sustainability

MDPI

Article

Development of Value Creation Drivers for Sustainable Design of Green Buildings in Saudi Arabia

Wael Alattyih [1,*], Husnain Haider [1] and Halim Boussabaine [2]

1 Civil Engineering Department, College of Engineering, Qassim University, Buraydah 51452, Saudi Arabia; husnain@qec.edu.sa

2 Faculty of Business and Law, The British University in Dubai, Dubai 345015, UAE; halim@buid.ac.ae

* Correspondence: alattyih@qec.edu.sa

Received: 8 September 2019; Accepted: 18 October 2019; Published: 22 October 2019

Abstract: The sustainability of green buildings has been widely recognized around the world in the recent past. Evaluating the investment on such buildings, with higher complexity than the conventional buildings, involves multiple and diverse stakeholders, such as consultants, contractors, general public, governmental institutions, etc. The selection of useful value creation drivers is a difficult task while accommodating the opinion of a group of stakeholders with varying perceptions and experiences regarding the value creation in green building design and the associated costs. In this research, a framework is proposed to develop a set of the most important value creation drivers (VCDs) for green buildings. Five primary VCDs were developed to cover the financial, functional, operational, environmental, and management aspects of a green building. Ninety-eight (98) performance value drivers (PVDs) were identified through the literature for assessing the performance of these value creation drivers. The identified PVDs were evaluated through a hand-delivered questionnaire survey, followed by detailed statistical analysis of the collected data while using Statistical Package for Social Sciences (SPSS) and Microsoft Excel software. Factor analyses were performed to eliminate the PVDs with least importance based on the responses obtained from 89 experienced managers (45%), engineers (38%), and architects (17%) working in the field of value management of construction industry in Saudi Arabia. Finally, 51 most important PVDs were grouped into two clusters for each value creation driver; for instance, control and planning clusters to assess the performance of management's VCD. The final outcome of the research in the form of five top level VCDs, 10 clusters, and 51 PVDs will facilitate the designers for enhancing the performance efficiency and value from investment for green buildings in Saudi Arabia, Gulf, and elsewhere.

Keywords: value drivers; value engineering; green buildings; construction; sustainable buildings; project management

1. Introduction

Modern construction works, such as green buildings, with increasing complexity and immensity involve a wide range of stakeholders, such as consultants, contractors, material suppliers, general public, governmental institutions, etc. Coordinating all of these parties simultaneously in the execution of a construction project is a big challenge [1]. Value management helps to improve communication between the project's parties, accommodate mutual understanding of the project objectives, provide better quality project definition, build innovation, and eliminate unnecessary cost [2]. Value can be understood in a multitude of dimensions through economic, cultural, and social interpretations [3]. The whole-life-cycle value exchange mechanisms are risky, complex, might have an effect on adding value, and are composed of value exchange and value creation (VC). Therefore, detailed investigations focusing on finding mechanisms for achieving sustainability targets over the entire life cycle of a project is required [4].

Globally, the construction industry has been showing greater interest in sustainable green buildings since the last few years [5]. Although, the primary benefits that were obtained from sustainable development have been defined in several manners, their financial impacts are alike, including sustainable VC and premium profits [6]. Value management aims to achieve the desired value with lower prices without compromising the quality and function of the building. Experience of several organization revealed that implementing green building initiatives by simply evaluating the existing processes efficiency reduced wastes, improved drives, and saved money [7]. Lützkendorf and Lorenz [8] identified several direct and indirect benefits for investors and other stakeholders, of applying value creation assessment for green buildings, such as: (i) drastic reduction in the operational cost and an increase in marketability, (ii) increase in useful life-spans, (iii) more stable cash flows, (iv) reduced exposure to increasingly stringent environmental legislation, and (v) significantly increased occupant productivity and well-being. Presently, the building sector in Saudi Arabia is also aiming to attain the advantages like the developed countries that have already benefited from the use of green buildings. Therefore, there is a need to set up a framework for improving the creation of value during the building development stage in Saudi Arabia by integrating value with project management.

It has been widely recognized that all of the projects have opportunities for improved VC. The primary aim of value engineering is to deliver quantifiable improvements in the value by reducing the cost, getting better quality, and improving the design features of the building for the customer [9]. It is a systematic process to gather a team of multidisciplinary professionals with experience in the construction industry to perform functional analysis of a system for providing the best value to the owner [10–13].

Improving the VC in a green building development project by improving the function longevity and operation and maintenance costs enhances the performance reliability, quality, safety, life-cycle cost, and brings additional revenue to the building owner. Kelly and Duerk [14] suggested that the client's value system, comprising of seven elements: time, capital expenditure cost (CAPEX), operating expenditure cost (OPEX), environment, exchange, esteem, and fitness of purpose, should be considered in the construction project. They go on to suggest that measuring and optimising an asset's performance involves economic performance (to obtain value for money), functional performance (to be fit for purpose such as appropriate in size and form), physical performance (concerns about the efficiency of the asset's operation and maintenance), and service performance (to achieve a satisfactory working environment for the occupants and satisfaction regarding quality from the client's perspective). Arena [15] believed that VC drives improving a company's performance. The nonfinancial performance indicators—which are time (to deliver, to develop, to market), quality, flexibility (respond to change, expansion), productivity, environment and sustainability, plus social responsibility—guide a company in predicting the VC and measure both revenue drivers and cost drivers. Identifying the performance variables in value management is necessary for appraising the client about the project value creation.

The Construction Industry Council (United Kingdom) has produced design quality indicators to evaluate and measure the design quality and the value obtained, including functionality, build quality, and impact within the project context of finance, time, and environment resources (natural and human) [16,17]. Kelly [18] described the performance variables for a client's VC system as nine non-correlated performance variables, which are: CAPEX, OPEX, time, esteem, environment, exchange, politics/community, and the use value, which is composed of flexibility and comfort.

The tangible value of the initiatives is hard to assess in green buildings, but improved productivity is certainly a valuable factor. Even a minor improvement in productivity leading to the corresponding increase in firm value would make more green building initiatives worth the investment [19]. Although several tools have been developed to assess the environmental performance of a green building, disconnect between the design community and the investment community still exists on the tangibility of VC over the short, medium, or long-term [20,21]. Conducting value analysis can identify project development contextual issues and thus provide opportunities for optimising the design and operation of the green building asset during early stages of the development.

Al-Yousefi [22] mentioned that approximately 60 to 80 value engineering training workshops are conducted annually and more than 80 value engineering study programmes are offered per year in Saudi Arabia and the Arab Gulf countries to foster the development of the value engineering technique. Thiry [23] claimed that identifying the key quality elements to create value and meet the project expectations varies depending on the type of asset, building, and/or project and identified 12 quality elements for a new university building to produce project value and obtain high performance; these identified quality elements are under four headings: operations (effectiveness, flexibility/expandability, and user comfort), resources (capital cost, operation & maintenance cost, and schedule), technology (environmental, engineering performance, and security/safety), and image (site planning, architecture, and community value). The National Audit Office (NAO) [24] classified the value creation drivers (VCDs) into six main categories for obtaining value for money: the effectiveness of the business case, project management efficiency, financial performance, the impact on locality, operational and environmental impact, and complying with the requirements.

The main objectives of this study are to: i) identify the most important performance value drivers for green buildings development in Saudi Arabia and ii) select, cluster, and rank the most important performance value drivers (PVDs) for the identified VCDs. The study will provide the inclusive guidelines for value management of commercial buildings in particular, and of construction industry, as a whole, in Saudi Arabia, Gulf region, and elsewhere.

2. Classification of Value Drivers

In this research, the VCDs were classified into financial, functional, operational, and environmental and management. The identified PVDs, through a detailed literature review are listed in Table 1. All the drivers are briefly described in the following sub-sections.

Table 1. Identified performance value drivers (PVDs) for green buildings through literature.

Code	Value Creation Drivers/Performance Value Drivers	References
VFI	**FINANCIAL PERFORMANCE VALUE DRIVERS**	Connaughton and Green [2]; Lützkendorf and Lorenz [8]; Arena [15]; Saxon [16]; Gann et al. [17]; Kelly [18]; NASA [19]; Chappell and Corps [20]; Thiry [23]; NAO [24]; Dell'Isola [25]; Kellay et al. [26]; Then [27]; ICE [28]; Building Radar [29]; Davies [30]; Green Building Council [31]; Greenwood [32]; Austin [33]; Kelly and Male [34]; Pasquire and Swaffield [35]; Bowyer [36]; Smith [37]; Ostime [38]; Muldavin [39]; PBS-PQ250 [40]; Kats [41]; Goldberger [42]; Alyami et al. [43]
VFI1	Efficiency of capital expenditure (CAPEX)	
VFI2	Efficiency of operational expenditure (OPEX)	
VFI3	Maximise the cost efficiency to build	
VFI4	Deliver/achieve cost certainty	
VFI5	Improve economic efficiency	
VFI6	Increase economic lifetime	
VFI7	Consider state of inflation	
VFI8	Maximise return on capex	
VFI9	Return on investment	
VFI10	Create investment planning and asset allocation	
VFI11	Maximise residual value	
VFI12	Minimise cost of capital	
VFI13	Prevent legal and potential damages costs—provide adequate insurance cover to protect against legal and potential damages costs	
VFI14	Prevent loss of revenue	
VFI15	Optimise risk-return ratio of alternative options	
VFI16	Reduce the fees payable	
VFI17	Increase turnover	
VFI18	Maximise sale price	
VFI19	Maximise rental price	
VFI20	Maximise occupancy rate	

Table 1. *Cont.*

VFU	**FUNCTIONAL PERFORMANCE VALUE DRIVERS**	
VFU1	Maintain adaptable building—useful to all	Connaughton and Green [2]; Kelly and Duerk [14]; NASA [19]; Thiry [23]; NAO [24]; Dell'Isola [25]; ICE [28]; Greenwood [32]; Austin [33]; Kelly and Male [34]; Muldavin [39]; Alyami et al. [43]; BEMU [44]; Pulaski [45]; Dryer [46]; Yates et al. [47]; Slaughter [48]; Kibert et al. [49]; Markeset and Kumar [50]
VFU2	Increase life of services	
VFU3	Provide function—fitness for purpose	
VFU4	Offer flexibility and the potential to cater for user changes in the future	
VFU5	Accommodate growth	
VFU6	Provide inherent possibilities and values in alternative uses	
VFU7	Increase ease of use	
VFU8	Increase efficiency—add capacity	
VFU9	Adequate size and efficiency (gross internal, net internal and net usable areas and ratio)	
VFU10	Achieve spatial quality	
VFU11	Allow for space allowance	
VFU12	Allow/ease of/control/secure accessibility	
VFU13	Provide disability access	
VFU14	Assure convenience	
VFU15	Provide durable building–last longer	
VFU16	Maintain durability	
VFU17	Enable buildability	
VFU18	Create reliable building—safer	
VFU19	Maintain security—health and safety	
VFU20	Suitability and maintainability of materials	
VFU21	Meet all statutory requirements and building regulations	
VFU22	Ensure designed elements are standardized	
VFU23	Configure design to enable an efficient construction process	
VFU24	Ensure construction efficiency is considered in specification	
VFU25	Reduce risk of failure	
VFU26	Provide functional ability of the foundation's requirements (strength and stability)	
VFU27	Ensure substructure functional requirements meet a satisfactory level of performance	
VFU28	Ensure superstructure functional requirements meet a satisfactory level of performance	
VFU29	Ensure functional requirements of exterior closures meet a satisfactory level of performance	
VFU30	Ensure roofing functional requirements meet a satisfactory level of performance	
VFU31	Ensure interior construction functional requirements meet a satisfactory level of performance	
VFU32	Ensure functional requirements of site work meets a satisfactory level of performance	
VFU33	Ensure mechanical functional requirements meet a satisfactory level of performance	
VFU34	Ensure electrical functional meet a satisfactory level of performance	
VOP	**OPERATIONAL PERFORMANCE VALUE DRIVERS**	
VOP1	Reduce/minimise/save energy usage	Connaughton and Green [2]; Saxon [16]; Gann et al. [17]; Thiry [23]; NAO [24]; Dell'Isola [25]; Then [27]; ICE [28]; Davies [30]; Green Building Council [31]; Greenwood [32]; Austin [33]; Pasquire and Swaffield [35]; Muldavin [39]; Kats [41]; Chiras [51];
VOP2	Maintain efficiency in terms of energy	
VOP3	Increase efficiency of utilities	
VOP4	Increase efficiency of heating, cooling and lighting	
VOP5	Easy to clean	
VOP6	Easy to maintain	
VOP7	Easy to manage	
VOP8	Easy to operate	
VOP9	Easy to inspect and maintain	
VOP10	Ease of running and managing the building's equipment	
VOP11	Provide building systems that are easy to operate and control	
VOP12	Manage maintenance and servicing of equipment	
VOP13	Accommodate telecommunications	
VOP14	Provide security services	
VOP15	Reduce operational risk	
VOP16	Improve waste management—reducing and dealing with waste	

