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MEASURING PROJECT VALUE: A REVIEW OF CURRENT PRACTICES AND RELATION TO PROJECT SUCCESS

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ABSTRACT

Achieving a higher project value for all project participants is a major concern in the construction industry and reflects the extent to which projects are successful. The major struggle, however, is in the ability to both identify and measure the tangible and intangible project value requirements. Having different interpretations of what project value constitutes, the literature offers a variety of practices and suggestions for measuring project value. However, since the offered methods are fragmented and do not build on one another, a further investigation is required. Accordingly, this research provides a review of the measures discussed in the literature and suggests new directions for evaluating project value. The research targets the construction industry in addition to other industries that also provide effective strategies to create and measure value in customer-based product developments. The study revealed a lack of a sufficient approach for quantifying value on projects. Consequently, this research aims at providing combined effective ways to help measure project value in an effort to align stakeholders' needs, increase stakeholders' satisfaction, and thus realize successful projects.

KEYWORDS

Benefits realization, integration, collaboration, stakeholders' value, project success.

INTRODUCTION

The value concept has been debatable in the construction industry since its early conception. In fact, the concept of value is one of the most overused and misused notions in the social sciences domains, and in particular, in the management literature (Salem Khalifa 2004). Construction related research has delved into the different interpretations of project value and what constitutes it. Mainly, project value was associated with clients' or owners' needs and objectives. However, project value has a broader meaning which encompasses the various needs, requirements, and visions of the different internal and external stakeholders involved on projects. This includes the social, economic, and environmental needs of the society and the impacted stakeholders as well (Salvatierra-Garrido et al. 2012). The literature also discusses the different aspects of project value. Specifically, Devine-Wright, Thomson, and Austin (2003) introduced a framework to translate *values* to value within the construction project; it recognised six potential levels

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of values that influence decisions: societal, industrial, organizational, professional, project and individual values. These levels reveal the complications behind project value and emphasize the need to comprehend all aspects of value to improve its delivery.

Another terminology for understanding value on projects from various stakeholders is the benefits realization concept which is a notion developed in the Information Technology (IT) sector (Bradley 2016). The benefit realization approach is implemented in the construction industry. Tillmann et al. (2010) discussed the paradigm shift for benefit realization where traditionally financial returns were the major concern for any investment, while now all outcomes of an investment serve as a potential source of value; as such, it's important to consider how this value will be achieved in the value generation process. Tillmann et al. (2013) highlighted the problem of tracking a project's value proposition throughout its entire implementation and discussed the importance of pursuing value on construction projects. To improve value generation, Tillmann et al. (2013) indicated the need to: engage key stakeholders in value definition efforts to capture their requirements, establish the required conditions for them to collaborate together, and set goals that shall be aligned with the business strategy. It is also important to include adequate means to track the generation of value or measure the achievement of outcomes (Tillmann et al. 2013).

Thyssen et al. (2010 p. 29) assured that "*value is not something that can be made explicit once and for all*", and elaborated on the shortcoming of the current practices specifically with the dynamic property of value. Value changes with time based on different project attributes that interact and change with project progression which affect value perceptions (Khalife and Hamzeh 2019).

Previous studies discussed topics related to what constitute value, however, the focus here is on how to measure what the literature defines as project value. Value judgement has a qualitative nature but combined with quantitative objectives. Therefore, it is important to highlight methods to be able to measure and monitor value. Another problem is that most studies focus on value creation and value capturing early on projects but fail to explain the fact that during the project delivery, there is often a value loss due to improper tracking or measuring of the development of value.

The main gap realized in the literature is the lack of a clear approach to quantify value over the project different phases and have a comprehensive method for tracking of project value as the project progresses. Accordingly, this study aims at: (1) exploring the literature on value creation, quantification, and measurement; (2) extracting methods and strategies for measuring and monitoring value from the construction industry and other industries, and (3) suggesting future directions and strategies for effective measurements of value on projects within the different project phases.

