Building Information Modelling (BIM) Value Realisation Framework for Asset Owners

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ABSTRACT: The paper is presenting a value realisation framework for asset owners based on an exploratory study. The study is descriptive in nature and adopting a qualitative approach towards data collection. The paper adopts the viewpoint of BIM business value measurement considering that; (i) if the process is better as a result of BIM-based processes, then it is different in some relevant way; (ii) if it is different in some relevant way as a result of certain BIM properties or characteristics, then the change is observable; (iii) if the change is observable because of certain direct BIM benefits, then it is countable; (iv) if it is countable using defined measurement metrics, then it is measurable; (v) if it is measurable using established measurement techniques, an organisation can value each unit and therefore, realise the benefits of BIM. The specific contribution of paper is to improve asset owners' understanding of BIM-business value measurement techniques and approaches.

1 INTRODUCTION

Building Information Modelling (BIM) in Asset Management (AM) is an area that has not been given much attention by researchers. There has been more focus on BIM business value realisation in pre-construction and construction stages rather than the post construction stage, which has a longer life of the asset (Love et al., 2014). Although, BIM is claimed to provide an efficient tool to asset managers in improving building performance and management of operations, there are very few case studies on the real use of BIM in the operations and use phase (Codinhoto & Kiviniemi, 2014).

BIM investments like other Information Technology (IT) based business initiatives are continuously questioned on the level of impact they have on organisational business value. Many clients worry that the value that BIM delivers may not be as high as expected. Similarly, like other IT-based investments, BIM suffers from the *'productivity paradox'* (Brynjolfsson 1993, Willcocks & Lester 1996). Some asset owners find themselves adopting BIM but cannot find sufficient economic justification. The investment in BIM in the Architectural, Engineering and Construction (AEC) industry is increasing and there are still doubts that the benefits may not be as high as expected. The difficulty in the realisation of BIM benefits can be related to weaknesses in measurement techniques and business value realisation practices of the AEC industry. These factors make it difficult to evaluate the benefits of IT-based tools or methodologies such as BIM (Vass & Karrbom Gustavsson, 2014).

As a result, asset managers constantly have to justify IT-based investments such as BIM because of the huge capital outlays and are compelled to appraise value at the strategic and operational levels (Irani, 2010). Many owner-operator organisations tend to approach the lifecycle management of BIM in an *ad-hoc* or unstructured manner. Investment evaluation should be conducted by asset owners in the same way projects are managed (Irani, 2010). One of the predominant issues is that managers tend to measure those activities that are easily identifiable, thereby, creating a tendency of ignoring and undervaluing those that are not (Dawes, 2010). There should be a parallel activity, where investment decisions are reviewed in relation to cost, risks and benefits. The conduct of this activity will help asset owners evaluate the success of BIM and the business value it delivers.

Benefits realisation management is a significant business process for asset owners to derive value from BIM. Defining requirements, measuring, analysing and monitoring the entire process is important for asset owners to be able to identify BIM business value (Lin et al. 2007, Love et al. 2014). A number of studies have attempted to measure the benefits of BIM (Giel et al. 2010, Kreider et al. 2010, Barlish & Sullivan 2012, McGraw-Hill 2012, Love et al. 2013, Love et al. 2014, Walasek & Barszcz 2017), but more research is needed to clarify the difficulty in measurement of BIM benefits in the operations and use phase.

2 METHODOLOGY

2.1 *Research Question*

This study presents a framework on how an asset owner can realise BIM business value in the operations and use phase of built assets. It also seeks to demonstrate how owner-operator organisations can link intangible to tangible value for easy measurement. The study will address the following research questions:

- What are the techniques and strategies of measuring the business value of BIM in AM processes?
- How can intangible value be linked to tangible value?

2.2 *Research methods*

This study adopts exploratory and descriptive methods of research. The study is divided into two phases. The first phase is the literature review, where the study explores existing research on techniques of measuring business value for BIM and other IT-based initiatives. The reviewed literature was used to identify elements of the framework for measuring BIM business value. The second phase comprises of development of the BIM business value realisation framework (Figure 1) and intangible business value linkage map (Figure 2).