Table 1. *Cont.*

VEN	**ENVIRONMENTAL PERFORMANCE VALUE DRIVERS**	
VEN1	Provide low carbon in use	
VEN2	Accommodate energy and carbon efficiency	NASA [19];
VEN3	Provide indoor environmental quality	NAO [24];
VEN4	Access to natural light, management of air quality and temperature	Davies [30];
VEN5	Increase use of natural ventilation	Green Building Council [31]
VEN6	Ensure lighting and acoustic criteria for the facility design meet a satisfactory level of performance	Austin [33]; Ostime [38];
VEN7	Specifying low-maintenance, durable, environmentally preferable materials and equipment	Muldavin [39]; Goldberger [42];
VEN8	Maximise resource reuse	Alyami et al. [43];
VEN9	Use renewable or recyclable resources	IGBC [52];
VEN10	Minimise consumption of resources	Inbuilt [53];
VEN11	Conserve water resources	Sleeuw [54];
VEN12	Respond to site microclimate	
VEN13	Conform/adapt to future changes	
VEN14	Consider people and their local environment	
VEN15	Design for minimum waste	
VEN16	Obtain environmental certification from appropriate bodies	
VMA	**MANAGEMENT PERFORMANCE VALUE DRIVERS**	
VMA1	Provide effective project management and delivery	
VMA2	Provide risk management	
VMA3	Create strategic planning	Connaughton and Green [2];
VMA4	Choose an appropriate procurement approach	NAO [24];
VMA5	Provide cost control to achieve the project objectives	ICE [28];
VMA6	Produce effective plans to achieve the project objectives	Green Building Council [31];
VMA7	Lead work design and delivery planning	Greenwood [32];
VMA8	Maximise organisational efficiency	Ostime [38]
VMA9	Able to design to scope/cost/budget/schedule/quality	Muldavin [39];
VMA10	Able to construct to scope/cost/budget/schedule/quality	Alyami et al. [43];
VMA11	Completed to specification	
VMA12	Maintain stakeholder interaction—accountability/clear expectations	

2.1. Financial Performance Value Drivers

Investigating and extracting the controllable financial value creation drivers (VFI) will help in attaining value engineering objectives by optimizing the financial investment and the project cost through examining the alternative options that were identified in the function analysis stage. A value management study needs to consider the capital expenditure, i.e, the investment costs incurred to complete the project and get the physical assets, and the operational expenditure, i.e., the ongoing cost required to operate the project and for further investigation that is required to understand and construct what the client wants [18]. The National Aeronautics and Space Administration (NASA) [19] suggests that it is important to find out the proper balance between the design/construction cost for a green building and the reduction in life cycle costing. Table 1 lists the VFI that need to be optimized during the design of green building assets. As per NAO [24], the financial performance for a project business case can be summarized as "optimizing the balance between the capital costs, operating costs and residual whole life value".

2.2. Functional Performance Value Drivers

Table 1 lists the list of important functional performance value drivers (VFU) that need to be used in optimizing VC during the design of green building assets. It has been postulated that achieving high green building asset function reliability would lead to an increase in the asset value in the business. Functional value is described as "an organized approach that is based on functional analysis which aims to obtain the essential functions at lowest cost within the required performance, reliability, quality and safety" [25].

The NAO [24] stated that a well-designed building can increase the asset value across its life. The design costs are likely to be 0.3–0.5% of the total cost over the lifetime of a building, construction cost about 2–3% of the total, and the cost of running the public services about 85% of the total. Hence large benefits can be gained through efficient building designs in comparison to the spent cost throughout its life. Building functionality can be defined as "the arrangement, quality and interrelationship of spaces and how the building is designed to be useful to all" [24]. It has a high impact on the other value generators: financial saving, high operating efficiency, maintain save working environment, and effective management. In the design phase, it is necessary to consider statutory and building regulations, standards, technical specifications, design and construction programmes, health and safety requirements, risk assessment, and environmental requirements [2,25,28].

2.3. Operational Performance Value Drivers

Table 1 lists the asset operational performance value drivers (VOP) that are needed to optimise the value creation during the design of a green building asset. The project life cycle information is important in value for economic analysis. Over the building's lifetime, the operating cost (running cost) would constitute approximately 80–85% of the total [19,29]. Efforts made in investing in a green building contribute to improve the performance life cycle operations by reducing the energy, water, utility, waste, and operation, and maintenance (O & M) costs [31,32,41]. In addition, a green building maintains a good indoor environment, which offers greater marketability, faster sale, and higher return on investment [33]. Moreover, green buildings have a positive impact on the occupants' health and productivity, which will generate more value for the business. Tenant satisfaction in a building is related to the building's temperature, acoustics, general health, and productivity factors [20].

2.4. Environmental Performance Value Drivers

Table 1 lists the environmental performance value drivers (VEN) that need to be optimized during the design of a green building asset. A green building design must relate to the site's microclimate and the building's functionality should also be adaptable to accommodate future uses to achieve a range of wider social and economic benefits [24]. The green building objectives should include sustainable site development, water efficiency, energy efficiency, indoor environmental quality, and resource consumption of building materials [30]. A green building should also contribute to the value for businesses by reducing the operating costs, offering a longer life cycle and lower development costs, and might improve the occupant productivity. Presently, there are several environmental assessment tools (such as BREEAM and LEED) that provide valuable information that needs to be considered in the green building design process [53,54]. A building that is certified by an environmental organization will obtain many benefits, such as an increase in its market value and lower energy consumption [31,32].

2.5. Management Performance Value Drivers

Table 1 lists the management performance value drivers (VMA) that need to be optimized during the design of a green building asset in order to create high value-creating project management activities. The value engineering techniques are sometimes considered as management tools to deliver the project on time with low cost and high quality. Additional value can be unlocked by integrating services, such as commissioning strategy, procurement path, and planning the construction processes [43]. Connaughton and Green [2] mentioned that the value management strategy can be used to identify the project objectives and provide a foundation for the stakeholders making accountable decisions. The NAO [24] stated that "the project teams should communicate well with all stakeholders. They should involve users, contractors and other members of the supply chain at appropriate times throughout the design and construction of the project to benefit from their expertise".

3. Methodology

3.1. Framework for Development of Value Creation Drivers

Figure 1 presents the framework showing the research methodology that was adopted in this research. Initially, five primary VCDs were identified through literature and expert judgment. Ninety-eight (98) PVDs were identified to assess the performance of the five identified VCDs. A questionnaire was developed to obtain the opinion of experts in the field on the importance of the identified PVDs. Subsequently, the selected PVDs were ranked by conducting a hand-delivered questionnaire survey, followed by detailed statistical analysis of the collected data by using Statistical Package for Social Sciences (SPSS) and Microsoft Excel software. Finally, the PVDs with the highest importance were ranked and grouped into clusters to facilitate the shareholders and designers to enhance performance efficiency and obtain more value from investment in green building assets. Details of all the steps are provided in the following sub-sections.

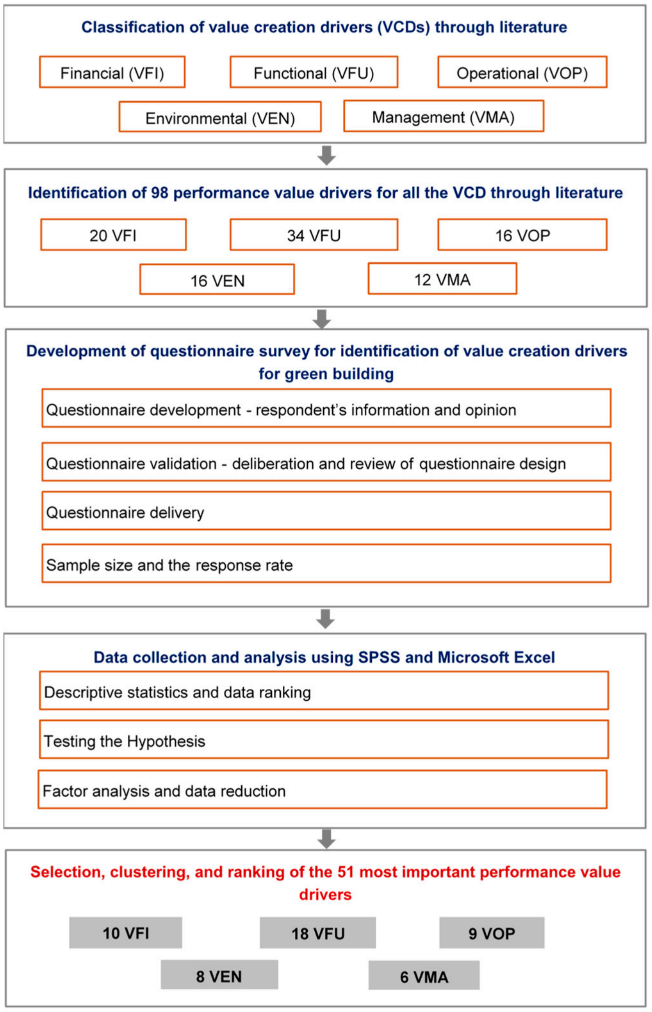

Figure 1. Methodological framework for the development of value creation drivers for green buildings.

3.2. Questionnaire Survey for Identification of Performance Value Drivers

3.2.1. Questionnaire Development

Overall, 98 value drivers were extracted through a detailed review of literature. The questionnaire form was initiated with an introduction of the research to respondents and it consisted of two main parts: (i) general information of the respondent, e.g., organization name, email address, phone number, postal address, job title, level of experience, etc., and (ii) the opinion of respondent on the value drivers.

The respondents were categorised into three groups based on the information obtained from first part of the questionnaire, including managers, engineers, and architects, to perform rational statistical analysis. In part two of the questionnaire, a Likert scale ranging from 1 to 5 was used to rank the VCD, with 1 being 'not important', 2 being 'slightly important', 3 being 'moderately important', 4 being 'very important', and 5 being 'extremely important'. Table 2 presents a part of the sample questionnaire survey form.

Table 2. A sample of questionnaire for financial performance value drivers (PVDs).

How important are the following *Financial Performance value drivers* to the project value created by green building designs?						
No.	**Controllable PVDs**	**Rate the Importance of Financial PVDs for Project Value Creation (Please Tick One Box)**				
		Extremely Important	**Very Important**	**Moderately Important**	**Slightly Important**	**Not Important**
1	Efficiency of capital expenditure (CAPEX)					
2	Efficiency of Operational expenditure (OPEX)					
3	Maximise the cost efficiency to build					
4	Deliver/achieve cost certainty					
5	Improve economic efficiency					
...	...					