METHODOLOGY

To explore the key concepts that are used when measuring value on projects, and to find out what are the effective strategies to measure project value in the architecture, engineering and construction industry, a review of literature was conducted. While there are a plethora of methodological approaches falling under the review family of literature, the purpose behind the review and the requirements for information retrieval would identify the review type (Sutton et al. 2019). Accordingly, based on the aforementioned objectives of this research, a similar approach to the scoping review was utilized and then extended to include some key assessment and new directions for future research. Arksey and O'Malley (2005) provide a methodological framework for scoping studies. A scoping

study addresses topics that connect to different study designs and it aims at mapping key concepts for a research area that has not been reviewed comprehensively before (Arksey and O'Malley 2005). In this research, the fact that measuring value includes a variety of approaches and study designs due to the complicated and dynamic nature of value, and since there is a lack of identification of the key concepts that affect measuring value on projects, it was deemed that a similar approach to examine the extent of research connected to measuring value, is admissible.

Accordingly, the following details were specified to identify relevant studies and the selection criteria. The review scope was based on papers collected from three major search engines: google scholar, Scopus, and IGLC conference papers. Major key words were used: value, measure, requirements or needs, and construction. The first step was to identify it within the engineering domain, specifically construction and then an extension towards other domains was performed. These keywords yielded to 37 studies in Scopus database. Then based on the title and the abstract, relevant papers were selected. Additionally, the selection process to define what to include and what to exclude was specified. The criteria followed was identifying the papers that refer to project value and how to quantify and measure it, while excluding the papers that only discuss creating value on projects through the traditional value management approaches. This is important because the literature, specifically the lean literature, contains a plethora of papers discussing value concepts and generating value on projects. Some of these papers discussing value creation and enhancement on projects were cited where suitable for the purpose of the flow of information. Subsequently, this narrowed down the papers to few papers that are relevant. Then again, a similar overlook from the IGLC conference was performed and from google scholar. Basically, the research presented in this paper discusses the 7 major studies in construction and 5 in other domains that were found to be of relevance to the topic and the key concepts that could help future research in addressing measuring value. Given this narrowed down scope, the methods were then discussed as needed to point out to major results out of these studies.

A critical assessment of the offered methods and suggested future directions for measuring value based on what was observed to be missing in the reported studies was then performed. Based on this assessment, abductive reasoning was used to develop the model shown in Figure 1 describing the dimensions and proposed indicators that need to be considered when value is measured on projects. Finally, the authors do not assume the completeness of the results, however, they propose this research as a preliminary step to expand on this topic for research and practical benefits.

BACKGROUND ON MEASURING VALUE

WHY MEASURE PROJECT VALUE: RELATION TO PROJECT SUCCESS

According to Loughborough University and Partners report in 2003 about value in construction "The benefits of thinking about value are often not understood by all" and "to work effectively, people need to see the value in what they do" (Kliniotou 2004). The relevance of discussing project value is related to project success. There is a new shift in understanding project performance that extends beyond the iron triangle of cost-time-quality performances, to embed the value performance in the new production era of lean thinking (Tezel et al. 2018). Many models and viewpoints have discussed the dimensions for assessing project success. Based on different models found in literature, Chan (2001) developed a consolidated framework for measuring project success which included the

value concept but from a commercial- profitable manner. However, other segments of this framework relate to project value including user expectation and satisfaction, environmental performance, and participants satisfaction (Chan 2001). In lean philosophy, adding value is an important foundation of project success. Projects are far more sophisticated than a single customer product that is considered successful if the user is satisfied with it; construction projects are dynamic systems involving a large number of interested stakeholders. Their needs, expectations and their ultimate satisfaction should be considered for project success.

When literature offers key performance indicators (KPIs) for project success, a major part is based on subjective measures or soft measures such as End-user's satisfaction, client's satisfaction, design team satisfaction, construction team satisfaction, etc. (Chan and Chan 2004); these measures are basically related to the perceived value of these entities for what project value constitutes. Moreover, measuring value is essential in achieving high-performance projects and facilities (Fischer et al. 2014). Consequently, the need to find means and measures for the expected benefits on projects or otherwise for the expected value considerations are essential to project success.

HOW PROJECT VALUE IS MEASURED: UNDERSTANDING PROJECT VALUE

The traditional description of value is the ratio of worth over cost (Fowler 1990), or function and quality over cost (Dell'Isola 1997) which represents an objective perspective for measuring value. Fowler (1990) also suggested a more subjective view of value: user's initial impression plus satisfaction in use, over first cost plus follow on costs. Later on, and based on those propositions, Thomson et al. (2003) suggested that value is the relationship between positive and negative consequences; thus value is benefits (what you get) over sacrifices (what you put in). This is a broader definition of value, but it still considers the value as an end result of the process and product development. In this research, the project value is the negotiated and collective guiding principles that are expressed by different stakeholders and from which the assessment of the project success is considered. Understanding the concept of perceived project value helps in deciding on methods to measure it.

