QUANTITY SURVEYORS INCORPORATING CIRCULARITY AT EARLY PROJECT DESIGN STAGE: A LITERATURE REVIEW

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Consumption of natural resources has followed a linear approach known as the 'take, make, use, dispose model'. Whereas, the Circular Economy, where the leading design principles are to eliminate waste and circulate products / materials at their highest value possible. The architecture, engineering and construction sector is recognised as one of the largest consumers of raw materials and to be systemically linear in its processes and delivery, therefore, this presents an opportunity to achieve effective change at scale. All built environment disciplines and their skillsets will be required for effective implementation of 'Circular Construction'. With attention to Quantity Surveyors and their role, they must be prepared to cost a circular proposal or present alternatives. This area is still within its infancy and presentation of circular costs continues to evolve, lacking in consistency and standardisation. The literature review seeks to scope what guidance is currently available at early project design stages to realise the full potential of circularity.

Keywords: circular construction; circularity; costing lifecycle; quantity surveyors

INTRODUCTION

The pressing matter of addressing climate change and its devastating effects has become more prominent within society, from personal endeavours, business strategies to government legislation, global climate pledges and more. With an ever-growing human population, the need for food, shelter, and infrastructure increases - particularly in cities, where 75% of the world's production of natural resources is consumed (ARUP and BAM 2016). The consumption of virgin natural resources (minerals, water, gasses etc…) has predominantly followed a linear approach known as the 'take, make, use, dispose model'. The industrial revolution, urbanisation and consumerism has accelerated the use of virgin materials, depleted their stores and resulted in other negative effects such as excessive waste, ecosystem pollution and rising carbon emissions (ARUP 2016). The global community is urgently seeking alternate solutions to the scarcity of the planet's resources due to excessive human consumption. Thus, there is a gathering interest and conversation surrounding the Circular Economy as a potential solution to help mitigate the pressures of excessive waste and reduce consumption.

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Globally, the architecture, engineering, and construction (AEC) sector is recognised as one of the largest consumers of raw materials and is also recognised to be systemically linear in its processes and approach to delivery (McDonough and Braungart 2009). As a large consumer and polluter producing structures of substantial scale that are taking possession of land and the natural environment with significant lasting effect, this sector presents an opportunity to achieve effective change on a considerable scale by adopting circular economy principles. Often targeted by climate pledges and government legislation, the sector is urgently exploring solutions to design out waste and pollution, lower their carbon emissions, optimise operational costs, and extend the lifecycle of its structures, whether existing or new build.

This aspiration to reduce consumption and minimise waste is a challenge for the sector that requires everyone involved, from design to operations, to be conversant and educated within circularity as it is the most promising solution currently. ZeroWasteScotland (2017) identified that the skillsets of both project management and data categorisation would be required for effective implementation of circular construction; both of which are key skillsets of built environment disciplines. Similarly, an understanding of the whole building lifecycle, and the construction value chain can enable built environment professionals to leverage the opportunities afforded by circular construction (ARUP and BAM 2016).

With specific attention to cost consultancy and surveying, Fischer (2019) believes that by supporting the balance of risks and future potential of circular buildings with detailed financial modelling, circular construction can, and will, be successful. Consequently, utilising the existing skillset of construction professionals with the evolving upskilling in more sustainable and circular approaches such as, specifying and forecasting the use of reclaimed materials within projects from the early stages, can greatly benefit in achieving the environmental targets required to mitigate the over consumption of the planets' resources.

Thus, considering the foregoing, the aim of this paper is to explore what influence a Quantity Surveyor (QS), primarily those operating within Cost Consultancy, may have and what guidance is available to them to incorporate circularity at the early-stage design and briefing of a project.

This scoping literature review seeks to define circular construction and what is currently available to the Cost Consultant for influencing circularity at early-stage design and briefing. Initial and early review of source material indicated a gap within the literature for Quantity Surveyors/Cost Consultants in terms of how they, specifically, may practically apply circular principles within their practice and why it may be beneficial. The literature is primarily sourced from Industry Professional bodies, such as the Royal Institute of British Architects (RIBA) and the Royal Institution of Chartered Surveyors (RICS), and leading industry research projects/reports in circular economy - principally from Arup and their affiliated co-partners. Arranged thematically, the definitions are established and the information available currently to the sector is explored with a focus on the applicability for the Cost Consultant.

