Quality in Construction Design Best Practice Tool

David Myers et al.

Draft for circulation to GIRI and ADM Members

Introduction

Poor quality in construction projects is a massive problem. We all know of construction projects that have failed to meet their targets – and by a wide margin. Analysis by GIRI (Get It Right Initiative, www.getitright.uk.com, a group of industry experts, organisations and businesses dedicated to eliminating error and improving the UK construction industry) showed that the average construction project overruns its budget by 20% with worst case examples being 300-400%. For multi-million pound projects, this is significant; in the UK alone this amounts to £21Bn per year. And further than that, GIRI reports that time overruns can be many years. Add to add to the costs, poor design also generates health and safety hazards.

Quality problems in design result in rework (which is a major element of the cost of poor quality). The GIRI analysis concluded that many project quality issues have their root cause in the design stages of a project. The Construction Owners Association of Alberta (COAA, Canada) undertook a Rework Cause Survey in 2001 found that about 85% of rework in construction projects is due to inadequate quality processes in the planning and design stages, due to inadequate Engineering and reviews (30%), Construction planning and scheduling (26%) and about half of the 18% attributed to inadequate Leadership. This is another way in which inadequate 'front end loading' of construction projects leads to 'back end' problems which cost much more than the cost of thorough planning up-front. For those with experience in the industry, these findings are unsurprising.

Best Practice in Construction Design

The failures identified in the COAA study are clearly not best practice. So what is?

The study provided data for a design and construction company which plotted the percentage budget overrun with the degree of conformance with their QMS requirements. The results were stark: those projects that had high conformance with the QMS came in close to budget; and the less a project conformed with the QMS, the greater the scatter of overruns – meaning that one or two poorly conforming projects still came in close to budget (probably by luck), most failed miserably.

In 2020, the Chartered Quality Institute (UK's leading Quality organisation) published a piece of Quality guidance called the Construction Project Lifecycle which laid out the key Quality steps required to maximise the chance of success in construction projects. This guidance sparked wide interest and positive comments around the world. These interested people felt that more guidance about Quality Best Practices in the design stages of projects would be a very useful guidance tool.

The authors considered that a tool that sets out best practice and measures degree of conformance to it would, if used properly, would go a long way to preventing construction design failures.

The 'Quality in Construction Design Best Practice Tool'

Since December 2020 a small global team of experts have developed the "Quality in Construction Design Best Practice Tool'. More about how they did this later – page 9 on.

Construction design commonly occurs in two main stages: Concept design and Developed design (as defined by UK's Royal Institute of British Architects; sometimes these are called the Options and Scheme design stages).

The Tool should be used during the Concept Design and Developed Design stages of a project

The starting point is the business case approval gateway (or some kind of project kick-off decision). That is, a client/owner has decided that an idea should be explored and set aside the necessary funds to develop a more detailed proposal.

At the end of the Concept stage, there may be a Recommended Options Approval Gateway, before the commencement of the Developed Design Stage. On lower risk projects, this may also include funding for the entire project.

At the end of the Developed Design Stage, it is likely that a more detailed cost and schedule would be used to seek approval for the funding of the entire project. After this (and not covered by this guidance Tool) the project would move to production design, delivery stages and then to handover and operations/maintenance.

The Best Practice Tool is in the form of a spreadsheet comprising two information sheets and three worksheets:

1. Rationale and Landscape
2. Glossary
3. Cover Sheet & Self-Assessment Summary
4. Concept Evaluation Assessment
5. Developed Design Assessment.

The Rationale and Landscape sheet sets out the rationale for this work (much of which is included in this paper) and lists the team members; the Glossary sheet is just that.

Of the three worksheets, the Coversheet is a schematic of the Tool's logic, and includes a '% maturity' score (i.e. alignment with Best Practice) for each section for each of the 'Concept Evaluation Assessment' and 'Developed Design Assessment'.

The 'Concept Evaluation Assessment' and 'Developed Design Assessment' sheets each comprise six tables:

1. Plan / Schedule / Cost
2. Requirements and Design Management
3. Risks / Assumptions
4. Communication, Collaboration, Stakeholders and Interfaces
5. Procurement and Contract Administration – Delivery
6. Concepts Evaluation & Report

Each table is divided into three Sections: 'Plan and Mobilise Checkpoint', 'Design Checkpoint', 'Validate & Assure Checkpoint'.

Each Section has a number of requirements, and for each requirement there is a self-assessed 6-point score:

Scoring	Definition
0	Not yet considered
1	Plan in place
2	Some progress
3	Significant progress
4	Activity complete
5	Approved and documented
n/a	Not applicable to this project

The Tool tracks the scores and totals them as a percentage of the perfect alignment with Best Practice (100%). The closer to 100% the scores are for each Section, the more confident the project leaders and owners can be that the project will be executed successfully.