Moreover, there are some subjective and objective measures based on the type of value each stakeholder is interested in. Three types of value are highlighted: the exchange value, which is usually of interest for the client or developer; the use value, usually of end users' interests; and the esteem value, which is related to the aesthetics and desirability of the project (Leinonen and Huovila 2000). The latter is usually of designers' interests while considering clients' requirements. Accordingly, there is a need to mutually agree on value parameters, that should consider all types of value. This is achieved throughthe use of quality function deployment (QFD)where many authors utilized QFD and utility theory to generate value in early design phases (Emmitt et al. 2004; Leinonen and Huovila 2000; Serugga et al. 2019). It is a typical approach to assess value by assigning weights to each core value in a decision matrix to reflect its importance to the project stakeholders.

Additionally, another key aspect for understanding and measuring value is the dimensionality of perceived value. Sánchez-Fernández and Iniesta-Bonillo (2007) differentiated between uni-dimensional value and multi-dimensional value. While the former represents a simplistic approach, the latter reflects the complexity of customers' perception of value and includes observing value through its component. Nonetheless, both approaches provide contributions to the study of value.

WHEN CAN PROJECT VALUE BE MEASURED

Project value is usually associated with the project lifecycle, from early inception phases to the completion of the project and its operation. However, in each of these phases, project participants change, and the interested stakeholders would also change, thus affecting project value. It is therefore important to consider two things when looking at project value in different phases: (1) the involved parties and (2) the characteristics of the phase. For instance, the design phase has a major effect on project value given the fact that it comes with major decisions regarding the project. This phase, in any engineering design, is mostly known for the three main challenges it possesses: being ill defined, iterative by nature, and complex;. Therefore, it is important to capture the positive iterations in the design phase that would increase project value (Ballard 2000).

According to research , value is said to be envisioned during the design phase, it is said to be harnessed during the construction phase, and finally, it is an experienced value during the use or operation phase (Devine-Wright et al. 2003). Consequently, project value will be completely measured with the final stage of a project. In fact, project value is dynamic, where the perception of project value changes over time (Emmitt et al. 2004; Khalife and Hamzeh 2019). Thus, it is important to observe value duringproject phases.

OVERVIEW OF THE MEASUREMENTS DISCUSSED IN THE CONSTRUCTION LITERATURE AND PRACTICE

Research in Loughborough University was conducted to form an approach to identify and monitor value; this approach is based on value management concepts. According to Kliniotou (2004) "*Measuring the value drivers helps to monitor the value development throughout the project. At key project stages, the design solutions or deliverables can be evaluated against the initial value drivers to monitor the progress made against the initial requirements. This helps the project team to visualize the extra value that their actions have added to the project*." Hence, the proposed approach included a scoring system from one to five for prioritizing the list of value drivers (ex. Attract future tenants, inspire the project team) and monitoring their corresponding measures (ex. Enquiries to rent/buy, enthusiasm of team). Project value is the summation of all value drivers, which are equivalent to the summation of benefits over sacrifices. However, each value driver is given a percentage importance from a total of 100 (maximum project value). Additionally, the scoring is performed in different phases, at project inception and then at post-project tender stage. The total value score, or the 'value index', is then evaluated based on the assigned weights. Kliniotou (2004) also pointed out that research suggests that each value driver measurement is dependent on the accumulation of all lower-level measures of the design attributes. However, they argue that not all lower-level attributes are measured with the same metric. Although Kliniotou's approach provides a good start for value index measures, the study did not provide any input on how to evaluate the best possible outcome which will receive a score of five; it is not clear whether this is agreed on objectively between different stakeholders.

Lin and Shen (2007) realized the importance of value management (VM) in the construction industry practices; thus they delved into the available measurements for assessing the performance of value management. They looked first into the focus of performance measurements in construction such as environmental performance, human resource performance, technology innovation performance, etc. The study then discussed the performance measurement of VM. The main step is identifying the critical success

factors (CSFs) that would describe how to measure and achieve the objectives of the VM studies (Lin and Shen 2007); the second step is to develop the necessary performance indicators or KPIs. The relation between CSFs and KPIs should be clear, this would help in measuring performance according to Chan and Chan (2004). The study concluded that no proper and rigorous framework is found in the literature for measuring the VM performance. Some recommendations were suggested but were too general.