Circular Economy

Founded for the purpose of championing the Circular Economy, the Ellen Macarthur Foundation is a leading authority who define the circular economy as a 'systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution'. To achieve this, the leading design principles of a circular economy are to; eliminate waste and pollution, circulate products and materials and, thirdly, regenerate nature (Ellen MacArthur Foundation 2021). Essentially, the linear take, make, use, dispose model evolves to a more circular and 'looped' approach such as; take (from reclaimed materials), make, maintain, reuse (or, hierarchically, repurpose or lastly recycle) with very little, yet responsible, disposal at the end of life. Circle Economy (2021: 8) in their annual Circularity Gap Report in 2021 stated that 'combining the twin agendas of circular economy and climate mitigation gets us on a path to…prevent the worst effects of climate breakdown,' therefore, the circular economy certainly has the potential to alleviate resource consumption issues. Worryingly, their fifth and most recent report also states the current economy is still only 8.6% circular; the same percentage as 2021 and a decrease from the first Circularity Gap Report in 2018 where a figure of 9.1% was established (Circle Economy 2022: 14). As the conversation of both circular economy and climate agendas has intensified, it would have been anticipated that circularity increases in tandem with climate aspirations, however, the downward trend within the Circularity Gap Reports is certainly a point worthy of note that globally, circularity has decreased.

Circular Construction

Whilst the global overview of circularity identified a downward trend, there are pockets of practice within the architectural, construction and engineering sector that are beginning to incorporate circular principles within their practises, thus the terming of 'Circular Construction.' A distinction is made within the circular economy between the biological cycle, whereby biologically based materials are designed to be integrated and regenerate, whilst the technical cycle primarily focusses upon recovery and reuse of non-living products and materials.

The architectural, engineering and construction sector can largely be aligned to the technical cycle, yet not exclusively as there are exceptions to the rule which successfully merge both cycles such as green roofs and living walls. There are a number of different processes and ideas that fall under the umbrella term of circular construction; however, they can almost exclusively be aligned with one of the three guiding principles of circular construction which are identified as; 1) urban mining (the recycling and reuse of materials from existing built assets), 2) transformation and life extension of existing buildings and 3) designing for disassembly and flexible construction (Charlsson 2021). Each of the guiding principles are briefly outlined here.

Urban mining is essentially centred around the reclamation and reuse of elements, products, or materials (EPM). Viewing a building as several layers, or skins, and retrieval of EPM is largely attributed to Fischer (2019) within their landmark report 'Building Value: A Pathway to Circular Construction Finance.' There is a hierarchy to the reclamation and reusing of materials; reuse of an element, material or product for the same purpose is true circularity and is operating at maximum value (including refurbishment of existing assets), repurpose of EPM comes next and includes recovery of materials/products from on site or from other sites and, lastly, recycling is seen as a last resort as this is downgrading of an asset.

Transformation and life extension of existing buildings is the retrofit and regeneration of existing assets in order to provide a building which operates at its optimal performance possible. There are inevitably areas of an existing building which, even when retrofitted, may not perform as efficiently as new build, however, with careful consideration to the retrofit design, it can achieve comparable efficiencies in use of materials to construct, maintain and operate. Extending the life through repair and maintenance of an existing asset prolongs the use and value of it, thus maximising the justification for the initial use of the resources in its' creation (ARUP 2016).

Ghaffer *et al. (*2020) advocate that designing for disassembly and flexible construction incorporates designing for future adaptation, or even future disassembly. When designing for adaptation or disassembly, recovery of the materials is also considered. Thus, several layering of materials with adhesives and the like are problematic for disassembly/recovery, and as such, the material specification and construction is carefully considered. Furthermore, they found in their study with industry stakeholders that legislation for re-use and recycling would substantially improve circularity. Some other areas of practice that enhance and are within the remit of circular construction are the standardisation and modularisation of the industry - standard sizes should result in less wastage of materials due to cutting on/off site to nonstandard sizes.

