

## QUANTITY SURVEYOR'S ROLE TOWARDS CIRCULAR ECONOMIC PRINCIPLES IN THE PRE-CONTRACT PHASE OF CONSTRUCTION PROJECTS IN SRI LANKA

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**Abstract:** The pre-contract phase of construction projects may cause plenty of issues in post contract phase such as project cost overruns, schedule delays, lack of productivity, losses of benefits, and poor stakeholder relationships. The circular economy concept is to create an economic system that makes it feasible for materials, products, and component regeneration while ensuring the longest possible value retention of projects. This research aims to ascertain the role of quantity surveyors in relation to circular economic principles in the pre-contract phase of construction projects in Sri Lanka and consists of four main objectives. Accordingly, research was conducted through a comprehensive literature review, preliminary interviews, expert interviews, and a questionnaire survey. Primary data were analysed through statistical and content analysis using SPSS software and NVivo software. The questionnaire survey had an excellent respondent rate of 84%, which is adding additional credit to the study's findings. Based on the different experiences and their scope of work in the pre-contract phase of construction projects, the industry experts proposed a wide range of solutions. Further, the results of the study demonstrate the importance of quantity surveyors' role towards circular economic principles throughout the pre-contract phase of construction projects in Sri Lanka.

**Keywords:** Quantity Surveyor's Role, Circular Economic Principles, Pre-Contract Phase, Construction Projects

### 1. Introduction

The construction sector is crucial to every nation's growth. Quantity and quality of physical infrastructure such as buildings, roads, and bridges may be used in numerous ways to measure a nation's pace of economic growth (Akinshipe et al., 2021). With the primary goal of bringing the project to a successful completion, construction project development involves various partners, various procedures, various timelines, and stages of work, and considerable input from both the public and private sectors (Akinshipe et al., 2022). The quality of each party's managerial, financial, operational, and organizational performance, as well as the associated risk management, the business environment, and economic and political stability, have a significant impact on how successfully construction projects are carried out (Takim & Akintoye, 2002). Conventional planning principles and traditional concepts used in the pre-contract phase of construction projects can result in inaccurate estimations, quality issues, cost overruns, delays, and a lack of sustainability concerns. Therefore, real-world construction project circumstances are intricate, dynamic, unpredictable, and singular; as a result, neither issues nor solutions are simple (Rotimi & Ramanayaka, 2015).

Different sustainability models, including the circular economy (CE), are being used in the effort to achieve environmental sustainability in different industries. A circular economy is an industrialized system that is intended to be restorative or regenerating by design (Mukhopadhyay, 2014). There is an increase in interest in the circular economy concept in recent years, a plan to replace the current manufacturing and consumption model that is based on perceptual development and increasing resource throughput. Therefore, the CE concept is becoming more and more recognized by the construction industry as a key policy action (Afshari et al., 2019). The desire to reduce waste output and the pervasive issue of resource scarcity makes the debate over environmentally friendly manufacturing methods more important than ever. There is a considerable effort to reduce the environmental effect of the construction industry via the circular economy concept hence the construction sector is one of the largest waste suppliers in the world (Sinha & Fukey, 2020).

The project clients employ the quantity surveyors as cost consultants who can be accountable for ensuring the cost of construction projects which can be afforded by them and quantity surveyors working on behalf of contractors are primarily responsible for managing the contractor's financial expenses (Reddy, 2017). Quantity surveyors' roles

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have modernized recently with the advancement of the construction industry. Accordingly, the quantity surveying profession has undergone significant transformation including the transition to the positions of cost manager and project manager (Panojan et al., 2022). This specifically emerged in the pre-contract phase of construction projects since the well-structured procedures and decisions made in the pre-contract phase directly affect the successful completion of construction projects and sustainability concerns. Therefore, quantity surveyors emerged in their conventional role in life cycle costing, cost-benefit analysis, risk management, etc (Reddy, 2017). Therefore, the application of circular economic principles via the quantity surveyor's role in the pre-contract phase might be extremely helpful specially to enhance the sustainability matters in the construction industry and ultimately reduce cost, and time and enhance the quality of construction projects.

However, there is very limited research conducted to identify the quantity surveyor's role towards circular economic principles in construction projects. Additionally, none of the studies have been researched on the quantity surveyor's role towards circular economy principles in the pre-contract phase of construction projects specially in Sri Lanka. Therefore, this study was designed to fill this research gap and aimed to determine the role of quantity surveyors towards principles of the circular economy in the pre-contract phase of construction projects in Sri Lanka follows by four objectives 1) to analyze the applicability of the circular economic principles towards the pre-contract phase of the construction projects 2) to investigate the relationship between the quantity surveyor's role and circular economic principles 3) to examine the barriers to implement the circular economic principles through the quantity surveyors role in pre-contract phase of construction projects in Sri Lanka and 4) to identify the strategies to implement circular economic principles through quantity surveyors role in the pre-contract phase of construction projects in Sri Lanka. This study examines how quantity surveyors may contribute to Sri Lanka's Circular Economy as more than just a real resource for completing construction projects successfully during the Pre-Contract phase. The scope of this study was restricted to Sri Lankan construction industry experts (engineers, quantity surveyors, architects, and project managers) with extensive expertise in pre-contract and circular economy principles.