Another vital study was conducted by X. Zhang et al. (2013) discussing an integrated set of techniques to support value creation for engineering product design development. The proposed method identifies implicit value and executes value modelling and simulation from customer statements (requirements) to design parameters. The study pointed out to some of the preliminary work that was performed for measuring the achievement levels of customer satisfaction (or value) through the KANO model and quality function deployment (QFD). The authors also highlighted some of the shortcomings of the previous models including: (1) the use of hierarchy to structure the levels of customers' requirements, where a more suitable approach would be structuring these in a network to reveal implicit customer needs; (2) assigning weights to customers' needs and objectives in the QFD method, while a good practice would be specifying a range of lowest acceptable level to a highest desired level; (3) the confusion in the ordinal ranking and the cardinal ranking, where individual rankings could be transformed into group ranking only in case of assigning weights not ranks; and (4) the selection of additive linear forms- that aggregate different attributes to assess the achievement level of customer satisfaction which assumes that preference independence among the attributes is satisfied, yet this is only true in certain situations. Consequently, to account for these shortcomings, X. Zhang et al. (2013) developed an integrative approach that helps in value-driven traceability, value-driven trade-off capability, and intangible value attention by utilizing the following tools: Means-end analysis, part-whole analysis, multi-attribute utility theory. The method helps in developing a system value model by first identifying and structuring objectives. An interesting qualification for the transformed objectives is provided: these objectives can be fundamental, means, or strategic objectives. Then, the set of attributes and their 'meaningful' weights are specified to measure the objectives. Thus, those attributes should be measurable, operational, direct, and unambiguous. The approach also suggests, based on the quantified group value model, performing sensitivity analysis and optimization. However, one critical aspect of this approach is listed in the paper itself; (1) it needs real effort to be translated in practice, and (2) it requires "hard work and creative thinking to transform subjective and ambiguous customer statements into measurable value" (Zhang et al. 2013).

Moreover, Fischer et al. (2014) talked about measurable value in the framework of integrated project delivery. The study criticizes the early, limited, and vague value definition which is not realized in later phases. Instead, the study suggests clearly defining, and more importantly tracking project value. However , the study only provides a simple example on that approach without digging into strategies for directing it except with the concept of integration of the systems, processes, the organization, and information.

Another value theory-based model was suggested by Zhang and El-Gohary (2016) to quantify and analyze the value of a project according to its properties and the different stakeholders' value perceptions. This approach studies how the project properties realize stakeholders' personal value systems. An automated value analysis process was suggested through employing the building information modeling (BIM) platform (Zhang and El-Gohary 2017). In this approach, the BIM model is used to retrieve value-specific

design information that would be used in quantifying the value of a project to a stakeholder. The approach is based on three modules: stakeholder value system solicitation module, building information retrieval module, and building valuation module. A stakeholder value importance score and value fulfillment degree are calculated to help decide on alternative design decisions (Zhang and El-Gohary 2017). The advantage of this approach is that it is automated with a developed user interface platform. Nonetheless, the researchers listed a set of future extensions for this approach to be more comprehensive. Additionally, the approach only provides the results of the worth for each stakeholder, but more analysis is needed to evaluate the effect on design decisions.

Moreover, Serugga, Kagioglou, and Tzortzopoulos (2019) employed QFD and Utility theory to aid the decision making processes and account for the emergent needs often faced in front end design processes (FED). FED is characterized by being an information intensive process and a main contributor for value generation; thus structured approaches are needed in this phase to avoid information loss due to uncertainties (Serugga et al. 2019). Accordingly, the model uses the utility theory to transform the high-level goals of stakeholders into measurable objectives and attributes to understand trade-off dynamics by employing the Expected Utility Value (EUV). The QFD is then employed to consider the design alternatives based on the correlational matrices. While this approach investigates forecasting requirements and accounting for uncertainty, it has not accounted for the implementation phase of projects. The study discussed information loss in the FED phase, but the major loss of information and value implementation is during the handing over between design and construction where it is a critical stage for the success of projects.

Giménez et al. (2019) presented a value analysis model for measuring value during the design phase based on the Kano model. While the study offers a new perspective on value losses on projects through the introduction of three value indexes, it is not clear how the model addresses the change in the potential value and the desired value.

Table 1 assembles the mentioned studies with their applied methodology and critique.

