections which need to focus on. The five chapters consist of;

Chapter 1 explained the background of research, problem statement, aim and objective, scope of research and the thesis outline.

Chapter 2 explained about the literature review. This chapter explained about the first objective which is to explore, appraise and systhesise relevant literature related to BIM with specific focus on the concept, usage, implementation requirement and success factors.

Chapter 3 explained about the research design & methodology to produce this research. In this section every part of methodology use in this research is explained from the preliminary of study till the data validation.

Chapter 4 explained about the result and analysis of the case study findings of stakeholders' interest during the workshop. This chapter also fulfill the second and third objective of the research which is to explore, appraise and systhesise relevant literature related to roadmap development with specific focus on the stakeholders' interest and lastly to explore and identify the stakeholders' interest.

Chapter 5 explained about the conclusion and recommendation of the research. In this chapter also the summary of research was discussed.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter discussed about the preliminary study of the research with the related literature review. This chapter also discussed about the first objective of the research which is to explore, appraise and systhesise relevant literature related to BIM with specific focus on the concept, usage, implementation requirement and success factors. In addition in this chapter also focus on the motivation for BIM implementation.

2.2 DEFINITION OF BUILDING INFORMATION MODELLING (BIM)

BIM is modeling technology and associated set of processes to produce, communicate and analyze digital information models for construction life-cycle (Steering Committee, 2013). In another view, R. Vanlande et al. (2008) state that Building Information Modeling (BIM) is defined as the process of generating, storing, managing, exchanging, and sharing building information in an interoperable and reusable way. According to Gu & London (2010), Building information modeling (BIM) is an IR-based approach that involves applying and maintaining an integral digital representation of all building information for different phases of the project lifecycle in the form of a data repository. From the other view, BIM refers to a set of interacting policies, processes and technologies that generate a methodology to manage the essential building design and project data in digital format throughout the building's life-cycle (Succar, 2012). In addition in the book of BIM Handbook;

According to Eastman (2008) the 3D parametric tool has the following characteristic;

1) Consisting of a geometric definition and associated data and rules;

2) Geometry is integrated non-redundantly and allows for no inconsistencies. When an object is shown in 3D, the shape cannot be represented internally redundantly, for example as multiple 2D views. A plan and elevation of a given object must always be consistent. Dimensions cannot be fudged.

3) Parametric rules for objects automatically modify associated geometries when inserted into a building model or when changes are made to associated objects. For example, a door will fit automatically into a wall, a light switch will automatically locate next to the proper side of the door, a wall will automatically resize itself to automatically butt to a ceiling or roof, etc.

4) Objects can be defined at different levels of aggregation, so the user can define a wall as well as its related components. Objects can be defined and managed at any number of hierarchy levels. For example, if the weight of a wall subcomponent changes, the weight of the wall should also change.

5) Object rules can identify when a particular change violates object feasibility regarding size, manufacturability, etc.

6) Objects have the ability to link to or receive, broadcast or export sets of attributes, e.g. structural materials, acoustic data, energy data, etc. to other applications and models.

Based on the statement by Eastman et al. (2011), BIM is 3D Parametric Modeling that gives a lot of benefit to the construction industry. This proved by the other source, the US National Institute for Building Sciences has given a following vision and a definition for BIM. According to Eastman et al. (2011), BIM is "an improved planning, design, construction, operation, and maintenance process using a standardized machine-readable information model for each facility, new or old, which contains all appropriate information created or gathered about the facility in a format usable by all throughout its lifecycle."

According to the National Institute of Building Science (2007:12) Building Information Modelling (BIM) is defined as "a digital representation of physical and functional characteristics of a facility and a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle." The definition however, appears to be generic to include any digital technology as long as it could contribute to form information on a facility. As further explained by Onuma in Smith & Tardif (2009), a spread sheet of spatial data is a building information model and if the use of alphanumeric data contained in the spread sheet is to simulate an actual business process in the life cycle of a building, then a Building Information Modelling is engaged. The generic definition of Building Information Modelling is also supported by Jernigan (2007) by pointing out that the interactions of spread sheets with the complexity and an interrelationship of organisation is also Building Information Modelling.