## 2. Literature Review

There is few research conducted relating to the QS role and CE principles in an international context. Specially in the Sri Lankan context there was no research found that related the QS role and CE principles in construction projects. Therefore, this research is providing new knowledge specifically to the Sri Lankan construction management expertise. The construction industry is one of the key industries in each economy which constructs buildings and infrastructure. Production and construction are distinct from one another since manufacturing sometimes involves remarks with an industrial theme without a specified consumer, whereas construction generally takes place on-site for a recognized client (Afshari et al., 2019). The construction business is inherently confusing when addressing it since it involves various stakeholders such as owners (consumers), consultants (advisers), contractors, financial institutions, material and plant manufacturers, regulators, and the public (Afshari et al., 2019). Despite its complexity, the sector makes a substantial contribution to the formulation and achievement of progressive objectives, and it is one of the largest and contributes around 10% of the GNP in industrialized countries (Enshassi et al., 2009). Quantity surveyors are key professionals who are involved in the construction industry and their main responsibility is to measure, value, and cost management of building works and services. QS's traditional roles include preliminary estimating, tendering, procurement management, tender analysis, costing, billing, and monitoring all cost-related matters (Akinsiku, 2014). Digital technologies are currently being used by quantity surveyors all around the world to help with tasks like measuring and costing construction projects (Akinshipe et al., 2022).

There has been a considerable shift in the role of quantity surveyor during the past few decades and there is the aspect of modern quantity surveying. The modern quantity surveyor services include life cycle costing, cost-benefit analysis, risk assessment and management, asset advisory, litigation support, property taxation, etc (Mangialardo & Micelli, 2018). Further modern quantity surveying is being transformed by digitalization, which is changing the profession's roles and enhancing performance and resource efficiency in the construction sector. Digital technologies are presently being used by quantity surveyors all around the world to help with tasks like measuring and costing construction projects (Akinshipe et al., 2022). According to RICS, the use of Building Information Models (BIM) has allegedly grown over the past few years (Akinshipe et al., 2021). The stakeholders of the construction industry specially governments identified the requirement of the emergence of sustainability concerns for construction projects where they can enhance the quality of output and more focus on environmental sustainability (Arayici et al., 2009). Therefore, quantity surveyors also need to more focus on the ways to emerge sustainability-related concepts such as circular economy in their projects.

The circular economy emerged as an innovative manufacturing and consumption strategy that promotes corporate sustainability (Sinha & Fukey, 2020). A circular economy is a systems-level approach to economic growth and a paradigm shift from the traditional concept of the linear economy model of extract-produce-consume-deplete (epcd2) to an elevated echelon of achieving zero waste by resource conservation through a changed concept of production processes, materials selection for higher life cycle, conservation of all kinds of resources, material and/or energy recovery all through the processes, and at the end of the process (Dorokhina & Kharchenko, 2021). The 3R principle served as a model for the basic CE idea (Reduce, Reuse, and Recycle). Thereafter, the 3R idea was combined with the three additional concepts of "redesign, reclassification, and renewability" to create the 6R

principles of CE (Macarthur, 2015). However, local input identified the unavailability of efficient waste management techniques that incorporate the 3R principles as the main challenge faced by stakeholders, and the improvement of environmental performance as the least significant project need for construction projects in Hong Kong (Yu et al., 2022). As a solution for that, a nested circle may be used to represent the circular economy as it is used in the construction industry and as inspiration for the ideas on the built environment and the circular economy which shows in the following figure 1 (Mangialardo & Micelli, 2018).



Figure 1: Circular Economy Concepts being used in the Construction Sector  
 Source: (Mangialardo & Micelli, 2018)

According to Wijewansha et al. (2021), putting all the 6R circular economic tenets into practice, specially at the pre-construction stage of the construction, when it is easier and less expensive to make changes to boost responsible tactics. There is a relationship between 6R principles in the pre-construction phase and 6R principles in the construction industry as identified by past researchers and shown in the following table 1.