Table 1: Summary of the studies with the suggested method and its critique

Reference	Method applied	Critique
(Kliniotou 2004)	Prioritizing value drivers, their corresponding value measures and value index	Not clear if the percentage importance of the value drivers is collectively agreed on
(Lin and Shen 2007)	Performance measurements for value management CSFs	Too general and focus on value management approach
(Zhang et al. 2013)	Integrative approach means-end analysis, part-whole analysis, and multi-attribute utility theory	Hard to transform subjective customer statements into measurable value
(Fischer et al. 2014)	Integrated Project Delivery IPD	No clear explanations about how to track project value
(Zhang and El-Gohary 2017)	Building information modelling Build-Infra-Axio, stakeholder value importance score (SVI)	Approach shall be expanded to be comprehensive specifically in relation to design decisions
(Serugga et al. 2019)	QFD and Utility theory in FED, Expected Utility Value (EUV)	Focussing on front end design and neglecting handingover
(Giménez et al. 2019)	Value Analysis Model-Kano	Value evolution not addressed

PROPOSED MEASUREMENTS FROM OTHER DOMAINS

Maximizing value for customers is a well-known concept in various domains including: manufacturing, marketing, engineering product design, real estate, and management. In what follows, the authors will discuss some of the ideas established in the literature of different fields that they think could help the construction industry practices.

In the business management sector, Kaplan (2009) revisited the balanced score card tool after he first introduced it in 1992. This tool focused on the intangible assets that had a central and critical role in value creation, and thus needed to be integrated in companies management system (Kaplan 2009). Kaplan explains that intangible assets seldom have value on their own, they must be associated with other intangible and tangible assets to create value. If we need to translate that into the construction industry, customer satisfaction is an intangible asset for the construction companies, but it could be measured through looking into sub-levels attributes that reflect what constitute customers' satisfaction. Another management technique is considered which is used in software-intensive systems; Agouridas et al. (2006) introduced the motivational rationale traceability matrix MoRal™ to support having aligned design requirements with stakeholders needs to develop electromechanical consumer products. The matrix collects relative satisfaction indicators and relative influence indicators for stakeholders needs and attributes respectively.

The aerospace industry has introduced the 'Stakeholder Value Network' analysis (Sutherland 2009). The value network is used to understand the interaction between the different stakeholders involved on a project by capturing the value flows and value loops between the entities. The SVN helps in visualizing value flows and pointing out important relations to be considered based on the intensity of need.

Another business related value consideration is the creation of value based on cross-functional involvement. Lambert and Enz (2012) conceptualized value co-creation as a set of three stages: (1) joint crafting of value propositions, (2) value actualization, and (3) value determination. Similar to other approaches, it depends on prioritizing potential drivers that increase sales based on improvement in customer value. The study stresses on the importance of jointly crafting value propositions over the life of a relationship not only through collaboration, but also through less structured ways. Value actualization is setting the required interaction level and implementation plan to create value.

Benefits realization is a concept which is used in the IT sector to improve the business benefits to organizations. This approach deals with: engaging the potential stakeholders, establishing the objectives from key stakeholders, specifying a set of realistic benefits supporting the objectives, relating the benefits in benefit dependency maps, prioritizing paths, determining the enablers, using assessment matrices, and using measures to "track performance throughout and beyond the programme life-cycle, to demonstrate success and to take corrective actions" (Bradley 2016). The construction industry already benefited from such ideas, but other important concepts are still overlooked, specifically with respect to tracking benefits realization performance, which is the focus of this study.

NEW DIRECTIONS FOR THE EVALUATION AND MEASUREMENT OF PROJECT VALUE

The aforesaid strategies discussed in the literature had a major weakness regarding time dimension considerations and the variation in the involved stakeholders' value over time. To this end, a suggested model is presented to reflect on the different factors interfering

with project value recognition over project phases. Figure 1 specifies the dimensions investigated in this study to direct value measurement.