The sample sizes used in this study were selected based on the professionals with knowledge of value engineering applications in the Saudi Arabian construction industry and the survey was conducted during the period from 19 December 2014 to 31 January 2015. The sample size is usually selected from a group of individuals to represent specific aspects of an identified population [55]. As per SAVE International, more than 1350 people have obtained value engineering certificates in Saudi Arabia [22,56]. Of this number, approximately 30 of them have obtained a Certified Value Specialist (CVS) certification. It was found that around 16% are from Saudi Arabia, as of year 2015, when compared with the total number of certified personal worldwide (i.e., about 8838). For a confidence interval of 10% and confidence level of 95% from the population of 1356, the research needed at least 76 respondents. Expecting a large number of non-respondents, the questionnaires were delivered to a sample size of 300 professionals in the Saudi Arabian construction industry. Precisely, the following methodology was used to develop the questionnaire:

Step 1: Preparation of draft questionnaire.
Step 2: Review of draft questionnaire by experts, e.g., question format, context, and relevance.
Step 3: Revision of draft questionnaire.
Step 4: Pre-test the revised questionnaire by the experts from academia and profession.
Step 5: Update the revised questionnaire based on the 2nd feedback from experts.
Step 6: Final check for the need of a subsequent pre-test.
Step 7: IF 'another pre-test is required' start from Step 4 again, OR 'finalize the questionnaire'.

3.2.2. Questionnaire Validation

A pilot study was conducted to verify the clarity and readability of the designed data collection format before sending the questionnaire to the chosen sample. The questionnaire validation was performed through deliberation and review of the questionnaire design before it was sent to the potential respondents by conducting a final check by the academicians and professionals who were selected based on their experience in the field and research interests. Finally, the questionnaire was updated based on their recommendations and comments.

3.2.3. Questionnaire Delivery and Survey Response

The identified value drivers were examined by sending a questionnaire to members of the Saudi Arabian construction industry to find out the most significant ones for use in the development of the green building design in the country. The hand-delivery questionnaire method was preferred. as it has a higher response rate and cheaper costs than a typical mail survey [55,57].

The questionnaire was hand-delivered to 300 professionals, and 89 of them returned their fully completed questionnaire. According to Akintoye [58], the normal response rate for a postal questionnaire survey in the construction industry is 20–30%. Hence, the response rate of 29.7% in present study was an acceptable rate of response for the selected sample size.

3.3. Data Collection and Analysis

3.3.1. Descriptive Statistics and Data Ranking

Statistical Package for the Social Sciences (SPSS) and Microsoft Excel were used to analyse the responses on VCDs. The comparison of the data ranking was carried out while using severity indices, average weighted mean, and standard deviation of each value creation driver. Further analyses of the data ranking were based on respondents' answers and their experience (0–5 years, 6–10 years, and more than 10 years of experience) and their professional job (manager, engineer, or architect).

The means, standard deviation, and the coefficient of variation values, which were calculated using Microsoft Excel, were found to be in agreement for all three groups of respondents (managers, engineers, and architects).

A mean weighted rating for each PVD was computed to indicate the importance of each indicator, while using Equation (1). Meanwhile, the range varies from 1 to 5; therefore, the moderate point for performance value drivers is 3.

$$Mean\ weighted\ rating = \frac{\sum R \times F}{n} \quad (1)$$

where R is the rating of each performance value driver (1, 2, 3, 4, 5), F is the frequency of responses, and n is the total number of responses.

A severity index (*S.I.*) measure was employed in order to rank the VCD according to their significance in terms of the percentage (%), as:

$$S.I. = \left(\frac{\sum W \times F}{n}\right) \times 100 \quad (2)$$

where W is the weight of each rating (1/5, 2/5, 3/5, 4/5, 5/5).

3.3.2. Testing the Hypotheses

Analysis of variance (ANOVA) was conducted to justify the statistical differences between the groups' responses. The SPSS software was used with a significance level of 0.05 to examine the differences between the groups regarding the importance of the PVDs. The following hypothesis were assumed:

- H_0: $p > 0.05$: There is no significant difference among the respondents' ratings for the importance of the PVDs.
- H_1: $p < 0.05$: There is significant difference among the respondents' ratings for the importance of the PVDs (at least one of the groups is significantly different from other groups).

Subsequently, a follow-up test was performed to make multiple comparisons to identify any significant difference among the respondents. The follow-up test used in this research was the Post Hoc Multiple Comparison Test; the Tukey test was used for the purpose, as the sample size is uneven.

3.3.3. Factor Analysis and Data Reduction

The objective of using a factor analysis process is to reduce data and eliminate redundant data that are not highly correlated variables from the survey. Factor analysis is often used to reduce the data and identify a small number of components, which shows the observed variance in a much larger number of manifest variables (SPSS 22.0.0.1). As a large number of variables often make the data more difficult to understand and manage, factor analysis allows for the researcher to reduce the number of factors without losing too much information from the original variables provided [59,60].

In the factor analysis process, a matrix of correlation coefficients and the components that have an Eigenvalue of 1 were extracted. Finally, a rotated component matrix was generated to find out which PVDs have a more effective influence on each component. The identified 98 PVDs were reduced down to 51 PVDs through identifying redundant data. The factor analysis process that is presented in Figure 2 shows that all the PVDs within each value creation drivers have been categorized into different clusters through the use of data reduction in SPSS. In present research, each of the VCDs contain two clusters which are explained in the following sections.

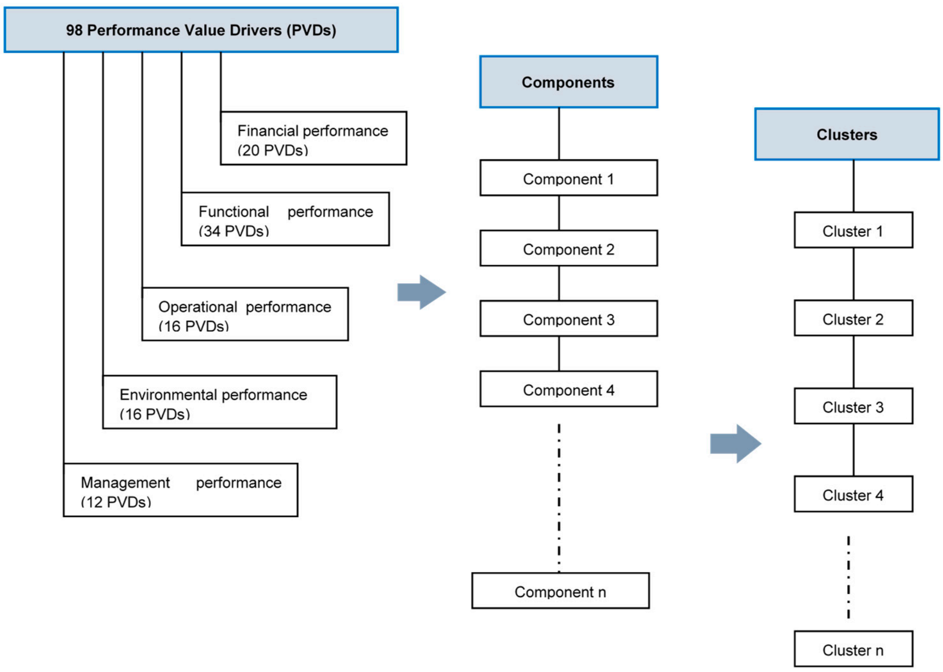

Figure 2. Factor analysis and data reduction process.

4. Results

4.1. Distribution of the Respondents

The questionnaire consisted of 98 identified PVDs that were distributed in five VCDs, as follows: financial performance (20 drivers), functional performance (34 drivers), operational performance (16 drivers), environmental performance (16 drivers), and management performance (12 drivers). The PVDs were ranked within the job description, the expert experience, and on overall basis.

Eighty-nine (89) respondents working in Saudi Arabia were asked two questions about their job description and experience to provide study and statistical data analysis. 40 respondents (45%) were managers, 34 respondents (38%) were Engineers, and 15 respondents (17%) were Architects.

Their years of work experience were: 14 (16%) had 0 to 5 year experience, 25 (28%) had 6 to 10 year experience, and 50 (56%) had more than 10 years of experience. Table 3 shows the respondents' years of experience. These statistics provide justification for the relevance and significance of their responses and reasonable support for the arguments in this research.

Table 3. Respondents' experience in construction project (Years).

Respondents	Years of Experience			Number of Respondents
	0–5 Years	6–10 Years	More Than 10	
Manager	8	9	23	40
Engineer	3	9	22	34
Architect	3	7	5	15
Total	14	25	50	89
% Contribution	16%	28%	56%	100%

4.2. Data Analysis Using Analysis of Variance (ANOVA)

Table 4 illustrates the output of the ANOVA analysis for each value attribute. The table shows that some statistically significant differences do exist between the groups of respondents' responses for some of the PVDs, such as for VFI2, VFU2, VFU13, VFU26, VFU28, VOP1, VOP6, VOP9, VOP11, VEN4, VEN5, VEN12, VMA1, VMA3, and VMA5. It can be seen in the table that the p values for these PVDs are less than 0.05. It was also observed that, for the drivers that were significantly different, the F values were equal to or larger than the F critical value of 3.10.

Table 4. Analysis of variance (ANOVA) analysis for rating the importance of the financial performance value drivers.

PVDs		Sum of Squares	Degree of Freedom (*df*)	Mean Square	*F*-Value	Significance
VFI2	Between Groups	6.348	2	3.174	6.586	0.002
	Within Groups	41.450	86	0.482		
	Total	47.798	88			
VFU2	Between Groups	4.553	2	2.277	4.168	0.019
	Within Groups	46.975	86	0.546		
	Total	51.528	88			
VFU13	Between Groups	4.930	2	2.465	3.611	0.031
	Within Groups	58.710	86	0.683		
	Total	63.640	88			
VFU26	Between Groups	8.563	2	4.281	4.164	0.019
	Within Groups	88.426	86	1.028		
	Total	96.989	88			
VFU28	Between Groups	7.262	2	3.631	3.968	0.022
	Within Groups	78.693	86	0.915		
	Total	85.955	88			
VOP1	Between Groups	4.401	2	2.201	3.913	0.024
	Within Groups	48.363	86	0.562		
	Total	52.764	88			
VOP6	Between Groups	7.889	2	3.944	4.183	0.018
	Within Groups	81.100	86	0.943		
	Total	88.989	88			

Table 4. *Cont.*

PVDs		Sum of Squares	Degree of Freedom (*df*)	Mean Square	*F*-Value	Significance
VOP9	Between Groups	8.901	2	4.450	4.556	0.013
	Within Groups	83.998	86	0.977		
	Total	92.899	88			
VOP11	Between Groups	7.222	2	3.611	4.722	0.011
	Within Groups	65.767	86	0.765		
	Total	72.989	88			
VEN4	Between Groups	5.723	2	2.861	3.356	0.040
	Within Groups	73.333	86	0.853		
	Total	79.056	88			
VEN5	Between Groups	6.222	2	3.111	3.671	0.030
	Within Groups	72.879	86	0.847		
	Total	79.101	88			
VEN12	Between Groups	6.270	2	3.135	3.621	0.031
	Within Groups	74.450	86	0.866		
	Total	80.719	88			
VMA1	Between Groups	3.161	2	1.581	3.679	0.029
	Within Groups	36.951	86	0.430		
	Total	40.112	88			
VMA3	Between Groups	5.510	2	2.755	3.506	0.034
	Within Groups	67.591	86	0.786		
	Total	73.101	88			
VMA5	Between Groups	4.282	2	2.141	3.316	0.041
	Within Groups	55.516	86	0.646		
	Total	59.798	88			

The ANOVA results presented in Table 4 do not show specific means for which groups are different from other ones. Therefore, a follow-up Post Hoc Multiple Comparison Test was performed to provide multiple comparisons. The Tukey test, as the post hoc tests, was used due to uneven sample size in present research. The PVDs with higher *F* values, as illustrated in Appendix A, describe the groups in different subsets with significant difference. For example, the rating for VFI2 is not significantly different between Managers and Architects, but it is found to be significantly different between Engineers and Managers or Architects.