Servitisation too is a practice whereby the product used remains under the ownership and maintenance of the Supplier, or 'Provider,' as is more appropriate in the scenario. ARUP and BAM (2016) note that servitisation is most known for lighting currently, however, there is scope for this to be used with other products too, particularly given the digitisation of the sector and 'smart' buildings. Magrini *et al.,* (2021: 2) have stated that the circular economy 'benefits from digital, online platforms and technologies. The digitisation of the AEC sector is occurring at a rate perhaps never seen, largely due to the acceleration in adopting digital practices as a necessity in responding to the COVID-19 pandemic and need to work from home, however, also with the range of digital technologies now available to the sector. This correlates with the findings of Cetin, De Wolf and Bocken (2021) who have developed a Circular Digital Built Environment Framework which maps digital technologies to circular construction practises in a bid to encourage practitioners to apply sustainable innovation in the sector.

Each of the guiding principles and practises have their own strengths, situational suitability, and barriers to implementation. Barriers to implementation can occur throughout the phases of a project, however, as much research suggests, successful projects begin with a strong, clear project brief and intent at the early stages, hence the focus within this scoping review on incorporating circularity at early-stage design.

The Design Team and Project Stages

Fischer (2019: 10) advocates that collaborative working in the sense of clear communication and cooperation between the stakeholders is key to successful implementation of circular construction as the 'the design, construction and harvesting process need to interlink closely'. Given construction projects have many stakeholders and involvement from a variety of disciplines, for clarity, this paper will focus upon the Client, Architect, Quantity Surveyor (Cost Consultant) and make occasional reference to the commercial entity of a Main Contractor.

To provide a framework and definition to 'early-stage design,' the paper utilises the most used, widely recognised and understood framework, which is that provided by the Royal Institute of British Architects (RIBA). Known as the RIBA Plan of Work, it provides a standardised framework for use by those in the construction industry, so everyone knows what is meant by a particular term, and what activities should be carried out at a particular stage. The RIBA Plan of Work, currently in the 2020 edition, divides a project into the various 8 stages of pre-tender (pre-contract) and post contract activity, commencing with Stage 0 'Strategic Definition' and ending with Stage 7 'Use' when the building is completed and starts its life as a fully operating facility.

In this paper, the focus will be on Stages 0 and 1, with elements of Stage 2. It is at these stages where the client must define their needs in terms of time, cost and quality before the design and cost activities can proceed. The main aim of a Quantity Surveyor is to link design and cost, to not only provide a balanced design but also ensure, as far as possible, value for money for the client. In practice, this means that a system is introduced and followed which allows both design and cost to be "tracked" at any stage of a project. The relationship between design and cost at every stage of the pre-contract process can be tabularised as follows:

Table 1: Design and Costing Activities mapped against RIBA Plan of Work

RIBA Stage	Design Activity	Cost Activity
0: Strategic Definition	Briefing by Client Initial Proposals	Feasibility Study / Preliminary Order of Cost Estimate
1: Preparation and Briefing	Feasibility studies: site, planning, etc.	Preliminary Order of Cost Estimate (to set the authorised budget)
2: Concept Design	Development of design / Alternative design proposals	First Cost Plan Estimate / Comparative Estimates
3: Spatial Coordination	Development of design Final Design proposals	Elemental Cost Planning
4: Technical Design	Full design of all elements, components, and specification	Pre-Tender Estimate Tender documentation e.g., bill of quantities

When considering each of the activities carried out under Design at any stage of the process, there is a corresponding activity under Cost. Initially we have the client identifying a need for the project, be it new build, refurbishment, or repair, and requesting some indication from the Design Team, which includes the Cost Consultant, of what can be achieved and for what cost. Construction is largely accepted as a client driven exercise and at the initial stages, it is imperative that the Client objectives are established for them to be successfully achieved and not diluted as a project - and the inevitable changes that occur - progresses. It is therefore key that circularity is considered from the outset for effective implementation. This is supported by Munaro *et al.* (2020) who evidenced the importance of incorporating, and discussing, circularity at the planning stage instead of the end-of-life stages to enable more informed decision making.

