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STRATEGIES ADOPTED BY DESIGN AND BUILD CONTRACTORS TO ENHANCE THE IMPLEMENTATION OF SUSTAINABLE CONSTRUCTION PRACTICES

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ABSTRACT

Despite of design and build (D&B) procurement being a feasible solution, the status of the implementation of sustainable construction practices (SCP) in the Sri Lankan construction industry is below the trend. Since unwillingness and unawareness of the D&B contractors have identified as a cause for the issue, strategies to overcome the problem are required. Accordingly, an extensive literature review was conducted to identify the SCP, and D&B concepts to provide a basis for a reliable set of strategies. Subsequently, the survey strategy under the qualitative research approach was accompanied to derive strategies. Accordingly, collected data from nine expert interviews from the purposively selected clients, contractors, consultants, and subcontractors have been analysed using deductive thematic analysis under eight main pre-defined themes. Appointment of a sustainability manager, market survey to recognise the status of sustainability, concern on passive construction technologies and identification of sustainable design requirements have identified as key strategies. Finally, this can be used by D&B contractors to identify the loopholes and enhance sustainable development.

Keywords: *Design and Build (D&B); Strategies; Sustainable Construction Practices (SCP).*

1. INTRODUCTION

Sustainability concerns the long term performance (Saunders and Hughes, 2018) to accomplish the needs of the present generation by maintaining the potential for future generation to accomplish their needs (Visser, 2017). It is a procedure planned for people, the planet, and prosperity with the aim of strengthening collaborative partnerships and development (United Nations, 2015). Consequent to the high resource demand in the construction industry, its focus on sustainability has increased (Ahuja, 2013). Sustainability has structured on the maintenance of the equilibrium in social, economic, and environmental aspects to maintain consistency in the persistent world (Roufechaei, et al., 2015). Since society, economy, and environment have become the key aspects to be kept in equilibrium, they have been recognised as the triple bottom lines of sustainability (Zuo, et al., 2012).

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According to the views of Akadiri, et al. (2012), and Goh, et al. (2020), the status of sustainable development in the construction industry is depraved. An extension of project schedules, knowledge deficiencies, less integration of stakeholders (Ahn, et al., 2013; Tokbolat, et al., 2020), and the fragmented nature of construction activities (Goh and Rowlinson, 2015) lead to the cause. Subsequently, Solaimani and Sedighi (2020) intensify the necessity of incorporating sustainable construction practices (SCP) to minimise negative influences. To strengthen the view, Gebre (2011) demonstrates the importance of structured planning and early involvement of the design team, and the concern for SCP in the design and development stage is vital (Majdalani, et al., 2006; Wang, et al., 2012; Zuo, et al., 2012).

Construction procurement is a prominent construction activity, which is oriented toward forecasting the future to create and manage the construction contracts (Ruparathna and Hewage, 2015) from the inception of the project. It is a key concern to accomplish the constructability of a project (Turina, et al., 2008), which ensures the successful implementation of construction techniques (Mathonsi and Thwala, 2012). Construction procurement has expanded over the years as separated, integrated, and management-oriented (Masterman and Masterman, 2013), which is later on classified as traditional, design and build (D&B), management related, and collaborative (Jaafar and Nuruddin, 2012; Rahmani, et al., 2017). Among the variety of available construction procurement systems, D&B is the widely used procurement method to ascertain sustainable construction requirements (Chen, et al., 2016; Rubasinghe et al., 2019). It is an effective project delivery method, that is practised with a single entity for both the design and construction phases of a project (Xia and Chan, 2012).

Even though the D&B procurement has been suggested as a favourable technique to successfully incorporate SCP, less implementation of SCP is noted in the construction industry (Molavi and Barral, 2016). Weerasinghe and Ramachandra (2018) assert less implementation of sustainable practices in the Sri Lankan context. Despite being a crucial participant in construction projects, several limitations have resulted in the less adaptation of SCP by construction contractors (Hwang, et al., 2018). Further, Karunasena et al. (2016) establish a similar argument, emphasising the deficiencies in willingness and awareness of the contractors as a key cause to hinder the implementation of SCP. Accordingly, this study investigates the strategies to be adopted by D&B contractors in enhancing the implementation of environmental, social, and economic SCP in Sri Lanka.