2.3 *Data Collection*

The study adopts a qualitative approach towards data collection. The review of literature was conducted to identify relevant existing studies on the business value of BIM, IT value realisation frameworks and techniques for measuring business value of IT-based methodologies. The elements of the proposed business value realisation framework were also identified through this exercise.

In developing the framework, the main factors were drawn from three main theoretical foundations, those are: the AM-FM business processes; the value realisation concepts of Gliderman (2000) (tangible); and the theoretical concepts of Carayannis (2004) and Nogeste & Walker (2005) (intangible). Each of the aspects contribute to the framework with specific types of information.

This review of secondary data sources led to the development of a BIM business value realisation framework (Figure 1). The framework provides a procedural model for approaching BIM business value realisation for asset owners. The framework organised concepts such as outputs, result evaluation and business value realisation dimensions that the study explored directly during data collection.

Finally, the concept map for linking intangible value to tangible for BIM-based processes (Figure 2) was drawn from the theoretical proposition of Bakis et al. (2006).

3 LITERATURE REVIEW

3.1 *Building Information Modelling (BIM) in Asset Management (AM)*

BIM is a technology-based process that enhances performance and information delivery in the lifecycle of a built asset. BIM as defined by Succar et al. (2007) is '*a set of interacting policies, processes and technologies producing a methodology to manage the essential building design and project data in digital format throughout the building's life-cycle*'. On the other hand, ISO 55000 (2014), defines AM as a '*co-ordinated activity of an organisation to realise value from assets*'. Certainly, AM facilitates a holistic methodology that manages an asset from inception to disposal. The implementation of BIM in AM is an opportunity for asset owners to attain value propositions in their organisations through effective management of business processes (Love et al., 2014). With handover standards such as COBie that deliver structured information of the facility to the client, asset managers have the ability to leverage asset data through BIM. It is however worthy to mention that these tools and techniques do not fully support the asset owner in realising all the benefits that BIM generates in AM processes (Love et al., 2014).

BIM implementation in the operations and use phase will require changes in business processes and development of new roles for asset owners to achieve desired benefits (Ayyaz et al., 2012). These business modifications and resultant benefits continuously change throughout a facility's lifecycle. Some of the challenges asset owners face are cultural and operational in nature. That is, managing the change process and putting in appropriate measures for smooth implementation of BIM in AM. Without addressing these issues an organisation may not be able to track the business value BIM generates. Similarly, Codinhoto & Kiviniemi (2014) suggest that asset owners need to be aware of their organisational inefficiencies in the first place before they can address technology related challenges associated with BIM implementation.

3.2 *Value Realisation Management*

IT business value is the sustainable benefit realised by an organisation through IT-based systems, either by collective or individual systems, assessed from an organisational perspective (Cronk & Fitzgerald, 1999). Consequently, value realisation is the process of evaluating these benefits. Value realisation management is defined as *'the process that realises the benefits that are achieved and manages the unexpected ones'* (Farbey et al., 1999). It is however the strategy adopted by an organisation to determine how benefits are realised, at what level and when. The main purpose of value realisation is not to forecast benefits but to make them come true (Ward et al., 1996).

Many studies on value realisation management have tried to address the issue of realising the benefits of IT-based investments, but the problem is a dynamic one. Andersen, et al., (2000) present a procedural benefits measurement framework for IT-related investments in the AEC industry. Also, in a bid to address the complex issues of value realisation, Sapountzis et al. (2007) review four value realisation management approaches that may support organisations in the optimisation of benefits from investment programmes. Ashurst & Doherty (2003) suggest best practice for value realisation through the development of a conceptual framework. Similarly, Ward et al. (1996) adopt a procedural approach and explains the steps within the value management process. On the other hand, Leyton (1995) propose a model which approached value realisation from the perspective of business change. Sapountzis et al. (2007), then propose a value realisation framework integrated with business and investment processes.