Within the context of Malaysia, Haron (2013) has defined BIM as an approach to building design and construction through modelling technology, an associated set of processes and people to produce, communicate and analyse building information models. The definitions sets a boundary to differentiate BIM with other technologies such as 2D/3D vector based means of creating objects, and 3D surface modelling which is used for the purpose of visualisation only, which carries no attribute to the element and therefore complemented by the definition of Building Information Model which is defined by Kymmel (2008) as digital representation of physical and functional characteristics of a facility where the information is contained or attached to the component of the model. In both definition, the 3D parametric tools is identified as main BIM tools as has been defined by Eastman et al. (2011) earlier in this subchapter. Meanwhile, at the national level, according to CIDB (2013), the steering committee has established the definition to be used by the industry. They define BIM as Modelling Technology and associated set of processes to produce, communicate and analyze digital information models for the construction life-cycle.

2.3 BUILDING INFORMATION MODELLING (BIM) CONCEPT

BIM concept is differed with 2D Computer Aided Design (CAD). In the CAD approach, the focus is given on the drawings production. Contrary with the CAD approach, the focus of BIM is centred on the 3D BIM models. The models become the main deliverables where they are first authored before project information can be extracted from the model. Therefore, the project information are centralised and coordinated within the same source of model and the model itself becoming the database of project information (Hardin, 2009). The examples of project information are the drawings, bill of quantity, specifications and etc. Since the project information is sourced from the same model, they are all consistent and accurate where changes on the model will automatically change the interrelated drawings and specification. Within this approach, the heart of BIM lies on the use of 3D parametric tools. According to Smith &Tardif (2009) the concept of Building Information Modelling is to build a building virtually, prior to building it physically, in order to work out problems and simulate and analyse potential impacts. The heart of Building Information Modelling lies in an authoritative building information model.

According to Kymmel (2008) virtual building implies that it is possible to practice construction, to experiment and to make adjustments in the project before it is constructed. Virtual mistakes generally do not have serious consequences provided that they are identified and addressed early enough so that they can be avoided in the actual construction of the project. When a project is planned and built virtually, most of its relevant aspects can be considered and communicated before the instructions for construction are finalized. It is like running a simulation of a construction project by considering all aspects of the construction life cycle.

In terms of the types of information or data that can be derived within a Building Information Model, generally, Elvin (2007) and Hardin (2008) explained that a Building Information Model could provide 2-D and 3D drawing with non-graphical information including specifications, cost data, scope data, and schedules. Kymmel (2008) on the other hand, categorised several types of information within Building Information Model based on the nature of the link between information and the model.

This pertains to all information that is part of, or connected to, the components as well as the physical information inherent in the model itself such as size, location, etc. It is important that all information required in making an actual analysis be available from the BIM. The categories of information, as can be summarised from Kymmel (2008) is as follows:

a) Component Information

Component information is the basic information contained in the 3D model file where it provides visual information and resides in the nature of the model part itself. Components in a 3D model also have specific locations in relation to an origin and to one another. An example of component information is a wall with material information or quantitative information such as part numbers.

b) Parametric Information

Parametric Information is information contained in the parametric object which can be edited. It is embedded in the object and the model. Some of this information can be graphical, while much of it can also be intellectual, such as area, volume or material-32 related qualities, such as density (providing weight based on the geometry of the object), R value, etc.

c) Linked Information

Linked Information refers to information that is actually not part of the model, but is connected to the model through external links. Visible links can be "flags" that will open a window or file when clicked to display that file. Invisible links could be, for example, connections to a database with cost information. When two files are linked, changes in one will result in adaptations in the other linked file, and vice versa.

d) External Information

External Information refers to information that is generated separate from the BIM, such as manufacturers" specifications of products. External information may be linked to the model or remain autonomous. It is possible to provide a reference to a catalogue without creating a link to an electronic file. Since not all information will be available in a compatible format it may be necessary to keep it accessible in printed form such as an external reference.