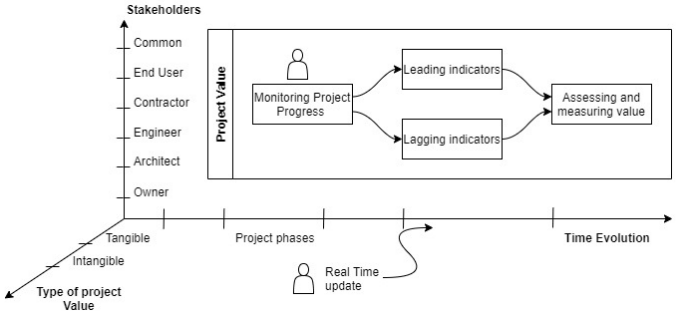

Figure 1: Dimensions for assessing and measuring value

The three dimensions shown on the axes of Figure 1 are central for measuring value. The first dimension is related to monitoring value throughout the project phases. Real time update is needed to reflect on value progress. Monitoring project progress, through KPIs, is a basic management principle which need to be expanded to encapsulate measurements of value drivers. A set of suggested measures under the title of leading and lagging indicators is proposed similar to the safety-indicators concept. These indicators, used in the context of safety, influenced the authors to consider similar concepts in the context of value based on the benchmarking research. Value leading indicators (VLead) are used to predict whether the project value is on the right track of development. Those VLead indicators would include: number of involved stakeholders, number and level of interaction, percentage agreement after meetings, and number of newly suggested design ideas. The level of interaction includes: communication, coordination, cooperation, and collaboration; each type of problem faced during progression of the project would require a different level of interaction. Those interactions should be monitored and adjusted to fit the need of the project based on value considerations. It is believed that when such interaction levels are reinforced a higher value level and value innovation can be achieved (Grilo et al. 2009). Other indicators could be added to the list depending on the project setting. These are only guiding indicators that are expected to give sense on whether participants are on the right track for enhancing project value. The value lagging indicators (VLagg) are indicators that explain the current actual achieved project value. Those include: fast client approval cycles, reduced conflicts during construction, improved collective understanding of design intentions, reduced changes during construction, reduced number of RFIs, and others. These are mostly based on the Yang and Chou (2019) study that listed these as expected-benefits measures when implementing BIM.

The second dimension examines project stakeholders' characteristics; different stakeholders have different levels of participation in the project; thus, it is important to check their level of engagement. Additionally, stakeholders have different control level or power within their network, therefore, it is crucial to measure their influence level by understanding their position. An important consideration here is the ethical dilemmas that usually occur on projects as a result of misalignment in value (Drevland et al. 2017). While some actors or stakeholders play an active role on projects, others are passive recipients of value on projects. Accordingly, considering stakeholders' position within the project network is crucial. Moreover, the knowledge and experience level of the parties shall be considered. Collectively, these considerations would be employed in

forecasting the progression of value, thus any needed proactive measures could be taken to adjust practices at any time in the project towards achieving better outcomes on the project level. The third dimension affecting value measurements is the type of value constituting the overall project value; these could be tangible value propositions or intangible ones. As explained in the literature section, stakeholders have different perspectives towards projects constituting both tangible value considerations including: improved overall project quality, better cost control and improved market price, or even environmental systems implementations, and intangible value considerations, such as: social acceptance and satisfaction, teams' satisfaction, or improved owners image. The issue with intangible value propositions is that they need to be translated into tangible measures to be assessed.

Accordingly, a set of recommended steps are suggested for measuring project value based on the literature and the above analysis, including:

- Identify value flows between the different involved stakeholders through a network for structuring needs and requirements; update throughout project phases.
- Apply relevant approaches including the utility theory and the means-ends methods to prioritize constituents of project value and translate them into suggested design solutions.
- Identify value drivers with their respective weights and a range for the lowest acceptable level and the highest desired level.
- Specify customized metrics for tracking the assigned value drivers, these metrics should be "informative, relevant, unbiased and comprehensive, action oriented, performance targeted, and cost effective" (Bleich 2010). KPIs and CSFs should be agreed on throughout the different phases, design and construction phases.
- Establish a data Acquisition system to track suggested metrics and other relevant information to evaluate VLead and VLagg indicators. Apply proactive measures based on results from VLead indicators and reactive measures after the VLagg indicators. Using BIM and an integrative approach is highly recommended.

CONCLUSIONS

Measuring project value is considered an important step towards enhancing value and achieving successful projects. A synthesis approach of reviewing the construction industry literature and other industries revealed a lack of focus on methods and approaches to monitor and measure value on projects along the project life cycle. Some of the approaches found were discussed and evaluated. Based on the revealed gaps in these methods, new directions are suggested towards measuring project value. Some of the suggested measures include value leading indicators (VLead) and value lagging indicators (VLagg). These are expected to help in monitoring value and taking both proactive and reactive measures based on these indicators. Future studies will target the applicability of those measures with the help of simulation tools and suggest a project value control dashboard before testing these measures on real case studies.

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