Table 1: Relationship between 6R Principles in Pre-Construction and 6R Principles in the Construction Industry

6R principles in the construction industry (Mangialardo & Micelli, 2018)	6R principles in pre-construction (Wijewansha et al., 2021),
Retain	Reduce
Refit	Re-classification
Refurbish	Renewable energy
Reuse	Reuse
Remanufacture	Redesign
Recycle	Recycle

All around the key industries in the world, the construction industry is one of the main industries that produce the most waste to the environment. Today, building waste makes up 30% of the waste in landfills (Dorokhina & Kharchenko, 2021). However, there aren't many construction firms or government authorities that take the treatment of construction waste seriously, and most of the building waste is discharged to landfill only through third-party companies (Wahyu Adi & Wibowo, 2020). It was identified that the present approach of design and manufacturing is not suitable to fulfill the circular economic principles under the design component of the pre-contract phase. The implementation of circular economic ideas in practical application has the potential to reduce the environmental effect of construction waste and promote resource reuse. Designers are responsible for the design process, and it is crucial to discuss if and how future designers may contribute to the development of more circular economic designs and the way of integrating circular principles into their design processes (Evans & Münster, 2022). Following table 2 shows the 6R circular economic principles and their related activities during the pre-contract phase.

Table 2: Circular Economic Principles (6R) and Related Activities at Pre-Contract Phase  
 Source: (Wijewansha et al., 2021)

6R Circular Economic Principles	Activities at Pre-Contract Phase
Reduce	A. Design strategically to minimize waste
	B. Adoption of "Design Freeze"
	C. Adopt standard dimensions in designs (modular concept)
	D. Minimize resource consumption by using waste where possible
	E. Review completed designs to identify opportunities for waste minimization
	F. Obtaining expert input for the design process
Reuse	G. Reuse of construction waste material
	H. Double checking of material quantities before ordering
	I. Maintaining detailed specifications of materials
	J. Reuse of paper
	K. Proper scheduling to keep track of material usage

Recycle	L. Adopting new technologies for services
	M. Developing a schedule of recyclable resources
	N. Procuring material from green certified suppliers
	O. Creating channels for selling or transferring waste material which cannot be treated at site level to third parties
	P. Recycling paper waste
Redesig	Q. Follow design optimization techniques
	R. Balance aesthetics with effective material utilization
	S. Adapt modular construction techniques
	T. Focus on disassembly during building design
	U. Follow environmental accreditation
	V. standards and sustainable construction guidelines
	W. Review completed project designs to ensure circularity principles envisaged are achieved
Re-classification	X. Introduce new product specifications focusing re-classification
Renewable energy	Y. Convince clients on the potential for life cycle cost savings through the use of renewables
	Z. Adopt new technologies for power generation (e.g. recovery of waste energy)
	AA. Design of rooftops to facilitate installation of solar power generation systems

However circular economic principles are not practically executed in the Sri Lankan construction industry yet. According to past research, the circular economy concept will help to reduce and mitigate some of the key issues in the construction sector and enhance the sustainability aspects of the projects. Further, the integration of circular economic principles in the pre-contract phase of construction projects will be aided to mitigate the emerging issues of post contract phase and operation stage of the projects. Therefore, this research identified the role of quantity surveyors towards circular economic principles in the pre-contract phase of construction projects in Sri Lanka.

### 3. Research Methodology

The two primary types of research approaches are the qualitative approach and the quantitative approach. According to Kothari (2004), the qualitative approach uses information that isn't dependent on numbers, and it emphasizes language, explanations, ideas, and concepts. This approach helps to draw a rich image of a critical issue and aids in developing a deep knowledge of it. The quantitative approach uses statistics and numerical data to quantify differences between variables and how those differences relate to each other. Here, your goal will often to be verify or authenticate a claim. Testing hypotheses frequently involves surveys, experiments, and the utilization of data from repositories. Further, the mixed research approach is a combination of both qualitative and quantitative approaches. Based on the research aim and objectives, a mixed research approach was applied in this research, combining both qualitative and quantitative approaches. The research approach was employed to gain a thorough knowledge of the role that quantity surveyors need to play in connection to the circular economy principles throughout the pre-contract phase of construction projects in Sri Lanka. Under the mixed research approach, preliminary interviews (Since the circular economy concept is quite new and specially the QS role in circular economic aspects are new to the existing body of knowledge, we needed to validate the activities at the pre-contract phase under 6R circular economic principles to the Sri Lankan context. Further, we needed to be clear about the Sri Lankan context before making the questionnaire survey), expert interviews (The research was conducted in 2022 during covid-19 pandemic which made the data collection quite hard. Therefore, only 3 expert interviews were conducted but covered all three key construction professions and knowledge in Engineering, Architecture and Quantity Surveying), and a questionnaire survey (Questionnaire survey was entirely included closed ended questions with "Yes" or "No" responses and Likert scale responses) were employed as data collection methods. The following table 3 shows the summary of the study's population and sampling technique used.