Elvin (2007) further added that another important feature of Building Information Modelling is how it creates an object-oriented database, meaning that it is made up of intelligent objects, for example representation of doors, windows, and walls which are capable of storing both quantitative and qualitative information about the project. So while a door represented in a 2D CAD drawing is just a collection of lines, in BIM it is an intelligent object containing information on its size, cost, manufacturer, schedule and more. But BIM goes further by creating a relational database. This means that all information in the BIM is interconnected, and when a change is made to an object in the database, all other affected areas and objects are immediately updated. For example, if a wall is deleted, doors and windows within the wall are also deleted and all data on project scope are instantly adjusted.

To extend the application of Building Information Modelling to integrated practice in construction, according to Eastman et al. (2008), the building information model should be used as a building model repository. A building model repository is a database system whose schema is based on an object based format. It is different from existing Project Document Management (PDM) systems and web-based project management systems in that the PDM systems are file based and carry CAD and analysis package project files. Building model repositories are object based, allowing query, transfer, updating and management of individual project objects from a potentially heterogeneous set of applications. In this context, the integration occurs at the level of data and could also integrate with other dimensions such as the time dimension (schedule) and cost dimension, which are known as 4D and 5D modelling respectively (Zhou et al., 2009; Koo & Fischer, 2000, Dawood & Sikka, 2007; Fischer & Kam, 2001). This application would allow construction phases to be analysed early in the design phase which as a result could support early involvement of the contractors in design development.

Figure 2.0 shows the concept of whole BIM process cycle. The BIM process cycle is take place in every part of the project from the conceptual design till the demolition process.