4.3. Factor Analysis and Data Reduction

Based on the factor analysis and data reduction, the most effective PVDs for value creation are 10 financial performance drivers that are distributed into two clusters (OPEX and CAPEX); 18 functional PVDs distributed into two clusters (Longevity, Reliability); nine PVDs for assessing the operational performance distributed into two clusters (Manageability, Energy, and Efficiency); eight environmental PVDs distributed into two clusters (Eco-resources, Adaptability); and, six drivers distributed into two clusters (Control, Planning) for assessing the management performance of a green building.

4.3.1. Financial Performance

Table 5 shows the components that were extracted by principle component analysis (PCA). It can be seen in the table that the components were set according to a series of correlations between different financial PVDs. The first column shows the components and the next three columns are categorised as: initial Eigenvalues, which are related to the Eigenvalue of the correlation matrix and indicate which components can remain in the analysis. Factor analysis was considered for the components with Eigenvalues of more than one, whilst those with Eigenvalues of less than 1 were excluded [59,60].

The next category, Extraction Sum of Squared Loadings, shows the sum of the squared loadings for the un-rotated PVDs, and the last category, Rotation Sums of Squared Loadings, is for the rotated PVDs' solution. The initial Eigenvalues and rotated were used to confirm the variation that was explained by each extracted value creation component.

In this analysis of the importance of the financial PVDs, just six components carry an Eigenvalue of more than 1 and account for nearly 67.6% of the variance, as shown in the Cumulative % column. Consequently, these six components can be considered to be representative of all the 20 financial PVDs included in this study.

Matching Table 5, the PCA shows that six components with a Eigenvalue of more than 1 are selected. Therefore, the following phase is the extraction of a rotated component matrix in order to find out which financial PVDs are having the highest level of influence on project value creation. Table 6 illustrates this level of influence, where the matrix loading scores are presented. The degree of influence of each value attribute for all the financial PVDs can be seen by using varimax rotation, and the PVD with the highest rate of influence can be distinguished. It is suggested that drivers' loadings with an absolute value greater than 0.4 should be interpreted whilst ignoring the + ve or − ve sign, which explains around 16% of the variance in the variable [60,61].

The drivers with the highest scores and correlation values in Table 6 were chosen for each component. For example, the value attribute VFI1 (0.695) has greater influence on component 3 s compared to other components, whereas the driver VFI11 (0.528) has more influence on component 1 in relation to other components, and VFI2 (0.876) has more influence on component 6 in relation to other components. This method is used for all of the drivers and components to extract the most important PVDs for each component.

After applying factor analysis and data reduction to the financial PVDs, the questionnaire's 20 drivers were reduced to six components, which are shown in Table 7. The table shows the percentages of variance of each component, Eigenvalue, loading score, and the value attribute, which are extracted from Tables 5 and 6.

The two new clusters that are presented in Table 8 are formed based on the six extracted components and their most important value drivers. The new clusters are considered to comprise the relevant financial performance design indicators for assessing the value created by green building design. The percentage of variance of each cluster is extracted from Table 7 by calculating the percentage of variance of each component in the generated clusters.

The variance percentage of each attribute is extracted from Table 7, and the percentage of variance of each cluster is calculated by a summation of each component's variance in the same generated cluster (see Table 8). For example, the OPEX cluster in Table 8 is one of two clusters for financial performance design indicators; it is composed of component 1 (variance of 15.92%), presenting VFI11 and VFI15 as the main indicators of its group, and component 6 (variance of 7.303%), presenting VFI2 and VFI5 as the main indicators of its set. Consequently, the percentage of variance for this cluster (OPEX) in Table 8 is calculated by the summation of the percentage of variance of its components. Therefore, the percentage of variance for the OPEX cluster is computed as 15.92% + 7.3% = 23.22%.

The financial performance design indicators are grouped into two clusters, which are highly manageable without losing a lot of data, and just 100% − 67.6% = 32.4% of the existing information is compromised. While using the method of factor analysis and data reduction, the questionnaire's 20 PVDs are reduced to 10 and then grouped into two fundamental clusters. Table 8 presents the final results of factor analysis and data reduction for the financial performance drivers.

Table 5. Total variance explained for financial performance value drivers.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.183	30.913	30.913	6.183	30.913	30.913	3.184	15.920	15.920
2	2.055	10.277	41.190	2.055	10.277	41.190	2.763	13.817	29.737
3	1.759	8.793	49.983	1.759	8.793	49.983	2.294	11.469	41.206
4	1.380	6.900	56.883	1.380	6.900	56.883	1.991	9.955	51.161
5	1.102	5.508	62.391	1.102	5.508	62.391	1.819	9.093	60.255
6	1.033	5.167	67.557	1.033	5.167	67.557	1.461	7.303	67.557
...	...	...	...						
19	0.199	0.994	99.090						
20	0.182	0.910	100.000						

Table 6. Rotated component matrix for the financial performance value drivers.

Financial PVDs	Component					
	1	2	3	4	5	6
VFI1	0.016	0.235	0.695	−0.373	0.056	0.085
VFI2	0.108	0.156	0.145	−0.015	−0.045	0.876
VFI3	0.168	−0.059	0.783	0.276	0.068	0.149
VFI4	−0.072	0.270	0.160	0.145	0.703	−0.007
VFI5	0.026	0.064	0.434	0.340	0.356	0.447
VFI6	0.141	0.297	0.650	0.065	0.001	0.023
VFI7	−0.080	0.580	0.250	0.217	0.320	0.173
VFI8	0.289	0.567	0.443	0.028	0.026	0.133
VFI9	0.201	0.824	0.162	0.071	0.015	0.080
VFI10	0.141	0.766	0.021	0.262	0.070	0.049
VFI11	0.528	0.297	0.165	0.039	−0.122	0.391
VFI12	0.154	0.414	0.263	0.448	0.189	0.070
VFI13	0.043	0.276	0.073	0.831	0.016	−0.181
VFI14	0.237	0.169	−0.020	0.644	0.083	0.332
VFI15	0.452	0.416	−0.090	0.333	0.181	0.153

Table 6. *Cont.*

Financial PVDs	Component					
	1	**2**	**3**	**4**	**5**	**6**
VFI16	0.315	−0.036	−0.047	−0.048	0.818	−0.054
VFI17	0.668	0.104	0.051	0.265	0.421	0.138
VFI18	0.827	0.077	0.194	−0.004	0.003	−0.020
VFI19	0.760	0.169	0.293	0.145	−0.087	−0.090
VFI20	0.773	0.083	−0.127	0.045	0.367	0.230

Table 7. Financial performance components.

Financial Performance Components	Extracted Eigenvalue	Extraction Sum of Squared Loadings: Variance %	Rotation Sum of Squared Loadings: Variance %	PVD Loading Score	Code	Performance Value Drivers
1	6.183	30.913	15.920	0.827	VFI18	Maximise sale price
				0.773	VFI20	Maximise occupancy rate
				0.760	VFI19	Maximise rental price
				0.668	VFI17	Increase Turnover
				0.528	VFI11	Maximise residual value
				0.452	VFI15	Optimise risk-return ratio of alternative options
2	2.055	10.277	13.817	0.824	VFI9	Return on investment
				0.766	VFI10	Create Investment planning and asset allocation
				0.580	VFI7	Consider state of inflation
				0.567	VFI8	Maximise Return on capex
3	1.759	8.793	11.469	0.783	VFI3	Maximise the cost efficiency to build
				0.695	VFI1	Efficiency of capital expenditure (CAPEX)
				0.650	VFI6	Increase economic lifetime
4	1.380	6.900	9.955	0.831	VFI13	Prevent Legal and potential damages costs—provide adequate insurance cover to protect Legal and potential damages costs
				0.644	VFI14	Prevent loss of revenue
				0.448	VFI12	Minimise cost of capital
5	1.102	5.508	9.093	0.818	VFI16	Reduce the fees payable
				0.703	VFI4	Deliver/achieve Cost certainty
6	1.033	5.167	7.303	0.876	VFI2	Efficiency of Operational expenditure (OPEX)
				0.447	VFI5	Improve economic efficiency

Table 8. Factor reduction for the PVDs to assess the financial performance.

	Cluster	Variance %	Component	Code	Performance Value Driver
Financial Performance	OPEX	23.22	1	VFI11	Maximise residual value
				VFI6	Increase economic lifetime
				VFI15	Optimise risk-return ratio of alternative options
			6	VFI2	Efficiency of Operational expenditure (OPEX)
				VFI5	Improve economic efficiency
	CAPEX	44.33	3	VFI3	Maximise the cost efficiency to build
				VFI1	Efficiency of capital expenditure (CAPEX)
			4	VFI12	Minimise cost of capital
			5	VFI4	Deliver/achieve Cost certainty
			2	VFI9	Return on investment

4.3.2. Functional Performance

A similar process was carried out for the functional performance. For this VCD, just seven components carry Eigenvalues of more than 1 and account for nearly 71.2% of the whole variance. Consequently, these seven components can be considered as being representative of the 34 PVDs that were included in this study.

The functional PVDs were grouped into two clusters, which are highly manageable without losing a large amount of data, and therefore just 100% − 71.3% = 28.7% of the existing information is compromised. Using the method of factor analysis and data reduction, the questionnaire's 34 drivers were reduced to seven components, and then grouped into two fundamental clusters, which finally include 18 most significant PVDs. Table 9 presents the final results of factor analysis and data reduction for the functional performance drivers.

4.3.3. Operational Performance

PCA revealed that three components were extracted that carry Eigenvalues of more than 1 and account for 68.661% of the whole variance. The operational performance is categorised into two clusters, which are highly manageable without losing lots of data, and, therefore, just 100%− 68.661% = 31.34% of the existing information is compromised. While using the method of factor analysis and data reduction, the questionnaire's 16 drivers were reduced to three components and then grouped into two pivotal clusters, including nine most significant PVDs. Table 10 presents the final results of factor analysis and data reduction for the operational performance.

4.3.4. Environmental Performance

The data reduction process is looking for variables that correlate highly with a set of other variables. For environmental performance assessment, four components found with an Eigenvalue larger than 1 accounting 74.5% of the whole variance were selected for further analysis. Table 11 shows the two new clusters comprising the relevant environmental performance design indicators for assessing the value that is created by green building design. The percentage of variance of each cluster is calculated by summation of each component's variance in the same generated cluster. The eco-resources cluster has a variance of 37.425% and Adaptability has a variance of 37.05%. The environmental PVDs are categorised into two clusters, which are highly manageable without losing a large amount of data and, consequently, just 100% − 74.475% = 25.525% of the existing information is compromised. The questionnaire's 16 drivers were reduced to four components and then grouped into two fundamental clusters with half of the original PVDs that represent the most relevant data on environmental performance design indicators for value creation using the method of factor analysis and data reduction.

4.3.5. Management Performance

The extracted components in this VCD have a cumulative variance of 66.568% for the first two components, which will be taken into account as being representative of the whole drivers. The Eigenvalue for component 1 is 6.936 and for component 2 it is 1.053 and so these two components were selected for further analysis. Table 12 groups the management PVDs into two clusters, which are highly manageable without losing a large amount of data and, therefore, just 100% − 66.568% = 33.4% of the existing information is compromised. Using the method of factor analysis and data reduction, the questionnaire's 12 PVDs are reduced to six grouped under two pivotal clusters.

Table 9. Factor reduction and clustering for the functional performance.