The Role of the Quantity Surveyor and Their Sphere Of Influence

The Cost Consultant has an integral role in the Design Team at the early stages and has a unique influence in relation to the cost of a project as they undertake Feasibility Cost Estimates, establish an Authorised Budget (or 'Cost Limit'), conduct Option Cost Appraisals, Whole Life Costs and Value Management/Engineering exercises. The activities a QS undertakes at these stages are intrinsically linked to one another and offer the potential of including circular construction; either to suggest the inclusion of circularity or ensure it remains within the design and cost parameters of the project - i.e., not removed or 'stripped out' due to being cost prohibitive.

The predominant professional body for surveyors is the Royal Institution of Chartered Surveyors (RICS). They regulate the practice of members and firms whilst providing guidance and market insights to the sector. One such insight related to the business case for the circular economy within the sector and, the then Chief Executive Officer Tompkins (2020) said:

> "RICS professionals will be uniquely placed to realise circular economy practices. Among the other built environment professions, it is our profession alone that is engaged at every stage of an asset's lifespan"

Whilst the statement arguably may not be inherently true that the profession is the only one engaged at every stage, the sentiment that it is one of the professions engaged throughout the lifecycle of an asset is important as this is critical to the 'loop' of the circular economy, making, maintaining, and reclaiming. As a client driven exercise, construction professionals respond to the needs of their client, which may or may not include circular principles. If not driven from the Client themselves, the design team could introduce circular principles into the design - this infers that designers, such as Architects and Engineers as the specifiers of materials and the design will have the greatest opportunity to influence. Yet, in many cases, cost is a driver and deciding factor in many material choices and design decisions.

As the QS discipline is present and integral to each stage, they do not have a bias to any one stage and can balance the needs of a given stage/time against those of, say, stages further in the lifecycle of an asset. That is to say, they have an appreciation for not only the capital expenditure of a project, but the Whole Life Cost (WLC). To a client, the actual cost of construction may be only one part of a wider picture. There are likely to be many other associated costs which the client will have to pay, and this is known as the Whole Life Cost. Potts and Ankrah (2013: 138) state that one of the most important of the many benefits of WLC is the communication it fosters between stakeholders; it encourages true interrogation of the proposed design and material choices and thus maximises the value to be obtained. They further discuss the importance of including the whole supply chain as early as possible in the design as "80% of the future costs of running maintenance repair is fixed in the first 20% of the design process." Interestingly, the guidance provided by RICS to its' members for Whole Life Costs has begun to evolve and be more holistic by its inclusion of sustainable construction concepts. The most recent publication on these matters, the RICS Cost Prediction Practice Statement is mandatory to comply with for its members and firms. The document contains a more fulsome diagram that is shown in Figure 1.

A more holistic view is being taken and that guidance now incorporates further standards. Interestingly, it is noted the phrase 'cradle to grave' is used in lieu of the more circular sentiment of 'cradle to cradle'. This does intimate that the tools and processes at the Quantity Surveyor's disposal do not necessarily promote and enable circularity, rather that they still tend towards more traditional linear approaches. To refer directly to the establishing of a Cost Limit, preparation of Cost Estimates and Plans at Stages 0 through to 3, possibly 4, it is the RICS New Rules of Measurement (NRM) 1 document the Cost Consultant will refer to. The RICS NRM is a suite of documents issued by the RICS Quantity Surveying and Construction Professional Group. The suite consists of 3 documents: NRM1, NRM2 and NRM3. The rules have been written to provide a standard set of measurement rules that are understandable by anyone involved in a construction project. RICS define the NRM documents as a 'Guidance Note' which essentially means it is recommended good practice - not mandatory compliance.