Table 3: Summary of the Study's Population and Sampling Techniques

Data Collection Method	Population	Sample	Sampling Technique
Preliminary interviews	Professionals who are working in the construction sector (Quantity Surveyors, Architects, Engineers).	05 professionals representing two Quantity Surveyors, an Architect, and two Engineers who have a minimum of 20 years of experience.	Purposive Sampling
Questionnaire Survey	Professionals who are working in the construction sector (Quantity Surveyors, Architects, Engineers, Project Managers, and Others).	70 professionals representing various construction professions.	Stratified Random Sampling

Expert interviews	Professionals who are working in the construction sector (Quantity Surveyors, Architects, Engineers).	03 professionals representing a Quantity Surveyor, an Architect, and an Engineer who has a minimum of 20 years of experience.	Purposive Sampling
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### 3.1. DATA COLLECTION TECHNIQUES

Preliminary interviews were conducted as semi-structured interviews with a preliminary interview guideline. When a researcher plans to explore deep into a subject with the objective of properly understanding the responses provided, a semi-structured interview is usually used since it effectively obtains extensive information for discussion (Kallio et al., 2016). Accordingly, 5 preliminary interviews were conducted with construction experts such as two chartered quantity surveyors, two chartered engineers, and one chartered architect who have more than 20 years of relevant experience. Different open-ended question types were used in the interview guidelines where section A was designed to gather the background information of the respondents and section B was to gather respondents' opinions on the applicability of the circular economic principles towards the pre-contract phase of the construction projects.

To investigate the relationship between the quantity surveyor's role and circular economic principles, a structured questionnaire survey was conducted. The questionnaire was prepared with the aid of a comprehensive literature review and preliminary interviews. To evaluate the relationship between the quantity surveyor's role and circular economic principles, the relationship was assessed between activities carried out in the pre-contract phase under 6R circular economic principles (as shown in table 2) and the roles of the quantity surveyor. Accordingly, the hypothesis was built between the 6R circular economic principles and the role of a quantity surveyor. The relationship between the dependent and independent variables is illustrated in the following figure 2. A web-based questionnaire was developed here using google forms and distributed the link to the industry professionals such as project managers, engineers, quantity surveyors, and architects via emails. In the questionnaire, section A was designed to identify the respondents' general information and experience, and section B was designed to gather respondents' opinions on the relationship between the 6R principles of the CE and the roles of quantity surveyors during the precontract phase of construction projects using a "Likert scale."

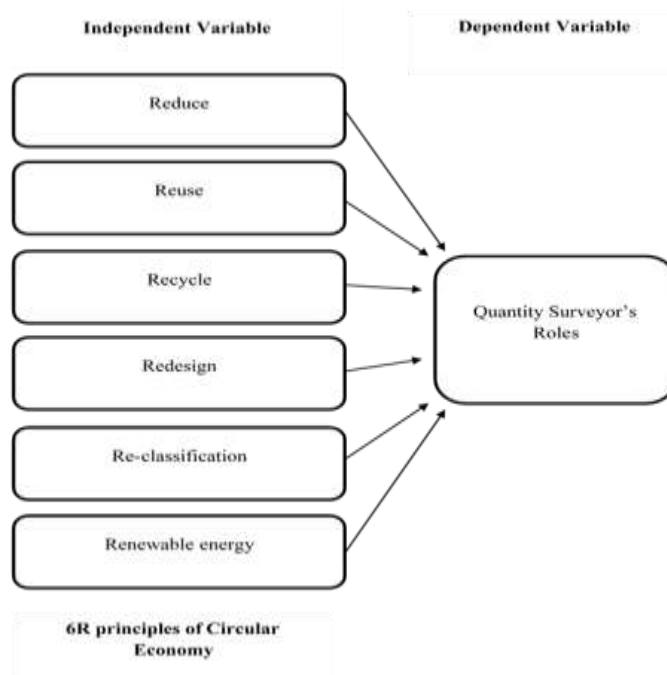


Figure 2: Independent and Dependent Variables

Expert interviews were conducted as semi-structured interviews to examine the barriers and strategies to implement the circular economic principles through the quantity surveyor's role in the pre-contract phase of construction projects in Sri Lanka. Here 3 expert interviews were conducted with industry experts; one chartered quantity surveyor, one chartered engineer, and one chartered architect who have more than 20 years of relevant experience. Expert interview guideline was developed with different open-ended questions which include two sections where section A plans to gather the background information of the interviewee and section B plans to gather respondent's opinions on the barriers and strategies to implement the circular economic principles through the quantity surveyor's role in the pre-contract stage of construction projects in Sri Lanka.