The main challenge of realising BIM business value is that asset owners do not plan to realise benefits in the first place. Value realisation has to be done deliberately and consciously. Some asset owners harbour the *'silver bullet thinking'* on BIM investments (Thorp, 1998). That is, if they invest in BIM, the benefits will come automatically. Lin & Pervan (2003), suggests the need for asset owners to change their strategy of value realisation management from a passive approach to a more proactive one. Love et al. (2014) further assert that BIM alone cannot deliver business outcomes and that the process of its implementation has to be proactively managed to ensure that the organisation realises the business value it expects. Irrespective of the primary strategic objective for adopting BIM, an organisation will have to understand its capability and maturity before it can realise any value from the whole process.

3.3 *BIM Business Value*

In identifying BIM business value, the main issue of contention for asset owners is how to identify the benefits and the methods with which to measure them. A number of studies have attempted to identify the benefits if BIM in the operations and use phase. Ding et al. (2009) find that BIM enabled facilities management yields a 98% reduction in time used to update asset databases. Similarly, Codinhoto & Kiviniemi (2014) identify thirteen (13) metrics of BIM benefits in the operations and use phase.

In a bid to evaluate the business value of IT-based investments, Willcocks & Lester (1996) propose a balance score card (BSC) approach to examine the contributions of the IT-based investment from the financial, internal business, innovation and learning, and customer perspectives. However, this method does not provide for an aggregate system for these factors, as the decision of worthiness of an investment still remains with the asset manager. On the other hand, Construct IT (1998) identify different IT business value and classified each benefit against three factors; (i) efficiency assigned with a financial value, (ii) effectiveness defined with a subjective value, and (iii) performance qualified with qualitative accounts, however, with no quantification. The benefits were also classified according to the business processes they support. Also, Gartner (2003) present a five-pillar benefit realisation framework; strategic alignment, business process impact, architecture, direct payback, and risk. The framework determines the overall business value expected to be created by an IT-enabled business initiative. It uses a standard set of concepts for quantitative and qualitative value methods. The Gartner framework provides an aggregate score card for IT-based investments. Melville et al. (2004) propose an IT business value model that uses a resource-based view (RBV) to focus on the impact of IT-based investments such as BIM on organisational resources and business processes. Similarly, Love et al. (2014) present a framework that asset owners can utilise to realise value from investing in BIM. The framework adopts governance, change management, performance measurement, and stakeholder management as factors that enable the strategic alignment of the asset owners' business strategy. However, the framework does not provide a scoresheet for aggregating the key factors. Furthermore, Sanchez et al. (2016) present an eight-step BIM value realisation framework that introduces a methodology together with a benefits, metrics and enablers dictionary to aid measurement. However, the framework focuses mostly on tangible and semi-tangible benefits.

Deriving business value from an IT-based system can be difficult and depends largely on many different complex factors that cannot be controlled or isolated for formal experiments (Bakis et al., 2006). This is because the workings of an organisation are a collection of various integrated systems to perform tasks and deliver outputs. It is not possible to isolate BIM from other closely interconnected processes, in order to assess it, or one independently of the other. Another reason why it is difficult to objectively prove business benefits of a BIM-based investment is because an IT system only has the potential to create value, and not direct value in its own right (Mooney et al. 1995, Farbey et al. 1999, Remenyi 2000, Love et al. 2014). Another argument is that an IT-based investment may not yield the desired benefits simply because it is not well implemented (Brynjolfsson & Hitt, 1998).

3.4 *BIM Value Measurement Techniques*

There are many value measurement techniques that can be used by asset owners to identify the value that BIM affects. Some techniques are generic and some may be unique to certain organisations. The study will focus on four techniques; Return on Investment

(ROI), Savings to Investment Ratio (SIR), Key Performance Indicators (KPI) and Process Mapping. It is worth mentioning that an organisation may utilise multiple methods to measure BIM benefits. Also, Love et al. (2013), argues that if financial techniques such as ROI are only used to justify investment in BIM, then the entire process is limited to financial management.