Figure 1 shows snapshots of the Tool – see the following pages:

Fig 1a Coversheet and Self -Assessment Summary

Fig 1b Concept Evaluation Assessment

Fig 1c Developed Design Assessment

Fig 1a Coversheet and Self -Assessment Summary

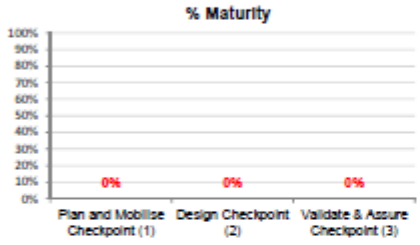
Concept and Developed Design - Quality Best Practice Self Assessment

Business Case	
Project	
Concept and Developed Design Director	
Delivery Director	

Project Manager	
Quality Manager	
Project Office Representative	

Concept Design Stage

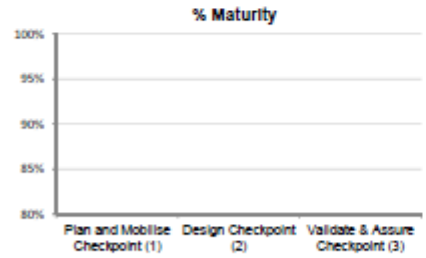
Plan and Mobilise Checkpoint (1)		Design Checkpoint (2)		Validate & Assure Checkpoint (3)	
Score	0	Score	0	Score	0
% of Total	0%	% of Total	0%	% of Total	0%



Commentary:

Developed Design Stage

Plan and Mobilise Checkpoint (1)		Design Checkpoint (2)		Validate & Assure Checkpoint (3)	
Score	0	Score	0	Score	0
% of Total	0%	% of Total	0%	% of Total	0%

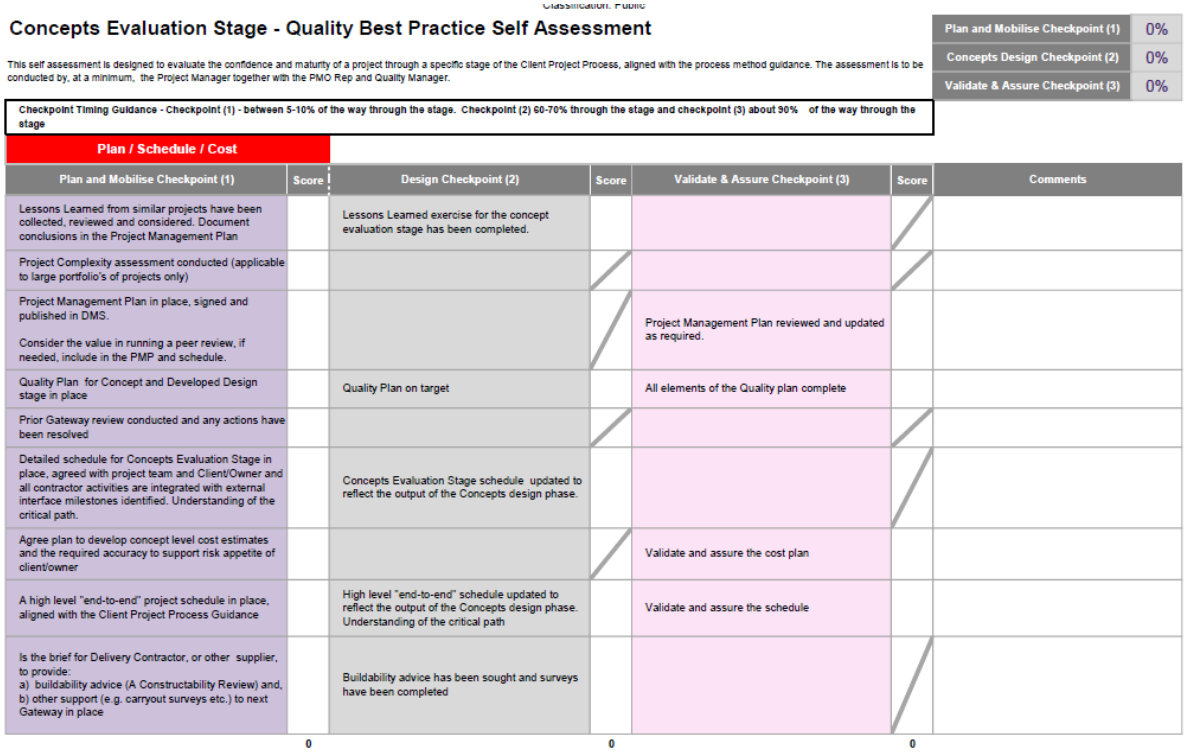


Commentary:

Scoring	Definition
0	Not yet considered
1	Plan in place
2	Some progress
3	Significant progress
4	Activity complete
5	Approved and documented
n/a	Not applicable to this project

Note: Do not delete this table.