Value Creation Driver (VCD)	Cluster	Variance %	Component	Code	Performance Value Drivers (PVDs)
Functional Performance	Longevity	36.44	1	VFU26	Provide functional ability of the foundations requirements (strength and stability)
				VFU27	Ensure substructure functional requirements meet a satisfactory level of performance
				VFU28	Ensure superstructure functional requirements meet a satisfactory level of performance
				VFU2	Increase life of services
			4	VFU3	Provide function—fitness for purpose
			6	VFU23	Configure design to enable an efficient construction process
				VFU24	Ensure construction efficiency is considered in specification
	Reliability	34.77	2	VFU19	Maintain Security—health and safety
				VFU21	Meet all statutory requirements and building regulations
				VFU22	Ensure designed elements are standardised
				VFU20	Suitability and maintainability of materials
				VFU15	Provide durable building–last longer
				VFU14	Assure convenience
			7	VFU18	Create reliable building—safer
			5	VFU1	Maintain adaptable building—useful to all
				VFU8	Increase efficiency—add capacity
			3	VFU13	Provide disability access
				VFU16	Maintain durability

Table 10. Factor reduction and clustering for the operational performance.

	Cluster	Variance %	Component	Code	Performance Value Drivers
Operational Performance	Manageability	51.063	1	VOP8	Easy to operate
				VOP6	Easy to maintain
				VOP9	Easy to inspect and maintain
			2	VOP11	Provide building systems that are easy to operate and control
				VOP15	Reduce operational risk
	Energy and efficiency	17.599	3	VOP1	Reduce/minimise/save energy usage
				VOP2	Maintain efficiency in terms of energy
				VOP3	Increase efficiency of utilities
				VOP4	Increase efficiency of heating, cooling and lighting

Table 11. Factor reduction for the environmental performance.

Value Creation Driver (VCD)	Cluster	Variance %	Component	Code	Performance Value Drivers
Environmental Performance	Eco-resources	37.425	1	VEN5	Increase use of natural ventilation
				VEN3	Provide indoor environmental quality
				VEN4	Access to natural light, management of air quality and temperature
				VEN7	Specifying low-maintenance, durable, environmentally preferable materials and equipment
			4	VEN10	Minimise consumption of resources
	Adaptability	37.05	2	VEN8	Maximise resource reuse
			3	VEN12	Respond to site microclimate
				VEN11	Conserve water resources

Table 12. Factor Reduction for the Management Performance: Two Categories.

Value Creation Driver (VCD)	Cluster	Variance %	Component	Code	Performance Value Drivers (PVDs)
Management Performance	Control	36.062	1	VMA10	Able to construct to scope/cost/budget/schedule/quality
				VMA11	Completed to specification
				VMA6	Produce effective plans to achieve the project objectives
	Planning	30.506	2	VMA3	Create strategic planning
				VMA1	Provide effective project management and delivery
				VMA5	Provide cost control to achieve the project objectives

5. Final Selection of the Most Important Value Creation Drivers

5.1. Financial Performance Value Drivers

The analysis showed that the survey respondents thought that the financial performance value drivers that are shown in Figure 3a,b significantly contribute to value creation in green buildings. The mean score of these drivers ranges between 3.92 and 4.16 (2.5 is the mean of the scoring scale). Figure 3 shows that the respondents have very diverse views regarding the importance of the financial drivers. It appears that engineers considered them to be least important, whereas managers were clued up to the significance of optimizing financial parameters. For instance, VFI11, VFI15, and VFI9 (Maximize residual value, Optimize risk-return ratio of alternative options, Return on investment) are ranked as the least important financial drivers. More unexpectedly, value drivers VFI3 and VFI4 (Maximize the cost efficiency to build and deliver/achieve cost certainty) did not receive the highest score. According to the Green Building Council [31], these two factors are necessary for optimizing the upfront cost with a view to decrease the long-term life cycle costs through "green buildings that feature high-performance façades and energy-efficient building systems".

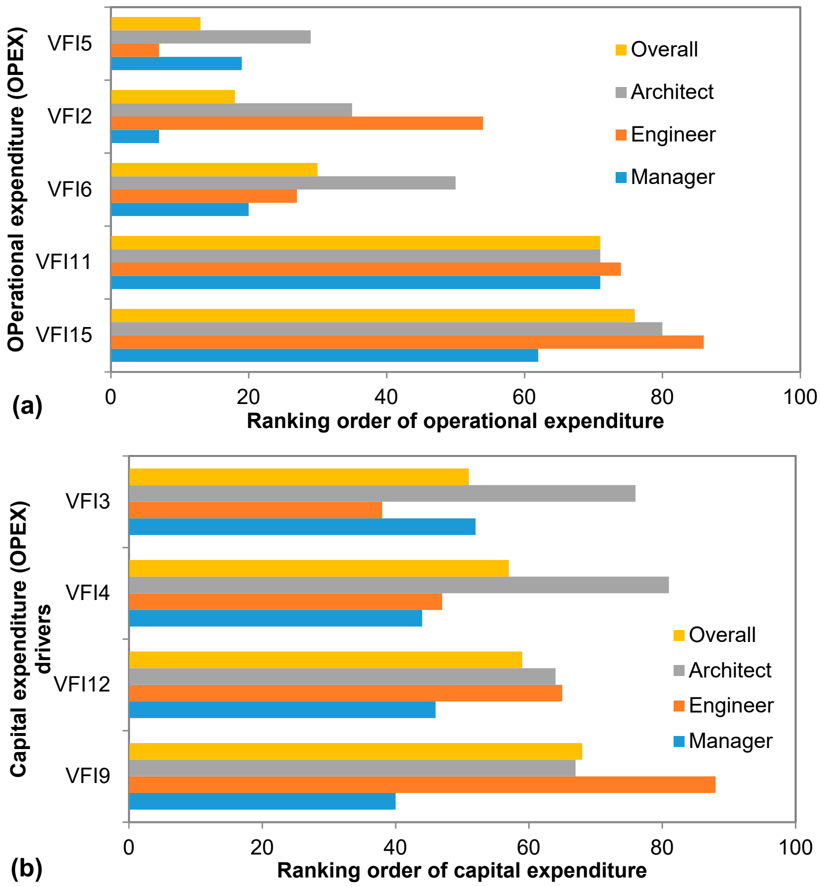

Figure 3. The ranking of the most importance financial performance drivers, (**a**) Operational expenditure (OPEX), (**b**) Capital Expenditure (OPEX). (Drivers are ranked from top to bottom on vertical axis).

Table 13 shows the research question related to the financial drivers cluster and hypothesis test. The ANOVA test shows that there were significant differences between the respondents regarding the VF12 financial performance driver. The possible reasons for these differences can be attributed to the fact that the respondents have different perspectives on how to implement OPEX strategy for value creation purposes. The surprising aspect of the results is that the architects did not highly rank this value driver. This might suggest that they were not aware of the importance of value creation through the optimization of operation costs.

Table 13. Financial drivers and hypothesis test.

Research Question	Financial Performance
Hypothesis	H_0: $p > 0.05$; H_1: $p < 0.05$
Results	The ANOVA results indicated that: There were significant differences between the survey participants regarding value drivers: VFI2: Efficiency of operational expenditure (OPEX)
Comments	Reducing operational expenditure is essential for reducing maintenance, water, energy, etc., expenses. The importance of each financial value driver is assessed according to professional bias. The results here might be influenced by that fact that Kingdome of Saudi Arabia (KSA) respondents are not familiar with the private sector expectation of a better return from the investment in green buildings. The author believes that "achieving the optimum balance between capital costs, a building's operating and maintenance costs and residual whole-life value" (NAO) is necessary for value creation.
Conclusion	The null hypothesis was rejected for VFI2: Efficiency of operational expenditure. The null hypothesis (H_0: $p > 0.05$) was retained for the other financial value drivers.

5.2. Functional Performance Value Drivers

Building functionality is considered as "functionality—the arrangement, quality and interrelationship of spaces and how the building is designed to be useful to all" [24]. One paradigm behind the design of green buildings is the focus on selecting material and design solutions based on durability/reliability and longevity performance criteria. The idea behind this design paradigm is that reliability and longevity increase the life service span of the building's systems, which results in fewer maintenance cycles and cleaning requirements, leading to financial value benefits. Figure 4a,b indicate that engineers did not highly rate drivers VFU27 and VFU28 (ensure substructure functional requirements meet a satisfactory level of performance and ensure superstructure functional requirements meet a satisfactory level of performance). This is a surprising result, because the maintenance of substructure and superstructure is normally costly and it leads to disruption of the building operation, which results in further additional revenue losses.

Reliability in this study concerns the potential of a green building to be reliable for users while also providing comfort. VFU1 "Maintain adaptable building—useful to all" is considered a key driver for delivering value to the businesses of the green building's occupants, as articulated by the NAO [24]: the "building [needs to] be easily adaptable to meet the future needs of users including expansion and change of use". This study's results show that there is an unspoken agreement between the respondents on the effectiveness of VFU22 (ensure designed elements are standardized) in value creation. Engineers and managers also agree on the usefulness of VFU20 (suitability and maintainability of materials) in the value engineering analysis. However, the architects perceived that this driver is not very useful.

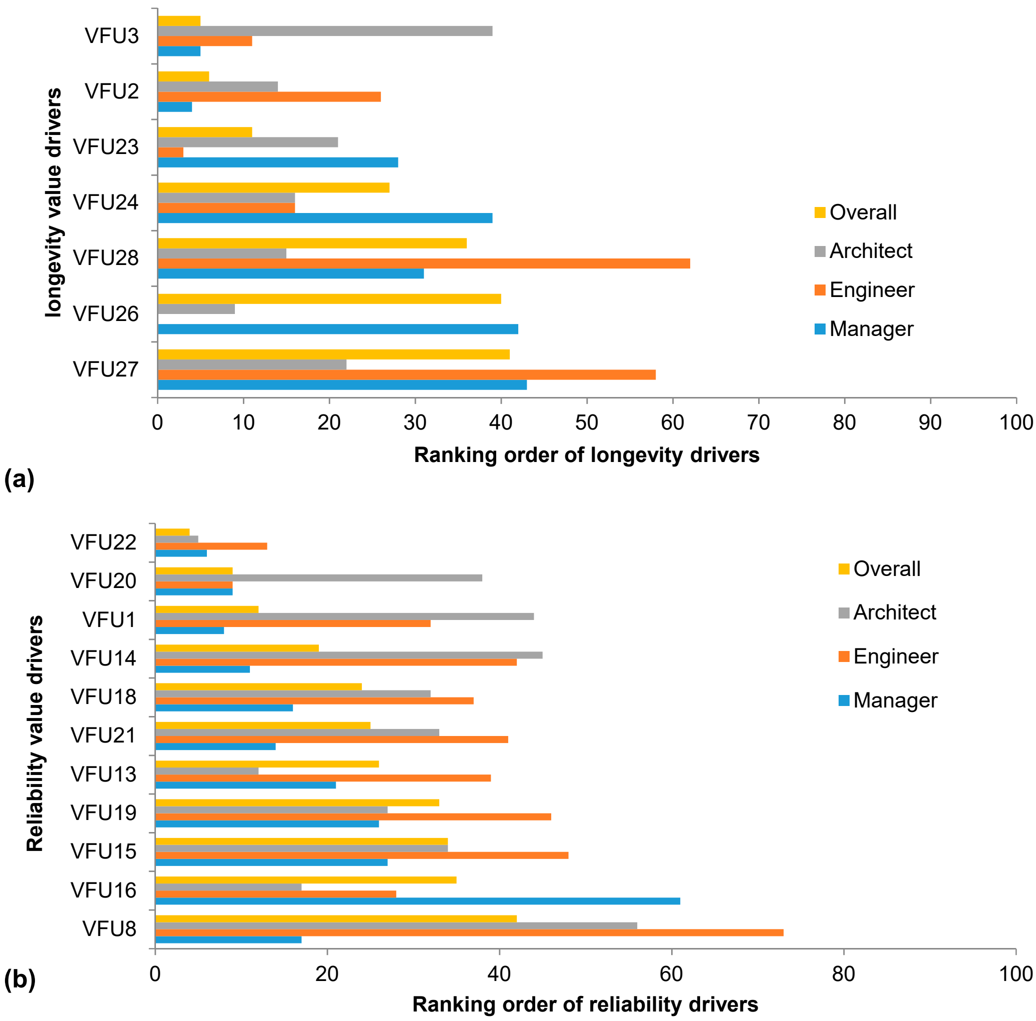

Figure 4. The ranking of the most functional performance value drivers, (**a**) longevity, (**b**) reliability. (Drivers are ranked from top to bottom on vertical axis).