3.4.1 *Return on Investment (ROI)*

ROI is defined as the ratio of resources gained or lost in a process or investment, as against the total amount of resources provided (White, 2007). When applied to BIM, it is suggested that positive ROI means business value to clients, contractors, consultants and other stakeholders and measurement to be calculated as a ratio of benefit to cost (Giel et al., 2010). ROI is calculated as:

$$ROI = \frac{Gain\ from\ Investment - Cost\ of\ Investment}{Cost\ of\ Investment} \text{ x } 100$$

One of the challenges of using this method to measure business value, is the lack of industry-wide accepted benchmark for measuring BIM ROI (Giel et al., 2010). Another problem is the inapplicability to generalise or compare ROI data because it is hardly ever possible to find two organisations using the same business processes and accounting policies.

3.4.2 *Savings to Investment Ratio (SIR)*

SIR represents the ratio of savings in relation to investment. The important factors when using SIR are investment cost and functional asset effectiveness (Ağra, 2011). When applied to BIM, an asset owner can determine whether the proposed savings in a BIM business case justifies the cost of the total investment. SIR involves the following processes; Determining the cost of the project; Determining the useful life of the asset; Determining the savings associated with the project; and Calculating the ratio. SIR is calculated as:

$$SIR = \frac{PV(Internal\ Project\ Cost\ Savings) + PV(Programme\ Cost\ Savings)}{PV(Initial\ Investment)}$$

One of the challenges of adopting this method to measure business value is the meticulous nature of identifying savings in relation to the total investment and comparing it with alternative options. This task requires a great deal of skill to execute but can be very beneficial if done correctly.

3.4.3 *Key Performance Indicators (KPI)*

KPIs are a set of data measures used to evaluate the performance of a system, task or operation (Cox et al., 2003). Evaluations using KPIs usually compare actual performance against estimated with reference to efficiency, effectiveness and quality of outcome and workmanship. KPIs can be used to assess both tangible and intangible value through quantitative and qualitative performance indicators.

One of the challenges of applying this method for measuring business value is the amount of resources required to develop performance benchmarks in owner-operator organisations. The benchmarking data for comparison has to be available for the asset manager to be able to evaluate whether targets have been met. Another weakness of using KPIs is that the models fail to identify actual parameters that represent change in performance (Cox et al., 2003).

3.4.4 *Process Mapping*

Process mapping is a technique that involves identifying, documenting, analysing and developing an improved process (Anjard, 1996). It can be used to identify where improvements can be made or to compare where improvements have been made. Process mapping is a useful tool for identifying business process problems such as errors, repetitive processes, delays and inefficiencies. A process map is a visual aid that helps show how inputs, outputs and tasks are interlinked (Anjard, 1996).

One of the challenges of implementing this method for measuring value is achieving the required level of detail and accuracy in process mapping. In some cases, mapped processes are not representative of the actual task. Another issue is the sourcing of skilled labour to draft process maps (Anjard, 1996). Similarly, patience to draft a process maps poses another drawback because the task of producing process maps organisation-wide can be overwhelming.

4 BIM BUSINESS VALUE REALISATION (BVR) FRAMEWORK

This section presents a framework for measuring business value of BIM-related outcomes for asset and facility managers (Figure 1). It suggests the process in a sequence and describes various aspects to be taken care of while observing outcomes, evaluating results, comparing planned and actual benefits, and finally, realising business value at the user, system or business dimension. The model is based on the methodology of BIM business value measurement considering that; (i) if the process is better as a result of BIM-based processes, then it is different in some relevant way; (ii) if it is different in some relevant way as a result of certain BIM properties or characteristics, then the change is observable; (iii) if the change is observable because of certain direct BIM benefits, then it is countable; (iv) if it is countable using defined measurement metrics, then it is measurable; (v) if it is measurable using established measurement techniques, an organisation can value each unit and, therefore, realise the benefits of BIM (Glideman, 2000). Furthermore, Cronk & Fitzgerald (1999), propose three dimensions to IT business value, they are: user, system and business levels.