2. LITERATURE REVIEW

2.1 SUSTAINABLE CONSTRUCTION PRACTICES

Feasibility of economy, awareness, sustenance from project stakeholders, policies and regulations, ability to operate in a sustained framework, reduced resource risks, and project management models are the criteria that influence to derive the SCP (Gan, et al., 2015). Accordingly, a variety of SCP have revealed in literature sources, which are structured under the three pillars of sustainability: social, economic, and environment.

Hakkinen and Belloni (2011) emphasise SCP which support all three pillars of sustainability as efficient use of resources, the reduction of harmful emissions, managing cost and productivity over the life cycle, and enhancing the performance of the stakeholders. Significantly, Durdyev, et al. (2018) and Tokbolat, et al. (2020) have identified enhancement of health and safety, uplifting cultural values, favourable

interaction with the community, widening of stakeholder relationship channels, providing quality output, and acquiring reputation and recognition on projects as the SCP with social impact. Serpell, et al. (2013) and Goh and Rowlinson (2015) illustrate SCP with an emphasis on the economy as conducting an economic feasibility study at the initial stage to acknowledge the life cycle cost of building, initiating cost-efficient construction practices, developing the proposals concerning the viability, and accomplishing competitive advantage. Furthermore, efficiency and conservation of energy, water, and resources, reduction of waste generation and active recycling of construction waste, the reduction of chemical generation, and environmentally friendly energy technology have identified as environmentally SCP (Manoliadis, et al., 2006; Ahn, et al., 2013).

A recent study by Tokbolat, et al. (2020) highlights the importance of the integration of SCP under the three pillars as the construction industry impacts the environment, significantly contributes to the economy, and provides the infrastructure to society. Hence, a collective investigation to amplify the status of the practice of SCP is vital and this study has structured it under the concepts of D&B procurement as themes.

2.2 DESIGN AND BUILD PROCUREMENT

D&B is a project delivery method that incorporates a single contract for both project design and construction (El Wardani, et al., 2006; Lam, et al., 2008). In the attribute of the contractor, D&B procurement increases the responsibility of the contractor within a fixed budget (Ramabodu and Verster, 2012). Further, Chan, et al. (2005) have emphasised that a D&B contractor performs the role of a designer, design manager, and contractor in D&B procured projects. Accordingly, there are a huge amount of duties to be performed by the D&B contractor.

Minchin, et al. (2013) have depicted that the emergence of the concept of sustainable construction, has strengthened the practice of D&B procurement consequent to its' feature of integration. Furthermore, the integration of two main aspects of a construction project, "design" and "construction" has provided D&B projects with positive impacts (Seng and Yusof, 2006) on sustainability. The key concepts of D&B procurement can be identified under the main categories of time, cost, quality, complexity, technical expertise, responsibility (Suratkon, et al., 2020), knowledge, and communication (Muriro, 2015).

2.2.1 Concepts of Design and Build Procurement

D&B projects exhibit different concepts in major attributes of a construction project. As evidence from the mentioned literature, the summarized concepts of D&B procurement have stated in Table 1.

Table 1: Key concepts of D&B procurement

Source	Category	Concept
(Seng and Yusof, 2006; Lam, et al., 2008; Chen, Jin, et al., 2016)	Time	• Shorter the duration of the construction project • Early commencement of activities • Use of fast tracking
(Chen, Xia, et al., 2016; Saaidin, et al., 2016)	Cost	• Mitigate cost overruns • Cost certainty • Fewer variation orders

Source	Category	Concept
(Lam, et al., 2008; Al Saudi, 2011; Suratkon, et al., 2020)	Quality	• Low cost • Ability to meet quality targets • Satisfaction in terms of function and aesthetic • Low mechanism to ensure quality and integrity
(Davis, et al., 2008; Gambo and Gomez, 2015; Ghamdamsi, 2016)	Complexity	• Less control of the employer over the detailed design • Integration of design and construction • Appropriate for complex projects
(Seng and Yusof, 2006; Al Saudi, 2011; Gambo and Gomez, 2015)	Technology	• Easy application of innovation and the latest technology • Higher level of specialisation • Advantageous for constructions with more technological inputs
(Davis, et al., 2008; Xia and Chan, 2010)	Responsibility	• Solo point responsibility • High involvement of the contractor • Requires clients' provision of information
(Seng and Yusof, 2006; Lam, et al., 2008; Suratkon, et al., 2020)	Knowledge	• The ability of multiple design options for the client • Use of both contractor's and consultant's knowledge at one firm to improve buildability • High understanding of the contractor regarding the design
(Xia and Chan, 2010; Muriro, 2015; Ghamdamsi, 2016)	Communication	• Eliminate second hand blames • Increase team spirit • High interaction between the client and the contractor