The results also demonstrated that managers alleged that VFU16 (Maintain durability) might not be useful in creating value. Engineers did not rank the VFU18 "Create reliable building—safer" value driver highly. More surprisingly, engineers and architects both thought VFU1 "Maintain adaptable building—useful to all" is not a very beneficial value driver as compared to others. The respondents' views of these drivers are not in keeping with existing literature, most of which point to the fact that this value driver should be an essential part of green building design. A plausible explanation for this is that Kingdome of Saudi Arabia (KSA) professionals may not be aware of recent studies that demonstrate the tangible and intangible benefits of green buildings.

Table 14 shows the research question regarding the functional drivers cluster and hypothesis test. The ANOVA test shows that there were significant differences between the respondents regarding several functional PVDs.

Table 14. Functional drivers and hypothesis test.

Research Question	Functional Performance
Hypothesis	H_0: $p > 0.05$; H_1: $p < 0.05$
Results	The ANOVA results indicated that: There were significant differences between the survey participants regarding value drivers: VFU2: Increase life of services VFU13: Provide disability access VFU26: Provide functional ability of the foundations requirements (strength and stability) VFU27: Ensure substructure functional requirements meet a satisfactory level of performance VFU28: Ensure superstructure functional requirements meet a satisfactory level of performance
Researcher's observation	It is understandable that respondents disagreed on structural functionality as a value-generating driver. However, there is unspoken agreement in the literature that increasing the life of services is an essential value-generating driver.
Conclusion	The null hypothesis was rejected for VFU2, VFU13, VFU26, VFU27, and VFU28 value drivers. The null hypothesis (H_0: $p > 0.05$) was retained for other functional performance value drivers.

5.3. Operational Performance Value Drivers

Operation performance value drivers are associated with issues concerned with managing, maintaining, operating, and cleaning the green facility once it is in operation. The present study clustered the operation performance value creation drivers into "Manageability" and "Energy and efficiency" drivers. According to the NAO [24], the manageability drivers have a significant impact on value creation. It is well known that there is a huge cost burden that is associated with acquiring, operating, maintaining, and disposing of a building and its complements. Thus, specifying building functions and building systems that are "Easy to maintain" (VOP6) is considered to be a vital value creator. In this survey, the architects recognized the importance of this driver, but the managers seemed to be unaware of its significance. Although Chiras [51] emphasises the importance of making buildings easy to operate, service, and maintain, the engineers in this survey perceived VOP11 "Provide building systems that are easy to operate and control" to be less important that other values in the cluster. VOP8 "Easy to operate" is considered by [24] and [51] to be a significant value generator. For example, the NAO state that "day to day, the building should be easy to clean, maintain and operate due to its finishes, layout, and structure and engineering systems".

As shown in Figure 5a,b, both architects and engineers recognized the importance of this value driver. Although, Chiras [51] pointed to the importance of "VOP11" (Provide building systems that are easy to operate and control", the engineers in the survey perceived that this value driver is less important. However, there does appear to be a general agreement between the respondents that VOP15 "Reduce operational risk" is an important value driver. In the energy and efficacy value drivers cluster the respondents were in agreement regarding the effectiveness of VOP1 "Reduce/minimize/save energy usage" and VOP2 "Maintain efficiency in terms of energy" value generators. This result denotes that these two drivers are important. This finding is supported by current literature. The importance degree scores for VOP3 "Increase efficiency of utilities" and VOP4 "Increase efficiency of heating, cooling and lighting" value drivers range between 3.97 and 4.40, with architects viewing these two drivers as being less significant in value generation.

Table 15 shows the research question about operational drivers cluster and hypothesis test. The ANOVA test shows that there were significant differences between the respondents regarding several operational performance drivers.

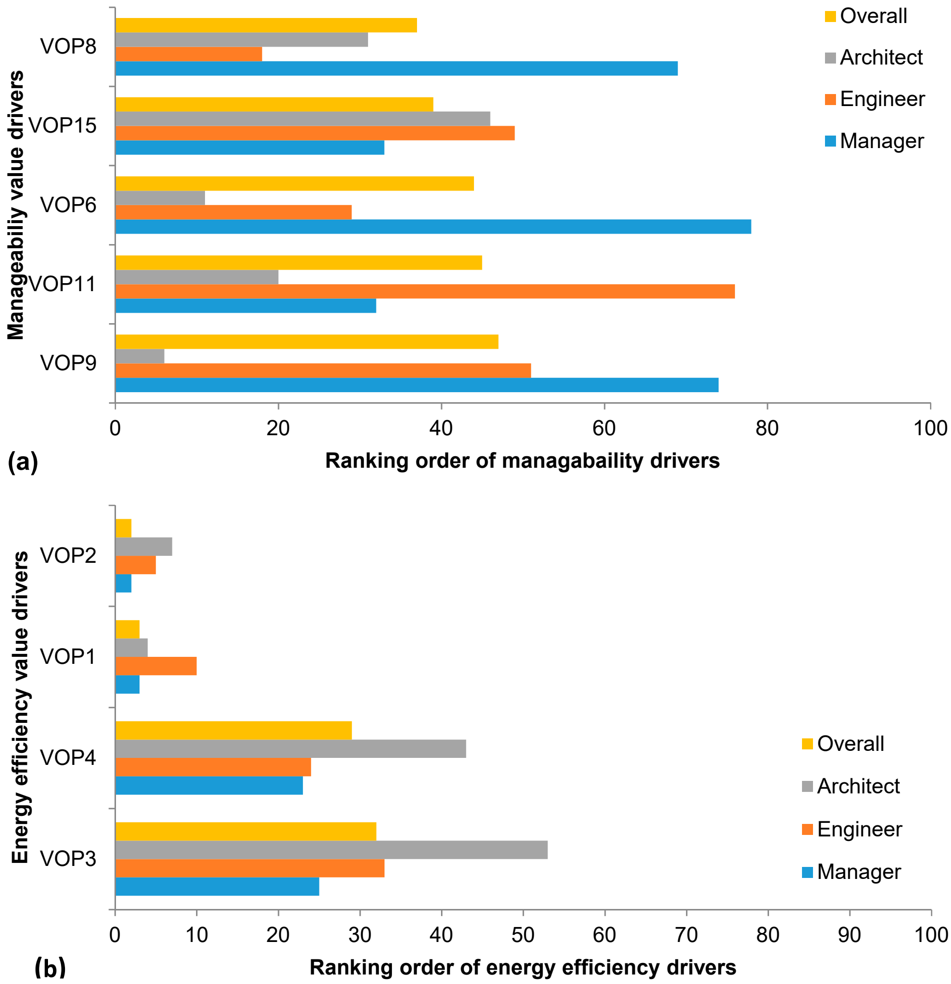

Figure 5. The ranking for the most important operational performance value drivers, (**a**) manageability, (**b**) energy efficiency. (Drivers are ranked from top to bottom on vertical axis).

Table 15. Operational drivers and hypothesis test.

Research Question	Operational Performance
Hypothesis	H_0: $p > 0.05$; H_1: $p < 0.05$
Results	The (ANOVA) results indicated that: There were significant differences between the survey participants regarding value drivers: VOP1: Reduce/minimise/save energy usage VOP6: Easy to maintain VOP9: Easy to inspect and maintain VOP11: Provide building systems that are easy to operate and control
Researcher's observation	Occupants of any building facility would like the opportunity to reduce operating costs, energy use, and environmental impacts. Building assets which incorporate sustainable operation strategies can create value such as increased rental rates and asset value, reduced risk of depreciation, and higher tenant attraction and retention rates.
Conclusion	The null hypothesis was rejected for VOP1, VOP6, VOP9 and VOP11 value drivers. The null hypothesis (H_0: $p > 0.05$) was retained for other operational performance value drivers

5.4. Environmental Performance Value Drivers

The tangible and intangible environmental values that were provided by green buildings have been widely reported. These include waste reduction, and economic and social benefits. These benefits are now well established and the next quest revolves around "how green buildings deliver on economic priorities, such as return on investment and risk mitigation, and on social priorities, such as employee productivity and health" [31]. The NAO [24] stressed that buildings must include the principles of environmental sustainability in their design and operation, and use renewable materials. The environmental performance value drivers in this study were grouped into 'Eco-resources" and "Adaptability". The findings showed that VEN3 "Provide indoor environmental quality" is considered to be less important by architects than by engineers and managers. This is somehow unexpected, as architects are normally responsible for specifying the indoor environmental parameters for interior and exterior design of the buildings. Existing literature indicates that VEN4 "Access to natural light, management of air quality and temperature" and VEN5 "Increase use of natural ventilation" drivers are necessary for a health working environment and increasing productivity. Loftness [61] points out that "improved temperature control, air quality, lighting control, and access to the natural environment will result in measurable productivity, health [benefits] … ".

In particular, architects emphasized natural ventilation as a key driver for value generation. The importance of VEN7 "Specifying low-maintenance, durable, environmentally preferable materials and equipment" and VEN10 "Minimize consumption of resources" is owing to the fact that low-maintenance building material and components result in longer service life, which results in economic (lower cost of maintenance) and environmental (lower waste and emissions from material disposal) benefits. Figure 6a,b indicate that architects and managers are not entirely convinced that the inclusion of VEN10 value engineering analysis aids the quest for value creation in green buildings.

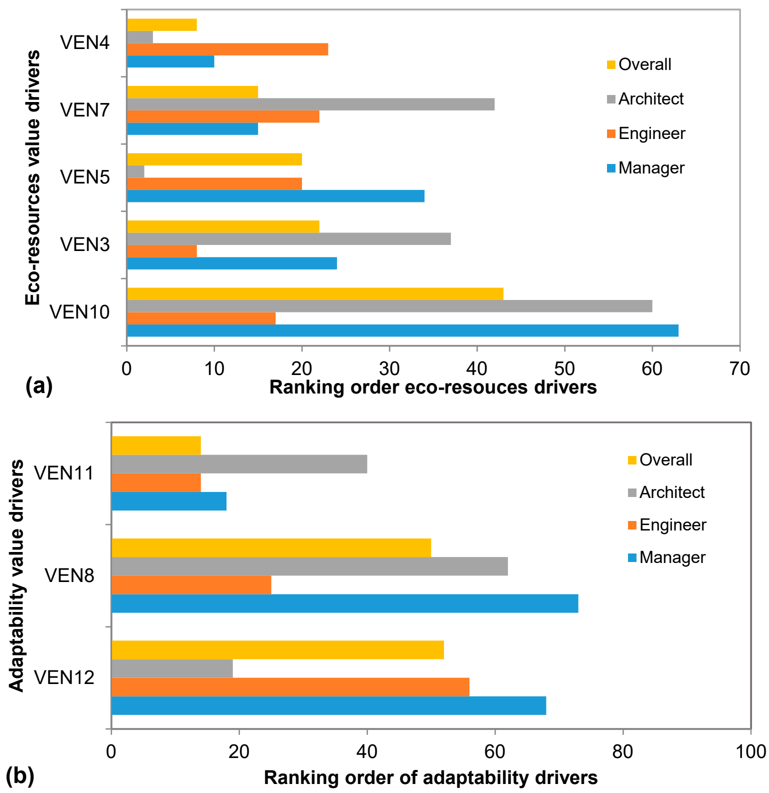

Figure 6. The ranking for the most important environmental performance value drivers, (**a**) Eco-resources, (**b**) Adaptability. (Drivers are ranked from top to bottom on vertical axis).