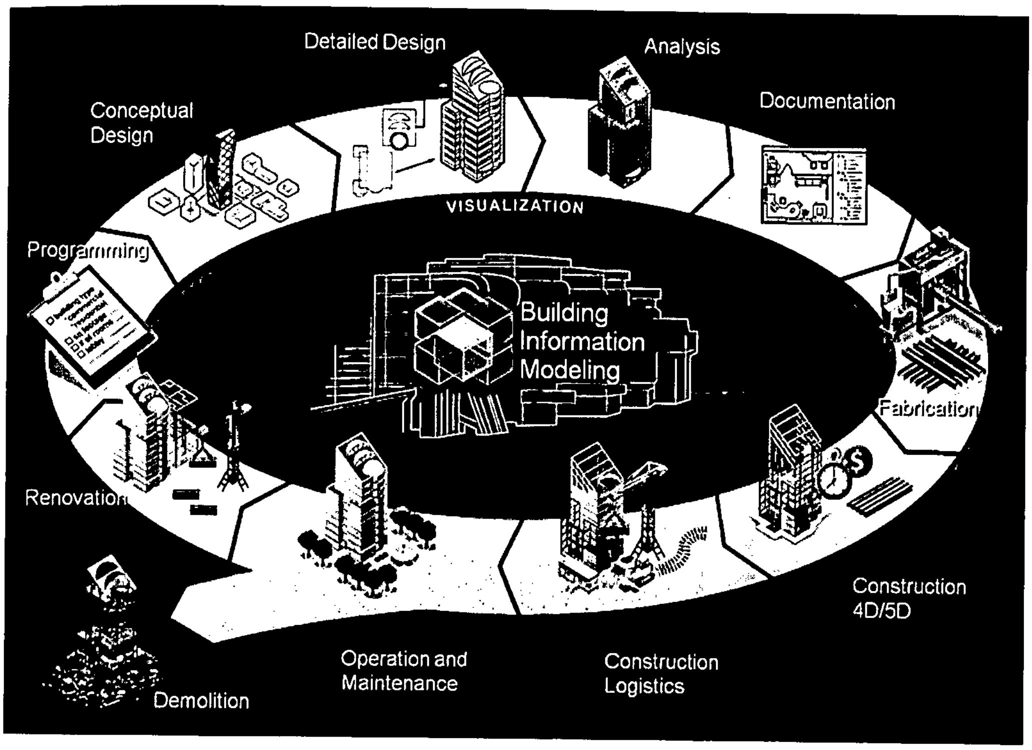

Figure 2.3: BIM Process Cycle

Source: BIMsolutions

2.4 MOTIVATION FOR BIM IMPLEMENTATION

The BIM Industry Working Group indicates that there are substantial organisational impacts through BIM implementation for all stages of the construction process. (Arayici et. Al, 2011). BIM is another key aspect leading to similar improved accuracy, design and construction is 3D visualisation. (BIMhub, 2012). The benefits of using BIM is one of the motivation why our construction industry and government eager to implement BIM. The implementation of BIM brings a lot of benefits. The benefits are better communication of design intent, knowledge gap reduction between junior and senior staff, reduced risk of losing project information process; it was streamline, and time saving. The details of the benefits are further discussed in the following subchapter as according to Haron (2013).

2.4.1 Communicate the Design Intent Better

All of the interviewees agreed that the implementation of 3D parametric modelling tools as part of BIM has improved the communication of design intent that takes place within and outside the organisational boundary. The improvement lies on the 3D visualisation and drawings consistency where everyone involved has the same understanding of what is being designed.

2.4.2 Reducing the Knowledge Gap between Junior and Senior Staff

The BIM implementation reduce knowledge gap between junior and senior staff as compared to using the 2D approach alone. The main reason is the fundamental nature of 3D modelling where each component is represented with digital 3D objects that carry attributes and parametric rules. The tools have assisted the junior designer to understand every component that they are authoring by providing 3D visualisation and the attributes that need to be assigned. In 2D approach on the other hand, every
object is made of a collection of lines and requires the designer"s interpretation and imagination to define what the object is. The 2D approach therefore requires a longer technical site experience to understand each component and its attributes and thus makes it difficult for the junior staff with a lack of experience. Furthermore, the 3D modelling tool has enabled the junior staff to try and experiment with the design which helps a lot in sharpening their skills and understanding.

2.4.3 Reducing Risk of Losing Project's Information

BIM help to keep the structure of the project"s data and information in a digital repository. When somebody in charge is moving out, the newcomer can simply refer to the BIM database and continue the job from there.

2.4.4 Process Streamline and Time Saving

In previous CAD-based process flows, one of the biggest challenges faced by the industry is to ensure drawings consistency and clash free design. The massive number of drawings that were produced individually in a project has made document consistency and clash checking a very time consuming and tedious process through the manual approach. Therefore, most of the time was spent on documentation and checking rather than focusing on the aspect of engineering and design. With the implementation of BIM, since the virtual 3D model is the source for all drawings, design errors caused by inconsistent drawings are all eliminated. Meanwhile, the clash checking process and Material Taking Off are taken automatically by using the software which also shortens the time duration. As an overall result, the time spent for documentation, checking and taking off material is reduced significantly and the people can give extra focus to the aspect of engineering and design. Thus, the company has managed to streamline the process flow and save time.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

Research methodology is important and it is refer as the procedure to develop the research. This statement had been explained by Fellows & Liu (2007), "research methodology refers to the principles and procedures of logical thought process which are applied to a scientific investigation." The procedure of the project had been explored before the research start to ensure that the research achieved their goal. In this research there are five stages of methodology used, there are;

First stage - Preliminary Study
Second stage - Area of focus and concept development
Third stage - Research Design and Development
Fourth stage - Exploratory Data Collection
Fifth stage - Data analysis and validation

This five stages of research methodology will be explained further in the next subsection. The figure below shows that overall stage involved in this research.