Overall, insufficient strategies for D&B contractors to successfully implement sustainable construction practices, extend this study to discuss the strategies for the successful utilisation of D&B procurement by contractors to enhance the implementation of SCP.

3. METHODOLOGY

Creswell (2014) has stated that the qualitative approach as the most appropriate approach for the exploration and understanding of factors related to human and social issues. Further, Myers (2009) has intensified that it helps the researcher to collect meaningful data on people's actions, beliefs, and motivations. Accordingly, a qualitative research approach with a survey strategy was utilised in this study to investigate the research problem. The reason for the selection of the approach was the necessity to conduct an in-depth exploration of the combination of two different attributes to extract rich and valid opinions. Since the researcher focused to identify strategies for the contractor to

successfully contribute to promoting SCP by capturing a vivid set of opinions and experiences of the experts in the relevant sector, a survey strategy was incorporated.

A comprehensive literature review was conducted to identify the SCP, D&B procurement concepts, and the role of the contractor in D&B procurement. Polonsky and Waller (2018) insist that the consideration of correctness, reliability, applicability, and volume of data required are vital in selecting the data collection techniques. Accordingly, for the process of data collection expert interviews were considered appropriate. Concerning the saturation of data obtained, nine semi-structured interviews were conducted with experts in the construction industry. Consequent to the deficiency of strategies in D&B procurement to address SCP in the global context, semi-structured interviews were utilised for the data collection. The guideline was structured under the main categories of D&B procurement concepts. The respondents were provided with examples of SCP in the construction industry, to get a general idea about the scope. Then, they were requested to provide strategies for contractors to successfully adapt the mentioned SCP, by utilising the key features of D&B procurement. Here the researcher mentioned the key concepts under each theme to obtain a versatile set of findings. The questions were raised under each theme of D&B procurement as the findings will be helpful for contractors to identify the possible strategies with the applicable concepts of D&B procurement.

To ensure the validity and reliability of the strategies provided, experts in the construction industry who have versatile knowledge of both aspects with the minimum experience on two sustainable projects and five D&B projects were selected as experts. The selection criteria were defined considering the status of SCP and D&B procurement in the Sri Lankan construction industry and respondents were selected through purposive sampling. Respondents from all attributes of the client, the contractor, the consultant, and the subcontractor were selected to eliminate the biased strategies. Table 2 presents the profile of the experts selected for the data collection.

Table 2: The profile of the respondents

Respondent	Discipline	Organization	Industry Experience	Sustainable projects	D&B Projects
R1	Senior Consultant (Structural Engineer)	Consultant	41 years	More than 10	More than 50
R2	General Manager Operations (Civil Engineer)	Contractor	26 years	More than 10	More than 40
R3	Civil Engineer	Contractor	18 years	2-5	10-15
R4	Project Chief Quantity Surveyor	Contractor	19 years	2-5	10-15
R5	Senior Technical Officer	Client	31 years	2-5	More than 15
R6	Quantity Surveyor	Contractor	9 years	2-5	5-10
R7	Civil Engineer	Consultant	11 years	More than 10	5-10
R8	Project Quantity Surveyor	Contractor	13 years	2-5	10-15
R9	Quantity Surveyor	Sub-contractor	10 years	5-10	5-10

The deductive approach of thematic analysis was adopted as the data analysis technique as thematic analysis is a popular method to analyse qualitative data findings with the flexibility (Braun and Clarke, 2012). Caulfield (2019) states two (02) thematic analysis approaches: inductive and deductive. This study utilised deductive thematic analysis for the analysis of the findings as the pre-determined concepts of D&B procurement were incorporated to provide a detailed set of findings under each category. Accordingly, the researcher became familiarised with the concepts of D&B procurement to classify the concepts and developed the themes. After, the data collection was conducted with semi-structured questionnaires arranged based on themes. Reviewing process was conducted for the collected data to identify the emerging themes (if any) and the write-up was completed.