### 3.2. DATA ANALYSIS TECHNIQUES

The collected data was analysed through the stational analysis and content analysis techniques with the aid of SPSS software and NVIVO 12 software. The relationship between activities in the pre-contract phase under 6R CE

principles and the role of the quantity surveyor was ascertained with the correlation analysis. The SPSS software was used to calculate the correlation coefficient and, in this study, the significant value for the relationship between the independent and dependent variables should not be more than 0.05. Accordingly,

- Significant value < 0.05 (Variables have a relationship with each other)
- Significant value > 0.05 (Variables haven't a relationship with each other)

Content analysis is used to analyse qualitative data such as responses of preliminary interviews, expert interviews, open-ended questionnaire surveys, etc. Therefore, in this research content analysis was used to fulfil all four objectives specially to explore the applicability of the circular economic principles towards the pre-contract phase of the construction projects and to examine the barriers and strategies to implement the circular economic principles through the quantity surveyors role in the pre-contract phase of construction projects in Sri Lanka. Content analysis was conducted through the NVIVO 12 software. Following table 4 shows the summary of the data collection and analysis techniques of the research.

Table 4: Summary of Data Collection and Analysis Techniques

Objective	Data Collection Technique	Data Analysis Technique
To analyze the applicability of the Circular Economic Principles towards the Pre-Contract phase of the construction projects.	Literature Survey Preliminary Interviews Questionnaire Survey	Content Analysis
To investigate the relationship between the Quantity Surveyor's role and Circular Economic Principles.	Literature Survey Preliminary Interviews Questionnaire Survey	Content Analysis Correlation Analysis
To examine the barriers to implementing the Circular Economic Principles through the Quantity Surveyors' role in the Pre-Contract phase of Construction Projects in Sri Lanka.	Expert Interviews	Content Analysis
To examine strategies to implement Circular Economic Principles through Quantity Surveyors' role in the Pre-Contract phase of Construction Projects in Sri Lanka.	Expert Interviews	Content Analysis

#### 4. Research Findings

Collected statistical data needs to be validated to make sure that was reliable and acceptable for statistical analytical procedures. This is crucial to ensure that the research study is succeeding in achieving its clear objectives. Reliability refers to the degree to which the measuring equipment corrects for random errors, and it relates to the degree of confidence that a person may have in the data obtained via the use of an instrument (Heale & Twycross, 2015). Therefore, "Cronbach's Alpha Reliability Test" is used to evaluate this by using SPSS software. The output should be a number between 0 and 1 in this test. Average stability is recognized for the Alpha value closer to 0.7 in this research which depicts the higher reliability of results.

##### 4.1. RESPONDENT PROFILE

Profiles of the interviewees in preliminary interviews and expert interviews were shown in the following table 5. All the interviewees had more than 20 years of experience overall and have experience in both public and private organizations as well as both local and foreign construction projects. Further, all interviewees had prior experience with the pre-contract phase of construction projects.

Table 5: Profiles of the Interviewees in Preliminary Interviews and Expert Interviews

Code	Profession	Years of Experience	Preliminary Interviewee	Expert Interviewee
INT 01	Quantity Surveyor	25 years	X	X
INT 02	Quantity Surveyor	22 years	X	-
INT 03	Engineer	29 years	X	X
INT 04	Engineer	23 years	X	-
INT 05	Architect	20 years	X	X

In the questionnaire survey, 70 questionnaires were distributed, and 59 completed responses were returned with an 84.29% response rate. Out of them, 39% are quantity surveyors, 25% are engineers, 17% are architects, 5% are project managers and 14% are from other professions. Further, among them, 10% have more than 20 years of experience, 14% have 15-20 years of experience, 17% have 10-15 years of experience and another 22% have 05-10 years of experience. However, 37% have 01-05 years of experience and approximately 63% of total respondents have more than 5 years of experience. Following figure 3 and 4 show the respondent profile of the questionnaire survey based on their profession and years of experience.

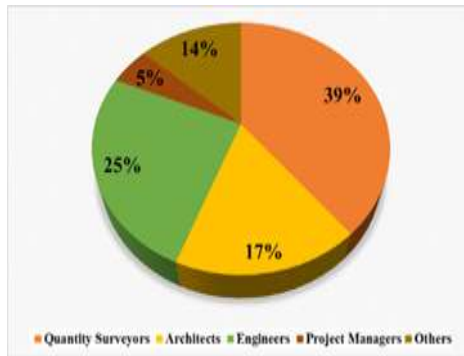


Figure 3: Respondent Profile of the Questionnaire Survey based on their Profession

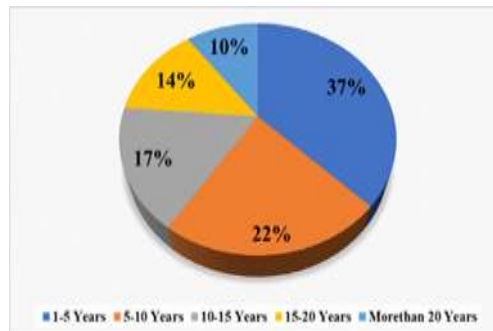


Figure 4: Respondent Profile of the Questionnaire Survey based on their Years of Experience