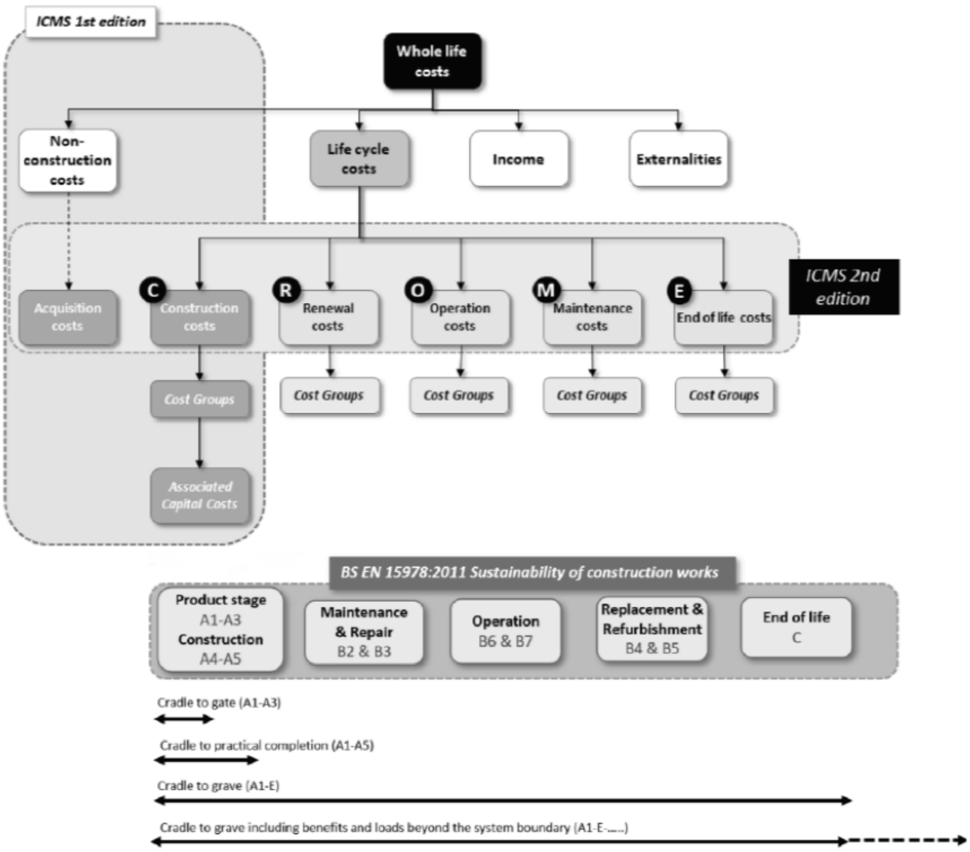

Figure 1: ICMS 2nd Edition mapped against ICMS 1st Edition and BS 15978:2011 (RICS 2020)

It is NRM1: Order of Cost Estimating and Cost Planning for Capital Building Works that concentrates on Pre-Contract Cost Forecasting; both Cost Estimating and Cost Planning - i.e., early stages of a project. RICS state the document to be 'indispensable guidance on the quantification of building works for the purpose of preparing cost estimates and cost plans' (RICS 2012: 2).

The three RICS issued guidance notes which are integral to the activities undertaken by a Cost Consultant at the stages critical for encouraging circularity; NRM1, Cost Prediction and Life Cycle Costing all currently fail to include any mention of circular principles. NRM1 does allude to sustainability strategies and in terms of incorporating any 'sustainability aspirations,' rely upon the information provided by the Architect. This appears to correlate with the findings of Fischer (2019) and Acharya, Boyd and Finch (2018) whereby both authors identified a challenge for circularity within the sector to be awareness and 'misalignment' between the various disciplines, business planning cycles and the built environment asset life cycle. The foregoing has predominantly focussed upon the Cost Consultant and Early Stages of Design/Costing; however, it is also important to note that to include circularity by way of reclaimed materials, contracting organisations and 'commercial' surveyors must also have an appreciation of circularity. For instance, there must be a market supply of elements, materials and products with consideration given to their quantity, testing, anticipated timing for programming purposes and their location for delivery and carbon considerations - many of which are considerations for the commercial surveyor (Fischer 2019).