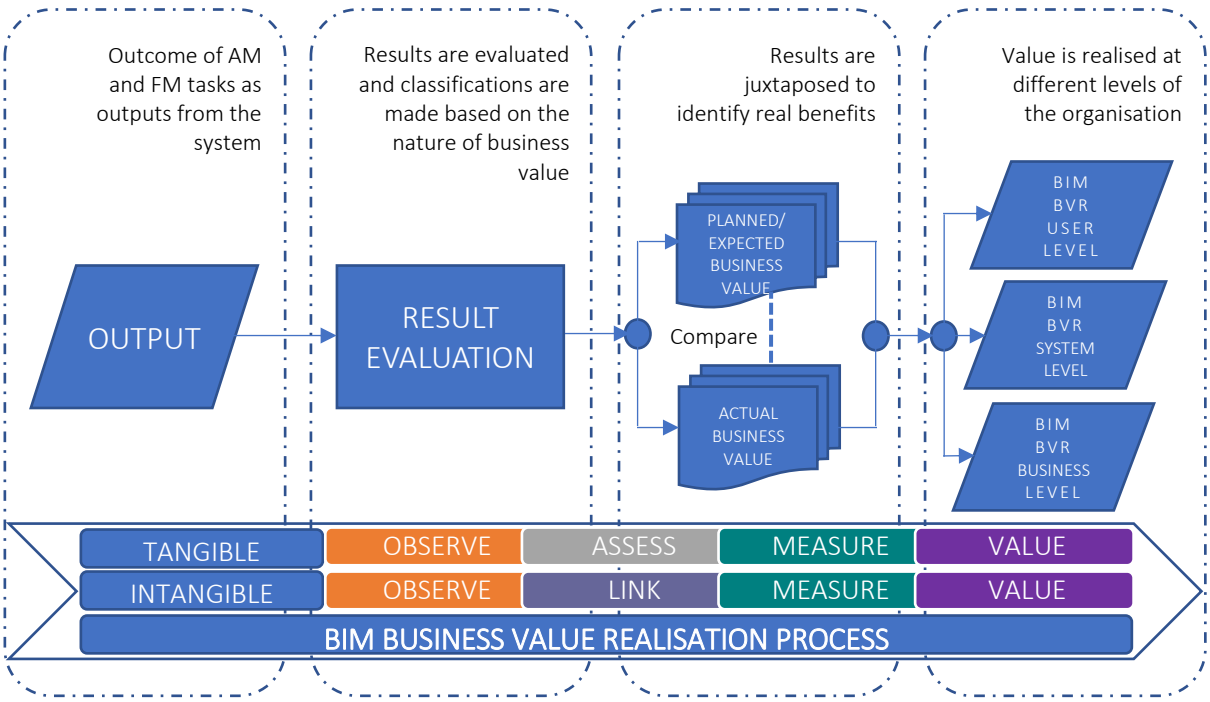

Figure 1: BIM Business Value Realisation (BVR) Framework

4.1 *Measuring Tangible Value*

The framework proposes a four-step process in measuring tangible value (Glideman, 2000).

- OBSERVE: The change to the system is to be observed closely and properly documented. This step should assess the value realisation plan produced at the beginning of the investment lifecycle and review the targeted benchmarks. It is important that benefit identification is closely connected to the value realisation plan and business case so that the benefits that BIM could deliver are aligned with the organisational business strategy.
- ASSESS: The next step is to assess the nature of the change, whether it is positive or negative. This can only be determined if the outcomes are properly classified to be measured against organisational performance benchmarks.
- MEASURE: At this stage, a drawdown list of expected benefits from the value realisation plan and business case should be compared with the outcomes that may materialise from the system. After identification, a suitable measurement technique is selected. Value is then measured using the identified technique.
- VALUE: The benefits or dis-benefits are realised at the end of the process. The nature of the BIM business value and its dimension is determined at the user, system or business level. The organisation will have to document the value realised for learning and continuous improvement.