4. RESULTS: STRATEGIES FOR D&B CONTRACTORS TO ENHANCE SUSTAINABLE CONSTRUCTION PRACTICES

The respondents suggested distinct ideas for the improvement of the implementation of SCP, through the adaptation of time, cost, quality, responsibility, knowledge, technology, complexity, and communication. However, some strategies were of multiple applicability under two or more categories. Accordingly, based on the status of the involvement of D&B contractors, and their knowledge of the concepts, strategies can be selected and followed.

Early commencement of activities and concurrent design and construction are the two main concepts of D&B procurement that help to manage the time for construction. The construction contractors can use these features in favour of SCP as it allows the contractor to identify the ultimate requirements of the clients in terms of sustainability. Further, consequent to the early commencement, the possibility to practice passive sustainable technologies like incorporating the available land orientation features for the building, is high. It was validated by the view of R3, that *"if contractor occupies early, he takes steps to ensure sustainability from the points at the early stage of control. For example, building orientation in the site can be well designed encountering the practicality of constructing…"*. Moreover, R2, R3, R6, and R9 suggested that the detailed exploration resulted in the contractor filtering the mentioned SCP by the client, based on the time availability and the realism of practising as appropriate. Further, it allows the contractor to schedule the construction program considering the practical barriers and it helps to maximise the incorporation of SCP.

The respondents highlighted the degree of favour provided in D&B projects to apply general cost-efficient options. Accordingly, R5 mentioned that *"I say, all the techniques I mentioned are good to be implemented with any procurement system, but may easy with D&B and can do with high efficacy."* Accordingly, the contractors can explore cost cut options to ensure value for money. Further, with D&B, contractors are provided with the opportunity to conduct a close examination of the project to identify, the prior flags of price deviations, and the costs in terms of sustainability. There is a general perception that the implementation of SCP is costly. However, with D&B, the contractor can contribute to identify additional costs which can be incurred consequent to sustainability and design to tally with costs. Moreover, as per views of R2, R3, R5, R7, and R9, if the contractor is working with a less experienced client, he can introduce more SCP with the idea of their additional costs or savings and can agree on the procedure to handle later

stage cost deviations in the beginning. More importantly, the contractor is required to prepare cost reconciliation reports to benchmark the costs consequent to the implementation of SCP.

Quality is a key concern in any construction project and contrast views on the quality of D&B projects have identified through the literature. Accordingly, to take the successful use of quality features of D&B, R2, R4, R7, and R8 demonstrated the importance of expanding the capabilities of the design team with the provision of adequate knowledge of sustainable concepts. R8 expressed a unique view regarding the importance of monitoring the design development simultaneously with the budget schedule to check the affordability of implementing SCP from the initial stage. Moreover, contractors are required to be strict with the quality requirements of the client and inform about possible deviations at the earliest possibility and this can be successfully practised by D&B contractors, as they involve in the construction project from the beginning. Further, ensuring the performance of subcontractors to meet the implementation requirements of SCP is a vital requirement to be performed by D&B contractors.

Construction contracts consider to be complex however, there are mechanisms to adjust flexibility. In the identification of actions of D&B contractors to contribute to enhance SCP, the legal component of the project was considered the most critical strategy. Accordingly, clarification of ambiguous terms and conditions in the contract, actively participating in the establishment of dispute resolution mechanism, and a clear understanding of laws and regulations are important. Further, irrespective of the complexity incurred consequent to the SCP, the contractor requires to be confident in the decisions made. Similarly, with the view of the R2, it was because *"there is no one to pass the ball"*.

Correct identification of the technological concepts and applications of them ensures the success of the requirements of any project. Specifically, R8 depicted that *"contractor permits to fully familiarize of both design and construction technologies moves in parallel with sustainability and therefore can expand the firm and resources…… So…. design-build contractor achieves personal improvements also when try to practice sustainability"*. Further, they can use passive green technologies and expand their knowledge of the latest construction technologies to effectively utilise the technology in the implementation of SCP.