Fig 1b Concept Evaluation Assessment – two snapshots



Classification: Public

Concepts Evaluation Stage - Quality Best Practice Self Assessment

Plan and Mobilise Checkpoint (1)	0%
Concepts Design Checkpoint (2)	0%
Validate & Assure Checkpoint (3)	0%

This self assessment is designed to evaluate the confidence and maturity of a project through a specific stage of the Client Project Process, aligned with the process method guidance. The assessment is to be conducted by, at a minimum, the Project Manager together with the PMO Rep and Quality Manager.

Checkpoint Timing Guidance - Checkpoint (1) - between 5-10% of the way through the stage. Checkpoint (2) 60-70% through the stage and checkpoint (3) about 90% of the way through the stage

Plan / Schedule / Cost

Plan and Mobilise Checkpoint (1)	Score	Design Checkpoint (2)	Score	Validate & Assure Checkpoint (3)	Score	Comments
Lessons Learned from similar projects have been collected, reviewed and considered. Document conclusions in the Project Management Plan		Lessons Learned exercise for the concept evaluation stage has been completed.				
Project Complexity assessment conducted (applicable to large portfolio's of projects only)						
Project Management Plan in place, signed and published in DMS. Consider the value in running a peer review, if needed, include in the PMP and schedule.				Project Management Plan reviewed and updated as required.		
Quality Plan for Concept and Developed Design stage in place		Quality Plan on target		All elements of the Quality plan complete		
Prior Gateway review conducted and any actions have been resolved						
Detailed schedule for Concepts Evaluation Stage in place, agreed with project team and Client/Owner and all contractor activities are integrated with external interface milestones identified. Understanding of the critical path.		Concepts Evaluation Stage schedule updated to reflect the output of the Concepts design phase.				
Agree plan to develop concept level cost estimates and the required accuracy to support risk appetite of client/owner				Validate and assure the cost plan		
A high level "end-to-end" project schedule in place, aligned with the Client Project Process Guidance		High level "end-to-end" schedule updated to reflect the output of the Concepts design phase. Understanding of the critical path		Validate and assure the schedule		
Is the brief for Delivery Contractor, or other supplier, to provide: a) buildability advice (A Constructability Review) and, b) other support (e.g. carryout surveys etc.) to next Gateway in place		Buildability advice has been sought and surveys have been completed				
	0		0		0	

Classification: Public

Requirements and Design Management

Plan and Mobilise Checkpoint (1)	Score	Design Checkpoint (2)	Score	Validate & Assure Checkpoint (3)	Score	Comments
Have prior Gateway actions been resolved or plan in place (if applicable)? Have you got a fully approved "Project OK to Start" document for the project?						
Have you considered: boundary diagram, concept of operations workshops, types of requirements etc. Are these activities in the schedule.						
Assure that all team members and stakeholders have provided updated requirements.		Have all types of requirements been documented? Have all the relevant specs and legislation been identified? Have Safety-in-Design and Sustainability-in-Design requirements been added?		Requirements document has been developed further, reviewed and agreed with relevant areas of the business (e.g. Operations, Asset Owners, Maintenance, Commissioning Teams, end users and affected stakeholders)		
Has the Requirements Document been updated ahead of design commencing, circulated to all team members/stakeholders and published in DMS? Are the project Client/Owner Requirements and the design requirements for the Concepts design clear, documented and referenced to the operational benefits?		Have changes to requirements that effect scope been communicated formally via the Contract mechanisms Change has been incorporated in the Basis of Design.		o Have any last minute changes to requirements that effect scope been communicated formally via the Contract mechanisms o Last minute change to requirements has been incorporated in the Basis of Design o Benefits quantified and linked to requirements were appropriate o Link to Benefits Plan and/or the Maintenance/ Operations Management plans where applicable..		
A Design Management Plan is in place including definition of the plan for BIM and a Common Data Environment (CDE), a Design Review Schedule and a design change approval process		All design changes have been approved				
The Design Brief is clear and unambiguous. Any assumptions that are needed have been specified. (See Risks and Assumptions section)		Has appropriate buildability and constructability input/advice been sought?				
All the design deliverables (within the brief) are clear?				All design deliverables met		
Required models and drawings to the Client/Owner specified format are clear?		All models and drawings are being prepared		All models and drawings have been delivered		
Are the timescales for the concept design aligned with the level of risk tolerated by the owner/client? i.e. The selected option will not be perfect unless the time allowed is infinite.		Is the design work on target? i.e. Is the design work driving satisfactorily to a timely conclusion? Are the timescales and risks still aligned? Are the number of unknowns reducing?				
Plan developed to load the requirements into the QVP (Quality Verification Plan), staring with the Client Requirements and benefits		QVP has been loaded with Client level requirements and is now owned by the Concept Evaluation Designer. Concepts design requirements have been added (this can be part of the Requirements document)		Updated QVP ready to be handed over to the Developed Design designer		
Basis of design aligns with Requirements.		Determine future on-site survey scope needed to inform the developed design. Incorporate these surveys into the project schedule.				
	0		0		0	