The reusability/adaptability value drivers aim to promote value creation through adaptation to local conditions and the reuse of resources to minimize waste and optimise cost. The VEN11 "Conserve water resources" value driver is seen as important, but it is only ranked 14th, whereas it would be expected to be ranked among top ten value drivers in the KSA environment where water comes mainly from desalination. Figure 6b shows that engineers rate VEN12 "Respond to site microclimate" more highly than the architects do, although architects would be expected to highly rank this value driver. The figure also suggests that engineers and managers were not very concerned about the issue of VEN8 "Maximize resource reuse". Evidence from existing literature suggests that these three value drivers are of importance in value creation [62,63].

Table 16 shows the research question regarding the environmental drivers cluster and hypothesis test. The ANOVA test shows that there were significant differences between the respondents regarding several environmental performance drivers.

Table 16. Environmental drivers and hypothesis test.

Research Question	Environmental Performance
Hypothesis	H_0: $p > 0.05$; H_1: $p < 0.05$
Results	The (ANOVA) results indicated that: There were significant differences between the survey participants regarding value drivers: VEN4: Access to natural light, management of air quality and temperature VEN5: Increase use of natural ventilation VEN12: Respond to site microclimate
Researcher's observation	Water, energy and atmosphere, materials and resources, indoor environmental quality, outdoor environment on site, etc., are core drivers in assessment tools like BREAM and LEED. Reduction of environmental impact ensures occupant satisfaction, drives better business outcomes, and maximises asset value (O'Mara, 2012).
Conclusion	The null hypothesis was rejected for VEN4, VEN5 and VEN12 value drivers. The null hypothesis (H_0: $p > 0.05$) was retained for other operational performance value drivers.

5.5. Management Performance Value Drivers

The drivers considered in this section are related to the management processes used, and the selection of an integrated team working throughout the development of the green building supply chain. There are opportunities to maximize the value and minimize the waste at every stage of the construction and procurement process, from the minute that the need for a building is identified to when it is ready for use [24]. Effective management of the development and operation processes of green buildings is crucial in value creation. This entails close collaboration and communication between all the stakeholders, and requires appropriate objectives (relating to costs, emissions reduction, etc.) to be developed right at the beginning of the development process and monitored throughout the service life of the green building.

Figure 7 shows the order of ranking of the most important management performance value drivers in this study. All of the management value drivers are ranked below 50. It appears that engineers and managers highly ranked VMA11 "Completed to specification", whilst the managers did not rank VMA5 "Provide cost control to achieve the project objectives", VMA6 "Produce effective plans to achieve the project objectives", and VMA10 "Able to construct to scope/cost/budget/schedule/quality" as highly as engineers and architects did.

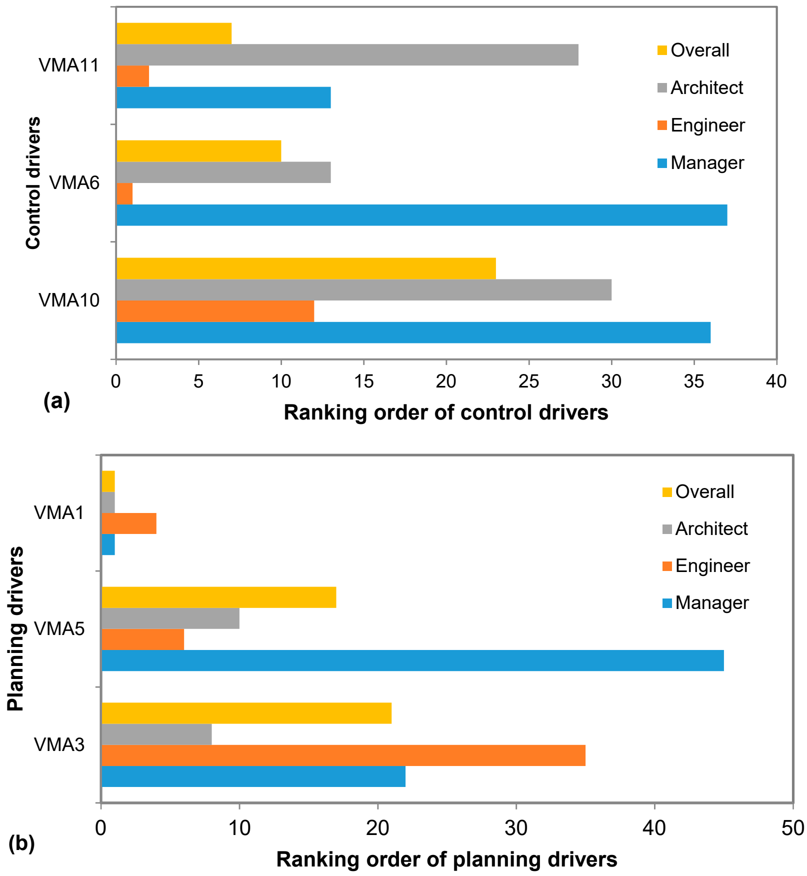

Figure 7. The ranking of the most important management performance value drivers, (**a**) Control drivers, (**b**) Planning drivers. (Drivers are ranked from top to bottom on vertical axis).

Table 17 shows the research question about the management drivers, clusters, and hypothesis test. The ANOVA test shows that there were significant differences between the respondents regarding several management performance drivers.

Table 17. Management drivers and hypothesis test.

Research Question	Management Performance
Hypothesis	H_0: $p > 0.05$; H_1: $p < 0.05$
Results	The (ANOVA) results indicated that: There were significant differences between the survey participants regarding value drivers: VMA1: Provide effective project management and delivery VMA3: Create strategic planning VMA5: Provide cost control to achieve the project objectives
Researcher's observation	Effective management by an integrated project team is essential to achieving this value. Effective value planning through the development of a project execution plan and the organisation of the project team is required to create added value to the project.
Conclusion	The null hypothesis were rejected for VMA1, VMA3 and VMA5 value drivers. The null hypothesis (H_0: $p > 0.05$) was retained for other management performance value drivers

The methodology that was developed in present study can facilitate the managers, engineers, planners, and architects to assess the value added during design of green buildings. Although the methodology has been applied to the scenarios of green buildings in Saudi Arabia, it can be used for other regions around the world. However, the outcomes in terms of ranking of the drivers might be different depending on the identified PVDs and VCDs, number and experience of respondents, and geographical location of the study area.

6. Conclusions and Recommendations

This research aimed to assess the sustainability of green buildings in Saudi Arabia. Green buildings may contain higher levels of complexities in their designs and operations in comparison to the conventional buildings. Hence, investments need to be evaluated with the involvement of multiple stakeholders, such as consultants, contractors, general public, governmental institutions, etc. With such diverse decision-makers, selecting suitable value creation drivers is a difficult task. In addition, their varying perceptions and experiences also impact the selection process of the drivers.

The decision-making framework proposed in present research provides a systematic approach for identifying, selecting, and ranking a set of the most important value creation drivers (VCDs) for green buildings. Five top-level VCDs covers the financial, functional, operational, environmental, and management aspects of the green buildings. Ninety-eight (98) performance value drivers (PVDs) that were identified through literature were evaluated through questionnaire surveys and subsequent statistical analysis. The response rate of 29.7% was achieved from 89 respondents out of 300 professionals working in the construction industry of Saudi Arabia. Further, 50% of these respondents have more than 10 years of relevant experience.

Each VCD was further sub-divided into two clusters (i.e., total 10 clusters for 5 VCDs) for the effective use of 51 most important PVDs. The proposed methodology provides a basis for improving the performance efficiency and value from investment for green buildings in Saudi Arabia, Arab Gulf countries, and elsewhere.

Further work needs to be carried out to refine the extracted value drivers for different types of the buildings for developing a more robust tool to assess value addition in green buildings. Moreover, future work should verify the correlation between risk factors and the value creation drivers.

Author Contributions: W.A. developed the methodology, developed questionnaire survey, performed detailed data collection and analysis, and was involved in paper writing. H.H. and H.B. were involved in the development of methodology, and paper writing.

Funding: The research was sponsored by Qassim University, Ministry of Education, Saudi Arabia.

Acknowledgments: The author gratefully acknowledges respondents from the construction industry in Saudi Arabia. The first author acknowledges the financial support secured at Qassim University which was provided by the Saudi Cultural Bureau in United Kingdom under the Higher Education Scholarship Program of Saudi Arabia. Authors also like to thank the School of Engineering, Faculty of Science and Engineering, University of Liverpool, UK for providing the technical support for this research.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

VFI2

Job	N	Subset for alpha = 0.05	
		1	2
Engineer	34	3.82	
Manager	40		4.33
Architect	15		4.47
Sig.		1.000	.753

VFU2

Job	N	Subset for alpha = 0.05	
		1	2
Engineer	34	4.00	
Manager	40	4.38	4.38
Architect	15		4.60
Sig.		.180	.534

VFU13

Job	N	Subset for alpha = 0.05	
		1	2
Engineer	34	3.91	
Manager	40	4.13	4.13
Architect	15		4.60
Sig.		.637	.113

VFU26

Job	N	Subset for alpha = 0.05	
		1	2
Engineer	34	3.76	
Manager	40	3.98	
Architect	15		4.67
Sig.		.746	1.000

VFU28

Job	N	Subset for alpha = 0.05	
		1	2
Engineer	34	3.76	
Manager	40	4.03	4.03
Architect	15		4.60
Sig.		.605	.093

VOP1

Job	N	Subset for alpha = 0.05	
		1	2
Engineer	34	4.12	
Manager	40	4.45	4.45
Architect	15		4.73
Sig.		.269	.383

VOP6

Job	N	Subset for alpha = 0.05	
		1	2
Manager	40	3.75	
Engineer	34	4.00	4.00
Architect	15		4.60
Sig.		.638	.081

VOP9

Job	N	Subset for alpha = 0.05	
		1	2
Manager	40	3.80	
Engineer	34	3.85	
Architect	15		4.67
Sig.		.981	1.000

VOP11

Job	N	Subset for alpha = 0.05	
		1	2
Engineer	34	3.71	
Manager	40	4.03	4.03
Architect	15		4.53
Sig.		.408	.107

VEN12

Job	N	Subset for alpha = 0.05	
		1	2
Engineer	34	3.82	
Manager	40	3.83	
Architect	15		4.53
Sig.		1.000	1.000

VMA1

Job	N	Subset for alpha = 0.05	
		1	2
Engineer	34	4.24	
Manager	40	4.55	4.55
Architect	15		4.73
Sig.		.215	.589

VMA3

Job	N	Subset for alpha = 0.05	
		1	2
Engineer	34	3.94	
Manager	40	4.13	4.13
Architect	15		4.67
Sig.		.747	.086

VMA5

Job	N	Subset for alpha = 0.05	
		1	2
Manager	40	3.98	
Engineer	34	4.18	4.18
Architect	15		4.60
Sig.		.653	.158

Figure A1. Historical Post Hoc test for rating the importance of the value attributes.