D&B is well known for single-point responsibility and accordingly the project responsibility and the majority of risks are aligned with the contractors. The main strategy identified by the respondents was to initiate a new job role as a sustainable manager to ensure coordination in design and construction. R6 emphasised the importance of the concept expressing that the *"continuation of sustainability is more feasible with one party and clustered responsibility"*. Additionally, the importance of being accountable, developing attitudes towards the sake of the project, and assigning technical responsibilities to parties have been identified as favourable to implement.

The respondents' ideas clearly emphasised the importance of the knowledge of both design and construction teams. Further R9 asserted that *"Sri Lanka is at the initial level of sustainability"* and consequently the role of the contractor is vital. Consequently, construction contractors have to examine the market well in advance before capturing sustainable construction techniques and make the design and construction teams familiarise themselves with the latest concepts and technologies. Specific attention to

measuring the competencies of the design team to proceed with sustainability is vital as otherwise, the project failures are unavoidable. More importantly, record keeping is required to proceed smoothly because it is a root for future projects to eliminate the practical barriers. Further, records help to ensure the acknowledgement of organisational staff on emerging concepts.

Communication of D&B contractors in construction projects has identified under three main methods as internal communication of the D&B team, communication between key stakeholders, and communication with external stakeholders. Accordingly, the conduct of morning meetings, keeping shreds of evidence of instructions provided, and feedback to ensure the proper communication between design and construction teams are the strategies to adopt. As the view of R9, the D&B contractors in Sri Lanka have less knowledge on designing to implement SCP.

Figure 1 represents the strategies suggested for the D&B contractors to enhance the implementation of SCP. Accordingly, some strategies overlap among the concepts of D&B procurement, which suggests that even though the status of D&B differs, there are practices that can be collectively used.

5. DISCUSSIONS

Research publications distinctly explore the role of the contractor to enhance SCP and D&B procurement. However, the construction industry of Sri Lanka suffers from the low implementation of SCP which portrays the malpractice of the identified strategies and the unavailability of the combined set of strategies. The findings of the empirical study identified the emerging strategies simultaneously with modifications in the available strategies.

The empirical findings of this research disclose similar ideas to the view of Rekola, et al. (2012), and Holloway and Parrish (2015) that suggest the requirement of making their own company sustainable and simultaneously practising the front end planning approach. It has further supported the idea of Akadiri, et al. (2012) that the strength of the decision making process with timely involvement of stakeholders as a practice for contractors. Further, the view of Riley, et al. (2003) and, Tiwari, et al. (2018) have strengthened through this study. Accordingly, the study identified the importance of value engineering proposals for the effective use of cost and knowledge concepts of D&B procurement. Further, the necessity of effective communication with the subcontractors is also verified through this study.

The outcome of this study to measure the competencies of the design team and familiarise them with the latest technology tally the findings of Tiwari, et al. (2018) which emphasise the balance of knowledge of the team as a strategy for D&B contractors to successfully contribute to D&B procurement. Accordingly, it is proved that some strategies for the success of D&B procured projects can be used for the enhancement of the implementation of SCP. The empirical findings of this study highlighted the importance of documentation and contract administration to effectively manage the complexity and responsibility of the projects. It coincides with the view of Papajohn, et al. (2019), which illustrates the importance of successful contract administration tools. Technological applications in D&B procurement have emphasised as the development of knowledge on technical based integration using Information Technology (IT) based communication systems (Rekola, et al., 2012).