4.2 *Measuring Intangible Value*

This is a procedural technique of measuring intangible value of BIM business value in the operations and use stage. A four-step process of measuring intangible benefits are observe, link, measure and value was adopted for this model (Carayannis, 2004, Nogeste & Walker 2005, Bakis et al. 2006).

- OBSERVE: The change to the system is to be observed closely and documented properly. Identifying intangible outputs is challenging and complicated, hence, managers will have to cast a wide net over many outcomes from the system. The value realisation plan and business cases should be reviewed so that performance benchmarks are identified.
- LINK: The next step will involve linking the observed phenomenon to measurable organisational metrics. This process is further explained in Section 4.2.1 (Figure 2). Intangible outcomes are to be linked to tangible outcomes for measurement. This process is exploratory as organisations have to develop appropriate pairing techniques.
- MEASURE: The next step is to compare the new observed phenomenon with already existing organisational standards or results. This is the stage where benefits planned for are monitored for realisation. The appropriate measurement technique is adopted and value is identified.
- VALUE: The benefits or dis-benefits are realised at the end of the process. The nature of the BIM business value and its dimension is determined at the user, system or business level. Finally, the process is properly documented.

4.2.1 *Linking Intangible Value to Tangible Value*

One of the difficult tasks of measuring intangible value is identifying a metric with which to measure

it. Also, measuring intangibles is very difficult because it is not always possible to quantify those values in absolute terms without any degree of subjectivity. Whether intangibles are assigned with value or not, these benefits still remain significant to achieving organisational objectives (Remenyi, 2000). Bakis et al. (2006) evaluate the inherent problems of quantifying business value and the difficulties associated with intangible value and demonstrated a business value linkage diagram for the benefits of IT-based investments.

In order to measure or quantify intangible business value of BIM, intangible value will have to be linked with tangible outcomes. Business value linkage is a technique which assists asset managers can utilise in identifying value and understanding the process through which value is created.

This study proposes a concept map used to link intangible to tangible value through a concept map. The BIM capability of the system is observed in order to identify the processes it affects and the value it delivers. Subsequently, the intangible benefits are identified. The possible semi-tangible benefits derived as a result of the intangible benefits are also acknowledged. The linking of semi-tangible benefits to the tangible benefits is done for ease of measurement. Finally, intangible value linked to tangible derived from the BIM-based process may be evaluated using any value measurement technique. The concept map proposes a simple four step process but, in some cases, it can be shorter or longer. Whilst using this process, asset owners need to establish benchmarks so as to improve linkage and measurement metrics over time.