References

1. Lee, J.; Kim, J. BIM-Based 4D Simulation to Improve Module Manufacturing Productivity for Sustainable Building Projects. *Sustainability* **2017**, *9*, 426. [CrossRef]
2. Connaughton, J.N.; Green, S.D. *Value Management in Construction: A Client's Guide*; CIRIA: London, UK, 1996.
3. Langford, D. Revaluing Construction—Hard and Soft Values. In *CIB Priority Theme—Revaluing Construction: A W065 'Organisation and Management of Construction' Perspective*; Sexton, M., Kaehkoenen, K., Lu, S., Eds.; Rotterdam (Netherlands) in-House Publishing: Rotterdam, The Netherlands, 2007; pp. 66–75.
4. Boussabaine, A. *Cost Planning of PFI and PPP Building Projects*; Taylor & Francis: Abingdon, UK, 2007; p. 38.
5. Zhao, R.-J.; Moh, W.H. Value Management Practices on Major Construction Projects and Green Building. *Front. Eng. Manag.* **2016**, *3*, 147–157. [CrossRef]

6. Kaczmarek, J. The Mechanisms of Creating Value vs. Financial Security of Going Concern—Sustainable Management. *Sustainability* **2019**, *11*, 2278. [CrossRef]
7. Birkenfeld, B.; Brown, P.; Kresse, N.; Sullivan, J.; Thiam, P. *Quantifying the Hidden Benefits of High-Performance Building, International Society of Sustainability Professionals*; TAMU Mays Business School Cooperative Study: Texas, TX, USA, 2011.
8. Lützkendorf, T.; Lorenz, D. Integrating sustainability into property risk assessments for market transformation. *Build. Res. Inf.* **2007**, *35*, 644–661. [CrossRef]
9. Janani, R.; Chakravarthy, P.K.; Raj, D.R.R. A Study on Value Engineering & Green Building in Residential Construction. *Int. J. Civ. Eng. Technol.* **2018**, *9*, 900–907.
10. Wao, J.O. Improving Creativity in the Value Engineering Process for Green Building Construction. In Proceedings of the Construction Research Congress, New Orleans, LA, USA, 2–4 April 2018; pp. 780–790.
11. Rachwan, R.; Abotaleb, I.; Elgazouli, M. The Influence of Value Engineering and Sustainability Considerations on the Project Value. *Proced. Environ. Sci.* **2016**, *34*, 431–438. [CrossRef]
12. Vijayan, R.; Geetha, T.T.; Nishanth, B.; Tamilarasan, M.; Kumar, V.V. Value engineering and value analysis of rear air spring bracket. *Mater. Today Proc.* **2019**, *16*, 1075–1082. [CrossRef]
13. Tao, J.; Yu, S. Product Life Cycle Design for Sustainable Value Creation: Methods of Sustainable Product Development in the Context of High Value Engineering. *Proced. CIRP* **2018**, *69*, 25–30. [CrossRef]
14. Kelly, J.; Duerk, D. Construction Project Briefing/Architectural Programming. In *Best Value in Construction*; Blackwell: Oxford, UK, 2002.
15. Arena, M. Chapter 4—Value Drivers. In *Performance Measurement and Management for Engineers*; Arnaboldi, M., Azzone, G., Giorgino, M., Eds.; Academic Press: San Diego, CA, USA, 2014; pp. 51–68.
16. Saxon, R. *Be Valuable: A Guide to Creating Value in the Built Environment*; Constructing Excellence: London, UK, 2005.
17. Gann, D.; Salter, A.; Whyte, J. Design Quality Indicator as a tool for thinking. *Build. Res. Inf.* **2003**, *31*, 318–333. [CrossRef]
18. Kelly, J. Making client values explicit in value management workshops. *Constr. Manag. Econ.* **2007**, *25*, 435–442. [CrossRef]
19. NASA. *Report on Sustainable Design, Design for Maintainability and Total Building Commissioning: For National Aeronautics and Space Administration Facilities Engineering Division (NASA), 7 March 2001*. Available online: http://www.wbdg.org/pdfs/nasacommissioning.pdf#search=\T1\textquoteleftbuilding%20maintainability (accessed on 29 August 2013).
20. Chappell, T.W.; Corps, C. High Performance Green Building: What's It Worth? Investigating the Market Value of High Performance Green Buildings. 2009. Available online: https://living-future.org/sites/default/files/HighPerfGB_ValuationStudy.pdf (accessed on 18 August 2015).
21. City Development. *Creating Value for the Future*; Sustainability Report 2015; City DevelopmentS Limited: Singapore, 2015.
22. Al-Yousefi, A. *Application of Value Engineering in Saudi Arabia and Arabian Gulf Countries*; PowerPoint slides; Ministry of Water and Electricity: Riyadh, Saudi Arabi, 2010.
23. Thiry, M. *A Framework For Value Management Practice*; Project Management Institute: Sylva, NC, USA, 1997.
24. NAO. *Getting Value for Money from Construction Projects through Design: How Auditors Can Help, Guidelines to Help Auditors Take Account of Good Design in Public Sector Built Environment Projects*; National Audit Office, Davis Langdon & Everest, Stairway Communications Ltd.: London, UK, 2004.
25. Dell'Isola, M.D. *Value Analysis Excerpt from The Architect's, Handbook of Professional Practice*; American Institute of Architects; John Wiley & Sons, Inc.: Hoboken, NJ, USA, 2003.
26. Kelly, J.; Male, S.; Graham, D. *Value Management of Construction Projects*; Blackwell Science Ltd.: Oxford, UK, 2004.
27. Kelly, J.; Morledge, R.; Wilkinson, S.; Then, D.S. Post-occupancy Evaluation. In *Best Value in Construction*; Blackwell: Oxford, UK, 2002.
28. ICE. *Design and Practice Guide, Creating Value in Engineering*; Thomas Telford: London, UK, 1996.
29. Building Radar. Life Cycle Costs—Construction Data, Construction Industry Market Research, Construction Projects. 2017. Available online: https://buildingradar.com/construction-blog/life-cycle-costs/ (accessed on 10 October 2019).
30. Davies, R. *Green Value Report: Green Building, Growing Assets*; Royal Institution of Chartered Surveyors: London, UK, 2005.

31. Green Building Council. *The Business Case For Green Building: A Review of the Costs and Benefits for Developers, Investors and Occupants*. 2013. Available online: http://www.worldgbc.org/files/1513/6608/0674/Business_Case_For_Green_Building_Report_WEB_2013-04-11.pdf (accessed on 20 August 2015).
32. Kelly, J.; Morledge, R.; Wilkinson, S.; Greenwood, M. The Management of a Project. In *Best Value in Construction*; Blackwell: Oxford, UK, 2002.
33. Austin, G.W. Sustainability and Income-Producing Property Valuation: North American Status and Recommended Procedures (2012). *J. Sustain. Real Estate* **2012**, *4*, 78–122.
34. Kelly, J.; Male, S. Value Management. In *Best Value in Construction*; Blackwell: Oxford, UK, 2002.
35. Pasquire, C.; Swaffield, L. Life-cycle/Whole-life Costing. In *Best Value in Construction*; Blackwell: Oxford, UK, 2002.
36. Bowyer, J. *Life Cycle Cost Analysis of Non-Residential Buildings*; Dovetail Partners, Inc.: Minneapolis, MN, USA, 2013.
37. Smith, N. Risk Management. In *Best Value in Construction*; Blackwell: Oxford, UK, 2002.
38. Ostime, N. *RIBA Job Book*, 9th ed.; RIBA Publishing: London, UK, 2013.
39. Muldavin, S.R. *Value beyond Cost Savings: How to Underwrite Sustainable Properties*; Green Building FC: Michigan, MI, USA, 2010.
40. PBS-PQ250. *Value Engineering Program Guide for Design and Construction—Volume 1*; Internal Operations and Management; U.S. General Services Administration, Public Buildings Service: Washington, DC, USA, 1992.
41. Kats, G. *Green Buildings Costs and Financial Benefits*; Massachusetts Technology Collaborative: Boston, MA, USA, 2003.
42. Goldberger, N. *Green Commercial Real Estate: Corporate Social Responsibility*; ISIS, Sauder School of Business, The University of British Columbia, UBC: Vancouver, BC, Canada, 2010.
43. Alyami, S.H.; Rezgui, Y.; Kwan, A. Developing sustainable building assessment scheme for Saudi Arabia: Delphi consultation approach. *Renew. Sustain. Energy Rev.* **2013**, *27*, 43–54. [CrossRef]
44. BEMU. *Design Quality for Building*; Home Office, Design Policy and Accommodation Procurement Team, Buildings and Estate Management Unit: London, UK, 2005.
45. Pulaski, M.H. *Field Guide for Sustainable Construction*; The Partnership for Achieving Construction Excellence; The Pennsylvania State University: Pennsylvania, PA, USA, 2004.
46. Dryer, K. *IGCC Series: Longevity and Adaptability in Green Building, Green Building Law Update, Environmental Law and Sustainability for Business*; Codes and Regulations: Louisville, MD, USA, 2011.
47. Yates, A.; Kapoor, P.; Rao, S. *Green Buildings Revisited: Small Projects*; IP 13/00; BRE: Riyadh, Saudi Arabia, 2000.
48. Slaughter, E.S. Design strategies to increase building flexibility. *Build. Res. Inf.* **2001**, *29*, 208–217. [CrossRef]
49. Kibert, C.J.; Sendzimir, J.; Guy, B. Construction ecology and metabolism: Natural system analogues for a sustainable built environment. *Constr. Manag. Econ.* **2000**, *18*, 903–916. [CrossRef]
50. Markeset, T.; Kumar, U. Integration of RAMS and risk analysis in product design and development work processes: A case study. *J. Q. Maint. Eng.* **2003**, *9*, 393–410. [CrossRef]
51. Chiras, D. *The New Ecological Home: A Complete Guide to Green Building Options*, 1st ed.; Chelsea Green Publishing: Hartford, VT, USA, 2004.
52. IGBC. *Building Environmental Assessment Method for Ireland IGBC: Exploratory Study*; Irish Green Building Council. UCD Energy Research Group; University College Dublin: Dublin, Ireland, 2012.
53. Inbuilt. *BREEAM versus LEED. Enterprise House*. 2010. Available online: https://educnet.enpc.fr/pluginfile.php/15200/mod_resource/content/0/breeamvsleed.pdf (accessed on 14 June 2015).
54. Sleeuw, M. *A Comparison of BREEAM and LEED Environmental Assessment Methods*; A Report to the University of East Anglia Estates and Buildings Division; University of East Anglia Estates and Buildings Division: Norwich, UK, 2011.
55. NOAA. *Introduction to Survey: Design & Delivery*; Social Science Tools for Costal Programs; The National Oceanic and Atmospheric Administration's Costal Service Centre: Charleston, SC, USA, 2007.
56. Al-Yousefi, A. *Total Value Management, Presentation*; PowerPoint Slides; Alyousefi Value Engineering: Dubai, Saudi Arabia, 2011.
57. Trentelman, C.K.; Petersen, K.A.; Irwin, J.; Ruiz, N.; Szalay, C.S. The case for personal interaction: Drop-off/pick-up methodology for survey research. *J. Rural Soc. Sci.* **2016**, *31*, 68.
58. Akintoye, A. Analysis of factors influencing project cost estimating practice. *Constr. Manag. Econ.* **2000**, *18*, 77–89. [CrossRef]
59. Field, A. *Discovering Statistics Using SPSS*, 2nd ed.; SAGE Publications: Thousand Oaks, CA, USA, 2005.

60. Punch, K.F. *Introduction to Social Research: Quantitative & Qualitative Approaches*, 2nd ed.; SAGE Publications: Thousand Oaks, CA, USA, 2005.
61. Morgan, G.A.; Leech, N.L.; Gloeckner, G.W.; Barret, K.C. *SPSS for introductory statistics: Use and Interpretation*, 2nd ed.; Lawrence Erlbaum Associate Publishers: Mahwah, NJ, USA, 2004.
62. Loftness, V. *Linking Energy to Health and Productivity in the Built Environment*. 2003. Available online: http://www.usgbc.org/Docs/Archive/MediaArchive/207_Loftness_PA876.pdf (accessed on 25 July 2015).
63. Jensen, T. *Drivers of Environmental Performance Among Green Buildings*; ISIS Research Centre: Winnipeg, MB, Canada, 2017.