#### 4.2. APPLICABILITY OF THE CIRCULAR ECONOMIC PRINCIPLES TOWARD THE PRE-CONTRACT PHASE OF THE CONSTRUCTION PROJECTS

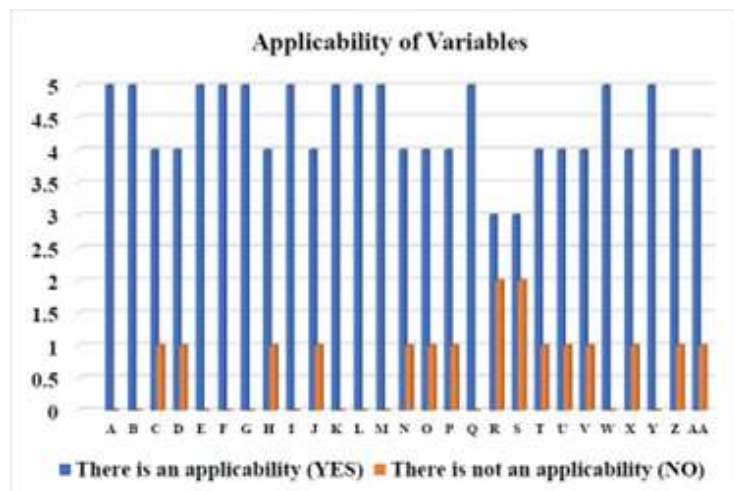


Figure 5: Applicability of 6R Circular Economic Principles at Pre-Contract Phase

Refer to the table (table 2) developed by Wijewansa et al., (2021), the applicability of circular economic principles to each activity in the pre-contract phase was assessed by the preliminary interviews. Applicability was assessed if 3 or more interviewees stated the activity can be applicable to circular economic principles out of all 5 interviewees. According to the following figure 5, all activities under 6R circular economy principles are applicable to the pre-contract phase which were identified through the literature review and can be processed to identify the relationship with QS’s role. A, B, C, D.....ZZ mentioned all activities at pre-contract phase under 6R Circular Economic Principles which are mentioned in table 2.

#### 4.3. RELATIONSHIP BETWEEN THE QUANTITY SURVEYOR’S ROLE AND CIRCULAR ECONOMIC PRINCIPLES

The following figure 6 demonstrates the Pearson correlation coefficient between circular economy principles; Reduce, Reuse, Recycle, Redesign, Re-classification, and Renewable energy and quantity surveyor's roles in the pre-contract phase of construction projects which were derived from the SPSS based on the respondents’ opinions from the questionnaire survey. According to the derived correlation coefficients, all 6R principles have a positive and strong relationship with the Quantity Surveyor’s Role in the pre-contract phase which means QS can directly involve implementing CE principles in the pre-contract phase of construction projects.

In the following correlation table;

N = No of respondents (59)

Independent Variables

- ARAQ = Average of circular economy principle ‘Reduce’
- ARBQ = Average of circular economy principle ‘Reuse’
- ARCQ = Average of circular economy principle ‘Recycle’
- ARDQ = Average of circular economy principle ‘Redesign’
- AREQ = Average of circular economy principle ‘Re-classification’
- ARFQ = Average of circular economy principle ‘Renewable energy’

Dependent Variables

- ARGQ = Average of Quantity Surveyor’s roles at the Pre-Contract phase of construction projects

		Correlations						
		ARAQ	ARBQ	ARCQ	ARDQ	AREQ	ARFQ	ARGQ
ARAQ	Pearson Correlation	1	.950**	.945**	.935**	.718**	.919**	.962**
	Sig. (2-tailed)		<.001	<.001	<.001	<.001	<.001	<.001
	N	59	59	59	59	59	59	59
ARBQ	Pearson Correlation	.950**	1	.948**	.921**	.702**	.894**	.950**
	Sig. (2-tailed)	<.001		<.001	<.001	<.001	<.001	<.001
	N	59	59	59	59	59	59	59
ARCQ	Pearson Correlation	.945**	.948**	1	.922**	.689**	.868**	.930**
	Sig. (2-tailed)	<.001	<.001		<.001	<.001	<.001	<.001
	N	59	59	59	59	59	59	59
ARDQ	Pearson Correlation	.935**	.921**	.922**	1	.718**	.888**	.935**
	Sig. (2-tailed)	<.001	<.001	<.001		<.001	<.001	<.001
	N	59	59	59	59	59	59	59
AREQ	Pearson Correlation	.718**	.702**	.689**	.718**	1	.701**	.703**
	Sig. (2-tailed)	<.001	<.001	<.001	<.001		<.001	<.001
	N	59	59	59	59	59	59	59
ARFQ	Pearson Correlation	.919**	.894**	.868**	.888**	.701**	1	.957**
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001		<.001
	N	59	59	59	59	59	59	59
ARGQ	Pearson Correlation	.962**	.950**	.930**	.935**	.703**	.957**	1
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	
	N	59	59	59	59	59	59	59

\*\* Correlation is significant at the 0.01 level (2-tailed).