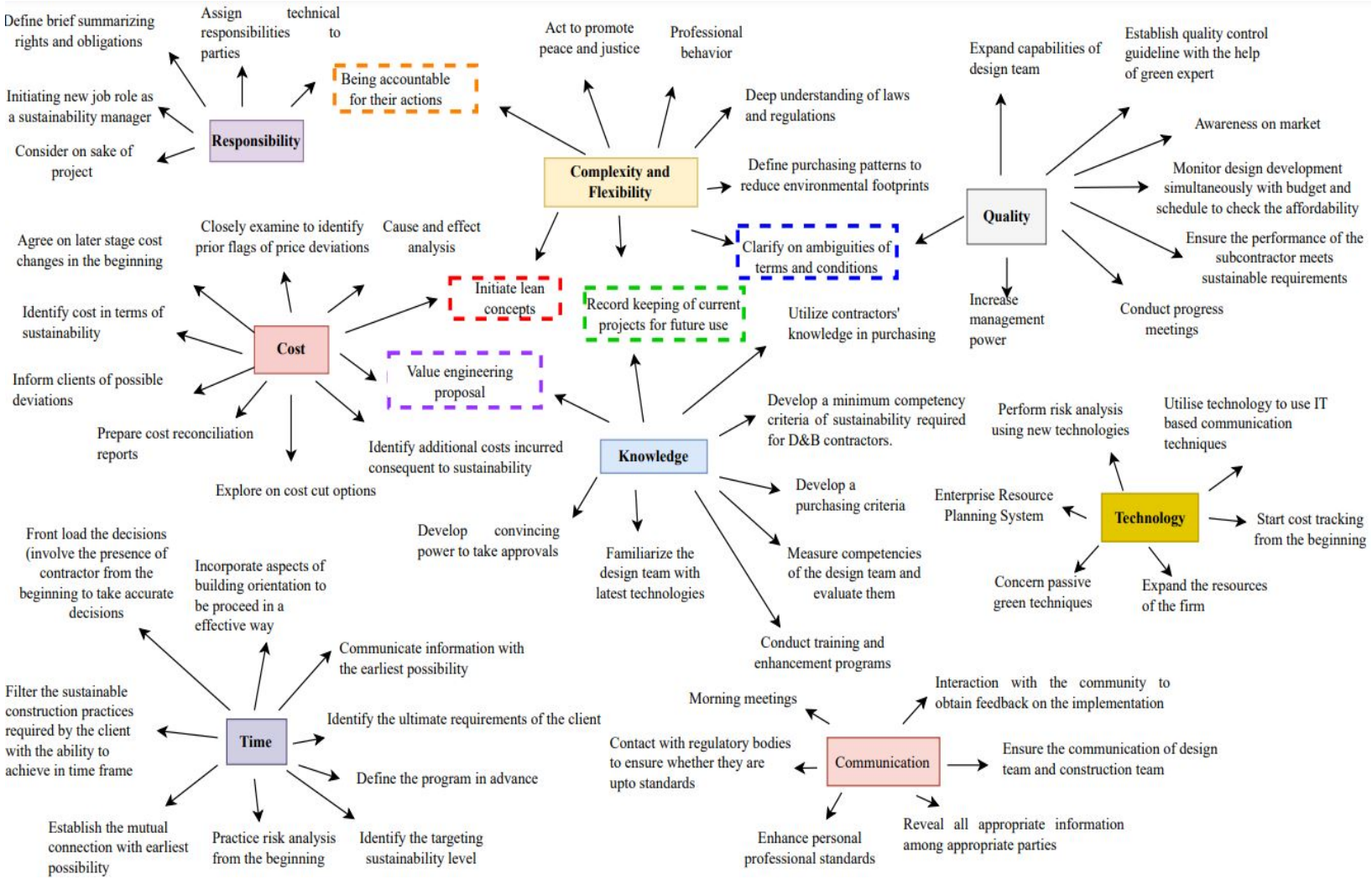

Figure 1: Strategies to successfully implement SCP

This view strengthens the empirical findings and accordingly, it can be positively adopted in the implementation of SCP. Overall, the researcher argues that distinct practices to improve SCP and D&B procurement are competent and can collectively be incorporated as strategies to enhance SCP by D&B contractors.

6. CONCLUSIONS

The dynamic nature of the construction industry creates the necessity for the implementation of SCP to assure sustainability. Even though a variety of actions to be followed have introduced, the implementation of SCP is not at a prolific level. Even though the D&B procurement method also have identified as a suggestion made for the successful practice of SCP, it is not successfully utilising consequent to the less contribution of D&B contractors. Accordingly, the importance of the strategies to follow as a guide has emerged. Strategies and opinions disclosed by nine experts have analysed based on themes to derive strategies that can be adapted based on the nature of the construction project, and the status of the knowledge and experience of the contractor.

Conduct of value engineering practices, strength in the decision-making process, and familiarise with the latest technologies are some prominent strategies which considered favourable to uplift D&B procurement and in this context can also be applied with SCP. Novel strategies of appointing a sustainable manager, a market survey to recognise the status of sustainability, concern on passive construction technologies, and identification of sustainable design requirements have identified as emerging considerations for D&B contractors.

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