How the QS Discipline Relates to the Architect

A professional discipline within the AEC sector which has set a precedent and included circularity principles within their issued guidance for embedding in practice is that of the Architect and the RIBA Plan of Work, complemented too by their Sustainable Outcomes Guide. RIBA (2020: 74) in the Plan of Work within the Sustainability Strategy strand begins in Stage 0 to explicitly include circular principles: 'Undertake a Site Appraisal of sustainability opportunities and constraints of potential sites and building assets. Prioritise total or partial reuse of existing facilities, buildings, components, or materials.' The prioritisation of reusing an existing asset in its totality or partially, is a fundamental principle of circularity. Furthermore, each of the Plan of Work stages has a sustainable strategy which corresponds with the RIBA Sustainable Outcomes, one of which is the Sustainable Life Cycle Value. RIBA (2019) explain this is the operational running costs of a building in use, with a metric of £/m2, compared against the return value, which is inclusive of rental, building value and, interestingly, social value.

The activities to be undertaken include the development of a whole life cost plan incorporating the value of sustainability outcomes at stage 0, progressing in stage 1 to 'define an outcome target for life cycle value for key building systems, determining the scope of life cycle assessment and specifying measurable outcomes and targets for whole life carbon, whole life costs, building life span, refurbishment rates, end of life and circular economy' (RIBA 2020: 77). Given the nature of the metric and the activities outlined, the design and cost balance reach an optimal intersection with circularity that requires both the Architect and cost consultant to contribute collaboratively for the most effective implementation. Equally, this inclusion of circularity by a professional body to its members and firms sets a strong precedent and an opportunity for a best practice collaborative framework which could be integrated into the tools and processes of the cost consultant to better enable them to influence and incorporate circularity into cost plans in a standardised approach.

CONCLUSION AND THE GAP IN KNOWLEDGE IDENTIFIED

As an exploratory literature review seeking to scope what guidance is available to the cost consultant at early project design to incorporate circular construction concepts, it was prudent to firstly define the circular economy and circular construction itself to provide context and distinguish the differences between the linear traditional approach currently most used, and understood, in the AEC sector today. Thereafter, the review focussed upon providing a framework and noted the activities undertaken by a Quantity Surveyor at early-stage design which were attributed, in the current, predominant linear practice of the AEC sector to be most likely conducted by a Cost Consultant as opposed to a commercial surveyor. In analysing the tools and processes available to the QS consultant at those stages, as issued by their regulatory professional body, it was found that they are not yet inclusive of circular principles or approaches, and indeed, may not even be conducive towards them.

The guidance for producing industry standard Cost Estimates and Plans fail to mention circularity or associated ideas and are more suited toward the traditional linear approach. The guidance and presentation of costs at early stage are largely focussed upon the Capital Expenditure of a project and do not feature the whole life cost as standard unless as a wholly separate report at the Clients request. It can be concluded that the driver for including circularity, and indeed even whole life costs, is largely from the Client and their requirements and not from the QS; not that the QS can, or should, be the sole driver of circularity, however, they are a key and integral member of the design team. The influence on the procurement and material choices of a project, largely driven by the Client objectives and cost do place the QS in a unique position within the team as they attempt to strike the optimal balance. Unfortunately, as a profession, it is concluded that they currently lack the standardised approach for inclusion of circularity and are thus not realising the potential of the influence they could have upon a project. As the sector seeks smarter and more sustainable methods and models of building, circularity could be a wise option at this inflection point of change in the industry and world.

In terms of limitations to this paper, literature specific to the cost consultant and circularity is sparse; their professional bodies and industry literature are exploring, and advocating circularity, however, the guidance and process have yet to evolve in tandem. A more systematic literature review could be conducted to identify parameters from the early scoping and then further interrogation of the topic by developing an appropriate methodological research design to investigate the extent of influence a cost consultant could have and whether there could be effective practical application. Until the inclusion of circularity within the tools and processes available to the cost consultant, it is likely to be the minority innovator or at the bequest of the client, that circular concepts become the norm. As more traditional, linear methods of procurement and material usage are ingrained within the culture of the industry, circular construction could be the disruptive model the industry needs to rectify the over consumption of resources and provide the built environment that the future generations will need - and of the climate conscious type they will want. This is indeed an opportunity to build back wiser.

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