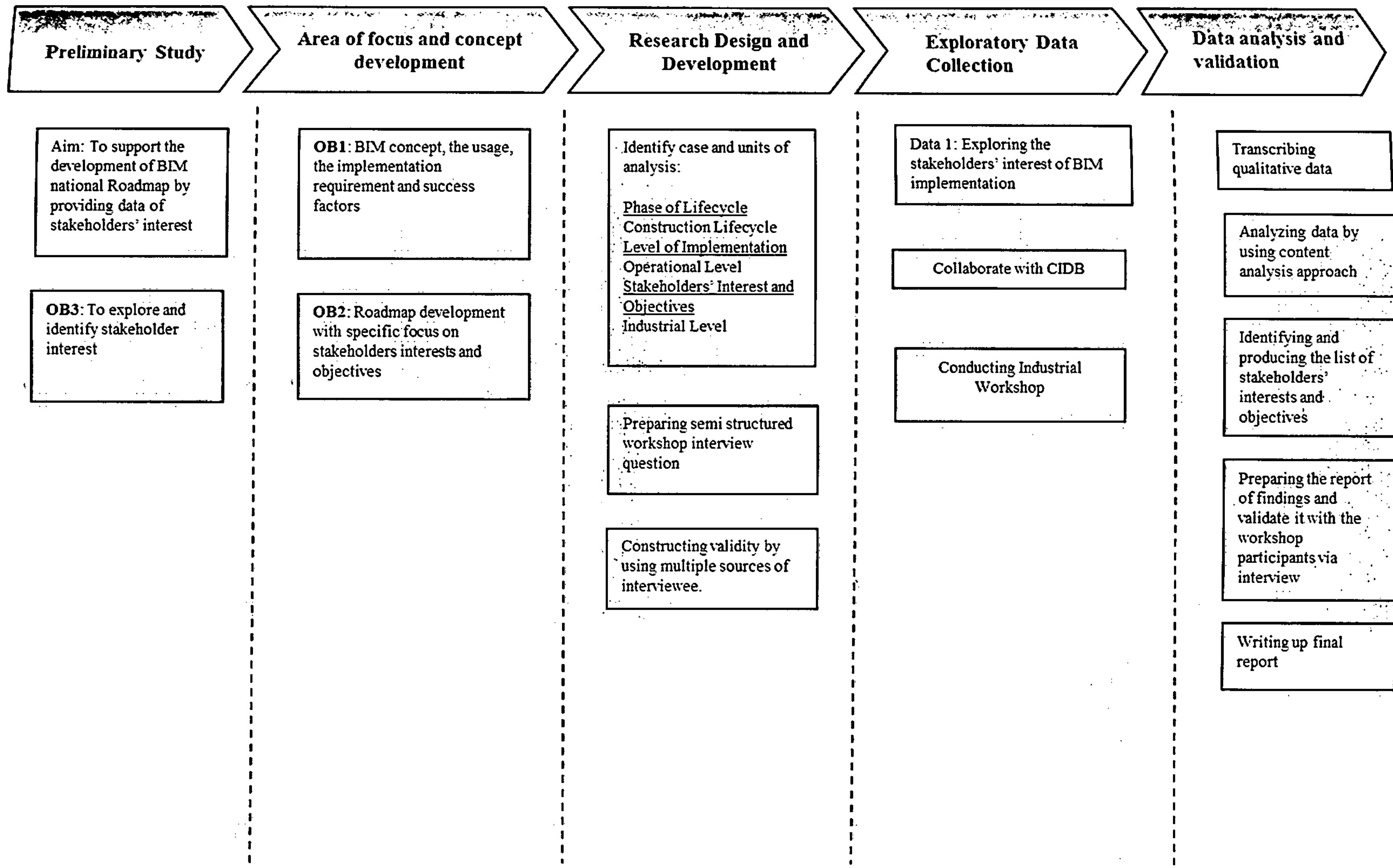

Figure 3.1: Research Methodology