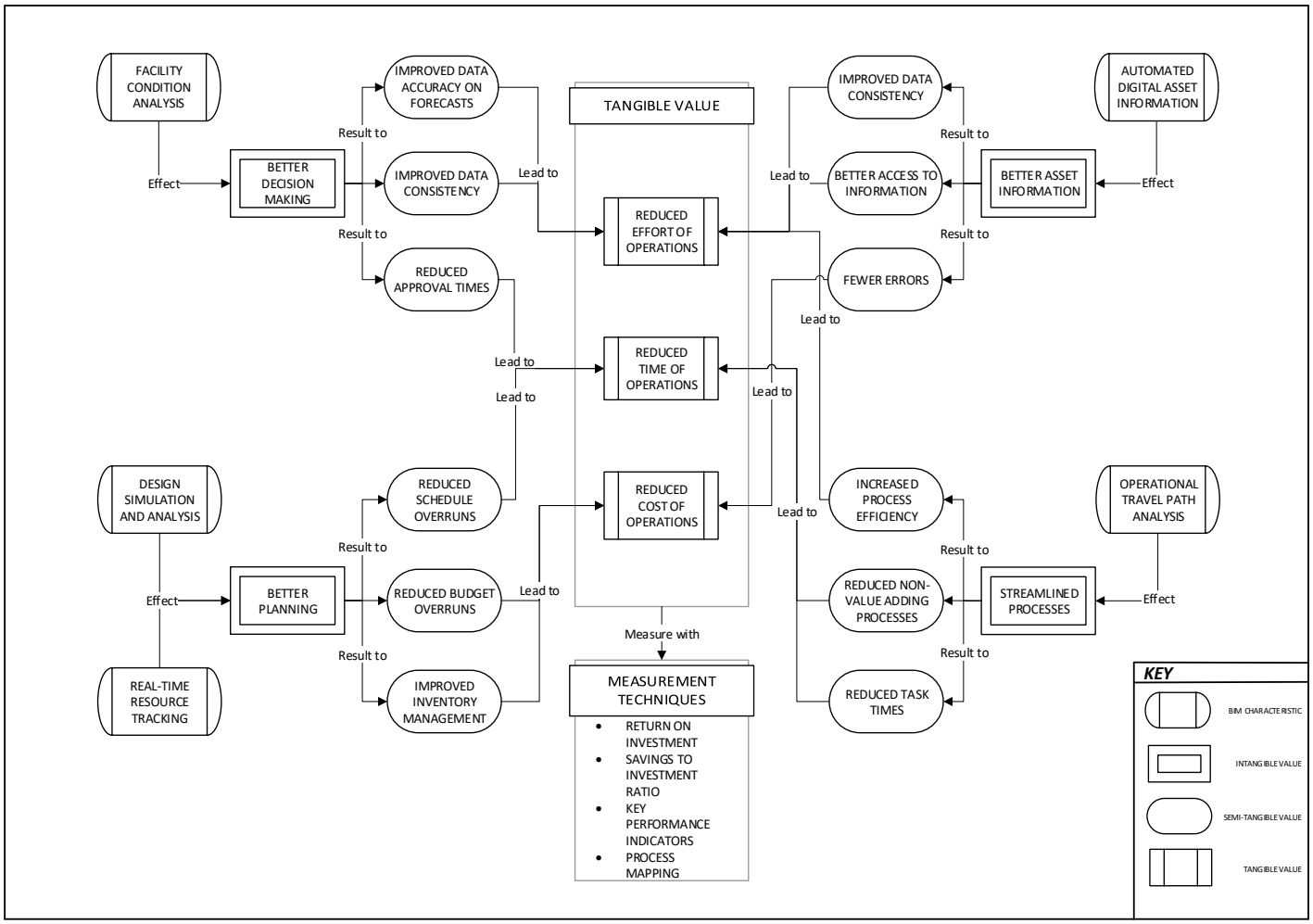

Figure 2: Concept map for linking intangible value to tangible value for BIM-based processes

5 CONCLUSION

The measurement of the BIM business value has been the subject of considerable debate within the normative literature. The difficulties in measuring benefits and costs are often the cause of uncertainty about expected benefits, particularly in AM. Thus, how then can an asset owner obtain business 'value' from investing in BIM?

In addressing this issue, a framework for measuring business value from an investment in BIM is proposed. Furthermore, the study proposes the use of concept maps in identifying intangible value and linking it to tangible based on BIM capability that an organisation may attain from its implementation. The proposed model is conceptual in nature but provides the underlying foundation for developing a strategy for asset owners to consider how BIM can

create value in their organisations. Whilst using this process, asset owners need to establish benchmarks so as to improve linkage and measurement metrics over time.

Tangible and intangible value have significant impact on the attainment of organisational business objectives. However, the measurement of intangible value is not a straightforward one. No matter how unclear the measurement is, it is still of value if the organisation learns and understands its processes more than they did prior to the process. It is worth repeating that asset owners need to plan for these benefits to be able to properly realise them. Having a value realisation plan is significant for asset owners to be able to track the benefits that BIM brings.

6 FUTURE WORK

Research focusing on business value of BIM has not been forthcoming. Therefore, the proposed framework in this study provides impetus for future research in this area.

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