Figure 6: Correlation Coefficient Analysis of Variables

4.4. BARRIERS AND STRATEGIES TO IMPLEMENT THE CIRCULAR ECONOMIC PRINCIPLES THROUGH THE QUANTITY SURVEYORS’ ROLE IN THE PRE-CONTRACT PHASE OF CONSTRUCTION PROJECTS IN SRI LANKA

Codes	Name	Files	Refer
<input type="radio"/>	Past Professionals don't trust about new techniques	3	3
<input type="radio"/>	A lack of communication	3	3
<input type="radio"/>	Monitoring of progress is lacking	3	3
<input type="radio"/>	Administrative flexibility is limited	3	3
<input type="radio"/>	Inadequate design and construction integration	3	3
<input type="radio"/>	Poor quality amenities offered to workers	3	3
<input type="radio"/>	Inadequate programs for skill development	3	3
<input type="radio"/>	Professional are fearing about the implementations of new things	3	3
<input type="radio"/>	Engineers mostly enroll with the Pre-Contract phase in Sri Lanka	2	2
<input type="radio"/>	Governmental regulations	2	2
<input type="radio"/>	Using traditional procurement strategies for construction projects in Sri Lanka	2	2
<input type="radio"/>	Professions are accessible	2	2
<input type="radio"/>	Lack of availability of certain abilities in construction	2	2
<input type="radio"/>	Most Professionals are trying to depend on their duties only	1	1
<input type="radio"/>	Restricted financial support for staff training	1	1
<input type="radio"/>	Institutional organizations' assistance is insufficient	1	1
<input type="radio"/>	Using typical practice in Sri Lankan construction industry	1	1
<input type="radio"/>	Mainly forecast about the budget of the construction project by Clients	1	1
<input type="radio"/>	Sri Lankan Construction projects have limited time duration for finishing Pre-Contract stage	1	1

Figure 7: Barriers to implementing CE Principles through the QS’ role in the Pre-Contract Phase of Construction Projects in Sri Lanka



Codes		Search Project
Name	Files	References
Provide training and time to learn	3	3
Organizations must engage in mindset development efforts	2	2
In project brief, the quantity surveyor must act as a consultant or adviser	2	2
Make a platform similar to "Learn from the Past"	1	1
Educate labours more than professionals	1	1

Figure 8: Strategies for implementing CE Principles through the QS' role in the Pre-Contract Phase of Construction Projects in Sri Lanka

The above figure 7 and 8 show the barriers and strategies to implement the circular economic principles through the quantity surveyors role in the pre-contract phase of construction projects in Sri Lanka which was derived from the Nvivo based on the opinions from expert interviews. According to that, key strategies would be providing the appropriate training and time to Qs to learn CE, enhancing the development motive of conventional construction firms of Sri Lanka, promoting QS services from the "brief" stage of the projects, making learning from past platforms within construction organizations and educate labour force as same as professionals.

## 5. Conclusion and Recommendations

The primary objective of this study is to determine the relationship between the role of the quantity surveyor and circular economic principles for the achievement of other primary objectives while carrying out construction projects in Sri Lanka. The study found that applying Circular Economic Principles and the role of the quantity surveyor at the Pre-Contract phase of the construction is essential for minimizing difficulties. Quantity Surveyors' role in Sri Lanka's construction projects' pre-contract phase allowed for the identification of strategies for implementing the Circular Economic Principles into practice. The challenges of implementing those techniques into practice were then discussed. The study revealed that Qs can highly engage in applying circular economic principles in the pre-contract phase of construction projects in Sri Lanka. But there will be critical barriers such as reluctance to change, lack of communication, lack of progress monitoring, lack of administrative flexibility, inadequate design and construction integration, poor quality amenities offered to workers, inadequate programs for skill development, fear of change etc. Therefore, this research recommends conducting seminars and workshops for upper-level management and lower-level management would be important where they can troubleshoot the practical implementation of circular economic principles. Further Qs can motivate to adopt of circular economic principles through BIM to Sri Lankan construction projects since the architectural, engineering, and construction (AEC) sector is undergoing a digital transition where principles of the circular economy may also be included in that.

## 6. References

- Afshari, A. R., Górecki, J., & Afshari, R. (2019). Circular economy in construction sector. <https://www.researchgate.net/publication/335701046>
- Akinshipe, O., Aigbavboa, C., Oke, A., & Sekati, M. (2021). Transforming Quantity Surveying Firms in South Africa Through Digitalisation. *Lecture Notes in Networks and Systems*, 267, 255–265. [https://doi.org/10.1007/978-3-030-80876-1\\_33](https://doi.org/10.1007/978-3-030-80876-1_33)
- Akinshipe, O., Ikuabe, M., & Aigbavboa, C. (2022). Digital Transformation in Quantity Surveying: Where Lies the Issues? *Social and Occupational Ergonomics*, 65. <https://doi.org/10.54941/ahfe1002658>
- Akinsiku, O. (2014). Assessment of Quantity Surveyors' Service Quality. <https://www.researchgate.net/publication/328857865>
- Arayici, A., Arayici, Y., Khosrowshahi, F., Marshal Ponting, A., & Mihindu, S. (2009). Towards implementation of building information modelling in the construction industry Title Towards implementation of building information modelling in the construction industry Towards Implementation of Building Information Modelling in the Construction Industry. <http://usir.salford.ac.uk/id/eprint/20702/>
- Dorokhina, E. Yu., & Kharchenko, S. G. (2021). Circular Economy in Russia. In *Circular Economy: Recent Trends in Global Perspective* (pp. 309–327). Springer Nature Singapore. [https://doi.org/10.1007/978-981-16-0913-8\\_10](https://doi.org/10.1007/978-981-16-0913-8_10)
- Enshassi, A., Mohamed, S., & Abushaban, S. (2009). Factors affecting the performance of Construction projects in the Gaza Strip. *Journal of Civil Engineering and Management*, 15(3), 269–280. <https://doi.org/10.3846/1392-3730.2009.15.269-280>
- Evans, S., & Münster, M. B. (2022). Designing for a Circular Economy. <https://www.researchgate.net/publication/359992233>
- Heale, R., & Twycross, A. (2015). Validity and reliability in quantitative studies. In *Evidence-Based Nursing* (Vol. 18, Issue 3, pp. 66–67). BMJ Publishing Group. <https://doi.org/10.1136/eb-2015-102129>
- Mangialardo, A., & Micelli, E. (2018). Rethinking the construction industry under the circular economy: Principles and case studies. In *Green Energy and Technology* (Vol. 0, Issue 9783319757735, pp. 333–344). Springer Verlag. [https://doi.org/10.1007/978-3-319-75774-2\\_23](https://doi.org/10.1007/978-3-319-75774-2_23)
- Mukhopadhyay, B. R. (2014). What is the Circular Economy? <https://www.researchgate.net/publication/354462443>
- Panojan, P., Perera, B. A. K. S., & Dilakshan, R. (2022). Work-life balance of professional quantity surveyors engaged in the construction industry. *International Journal of Construction Management*, 22(5), 751–768. <https://doi.org/10.1080/15623599.2019.1644759>

- Reddy, Y. B. (2017). Modern Quantity Surveying-A complete package adding values to projects The Barriers to Implementation of BIM in Developing Countries View project. <https://doi.org/10.13140/RG.2.2.23580.08325>
- Rotimi, J. O. B., & Ramanayaka, C. D. D. (2015). Analysis of the influence of a strategy-led planning approach on successful construction project implementation. *Construction Economics and Building*, 15(2), 13–30. <https://doi.org/10.5130/AJCEB.v15i2.4282>
- Sinha, M., & Fukey, L. N. (2020). Circular Economy. In *Circular Economy for the Management of Operations* (pp. 89–117). CRC Press. <https://doi.org/10.1201/9781003002482-5>
- Takim, R., & Akintoye, A. (2002). Performance indicators for successful construction project performance Defects Liability Period Management View project sustainable View project. <https://www.researchgate.net/publication/284823994>
- Wahyu Adi, T. J., & Wibowo, P. (2020). Application of circular economy in the Indonesia construction industry. *IOP Conference Series: Materials Science and Engineering*, 849(1). <https://doi.org/10.1088/1757-899X/849/1/012049>
- Wijewansa, A. S., Tennakoon, G. A., Waidyasekara, K. G. A. S., & Ekanayake, B. J. (2021). Implementation of circular economy principles during pre-construction stage: the case of Sri Lanka. *Built Environment Project and Asset Management*, 11(4), 750–766. <https://doi.org/10.1108/BEPAM-04-2020-0072>
- Yu, Y., Junjan, V., Yazan, D. M., & Iacob, M. E. (2022). A systematic literature review on Circular Economy implementation in the construction industry: a policy-making perspective. In *Resources, Conservation and Recycling* (Vol. 183). Elsevier B.V. <https://doi.org/10.1016/j.resconrec.2022.106359>