Classification: Public

Risks / Assumptions

Plan and Mobilise Checkpoint (1)	Score	Design Checkpoint (2)	Score	Validate & Assure Checkpoint (3)	Score	Comments
Risks & assumptions have been explored & captured. Project Assumptions Register is published in DMS.		Risk register with mitigation plans exist and are published in DMS.		Risk register with mitigation plans has been reviewed and updated in line with the Concept selected.		
		Have assumptions been reviewed and updated as required?		Have assumptions been reviewed and updated as required and incorporated in the risk assessment?		
		Risks and assumptions around functional and non-functional requirements have been explored and captured				
		Have the relevant Lessons Learned been considered in the Concepts design?				
	0		0		0	

Communication, Collaboration Stakeholders and Interfaces

Plan and Mobilise Checkpoint (1)	Score	Design Checkpoint (2)	Score	Validate & Assure Checkpoint (3)	Score	Comments
Stakeholder Engagement Plan and Project Organisation Chart in place published in DMS. (If required - Maybe part of the PMP)		Stakeholder Engagement Plan has been updated including records of consultation and engagement		Stakeholder Engagement Plan is updated including records of consultation and engagement		
Appropriate Collaboration events are planned (e.g. Design for Safety, Buildability, Design Reviews, co-ordination/interface reviews)				Concept evaluation workshops held and minuted with all stakeholders		
Are interfaces with other projects understood and high level project interface milestones identified?		Have interfaces with other projects, operations or any others changed?				
	0		0		0	

Classification: Public

Procurement and Contract Administration - Delivery

Plan and Mobilise Checkpoint (1)	Score	Design Checkpoint (2)	Score	Validate & Assure Checkpoint (3)	Score	Comments
Has the Procurement Strategy been agreed and documented? If it is outside the standard client procurement model was approval obtained. (If required,)		Draft Contract Documentation prepared?. Have the Employers Requirements been included?		If required; has agreement to Procurement Plan been obtained?		
If outside the standard client procurement model, has the support needed for the new contractors been discussed with the quality team and necessary actions taken?		Do the contracts deliver the expected levels of quality assurance?				
	0		0		0	

Concepts Evaluation & Report

Plan and Mobilise Checkpoint (1)	Score	Design Checkpoint (2)	Score	Validate & Assure Checkpoint (3)	Score	Comments
Has the Structure and approach for Concepts report been agreed between Client and design Contractors?		Have the "Concept Evaluation Criteria" been developed for each Concept that will be evaluated?		Has the Concept Report reviewed, agreed and signed off by Client/Owner Project Manager and does it fulfil the "Concept evaluation criteria"?		
		Has the basis for Concepts evaluation been agreed with the project team and key stakeholders?				
		Has an Concepts Report been produced with clear preferred Concept evaluated?				
	0		0		0	
Plan and Mobilise Checkpoint (1)	0	Design Checkpoint (2)	0	Validate & Assure Checkpoint (3)	0	
Total as a percentage	0%	Total as a percentage	0%	Total as a percentage	0%	

Fig 1c Developed Design Assessment – two snapshots

Classification: Public

Developed Design Stage - Quality Best Practice Self Assessment

Plan and Mobilise Checkpoint (1)	0%
Concepts Design Checkpoint (2)	0%
Validate & Assure Checkpoint (3)	0%

This self assessment is designed to evaluate the confidence and maturity of a project through a specific stage of the Client Project Process, aligned with the process method guidance. The assessment is to be conducted by, at a minimum, the Project Manager together with the PMO Representative and Quality Manager.

Checkpoint Timing Guidance - Checkpoint (1) - between 5-10% of the way through the stage. Checkpoint (2) 60-70% through the stage and checkpoint (3) about 90% of the way through the stage

Plan / Schedule / Cost

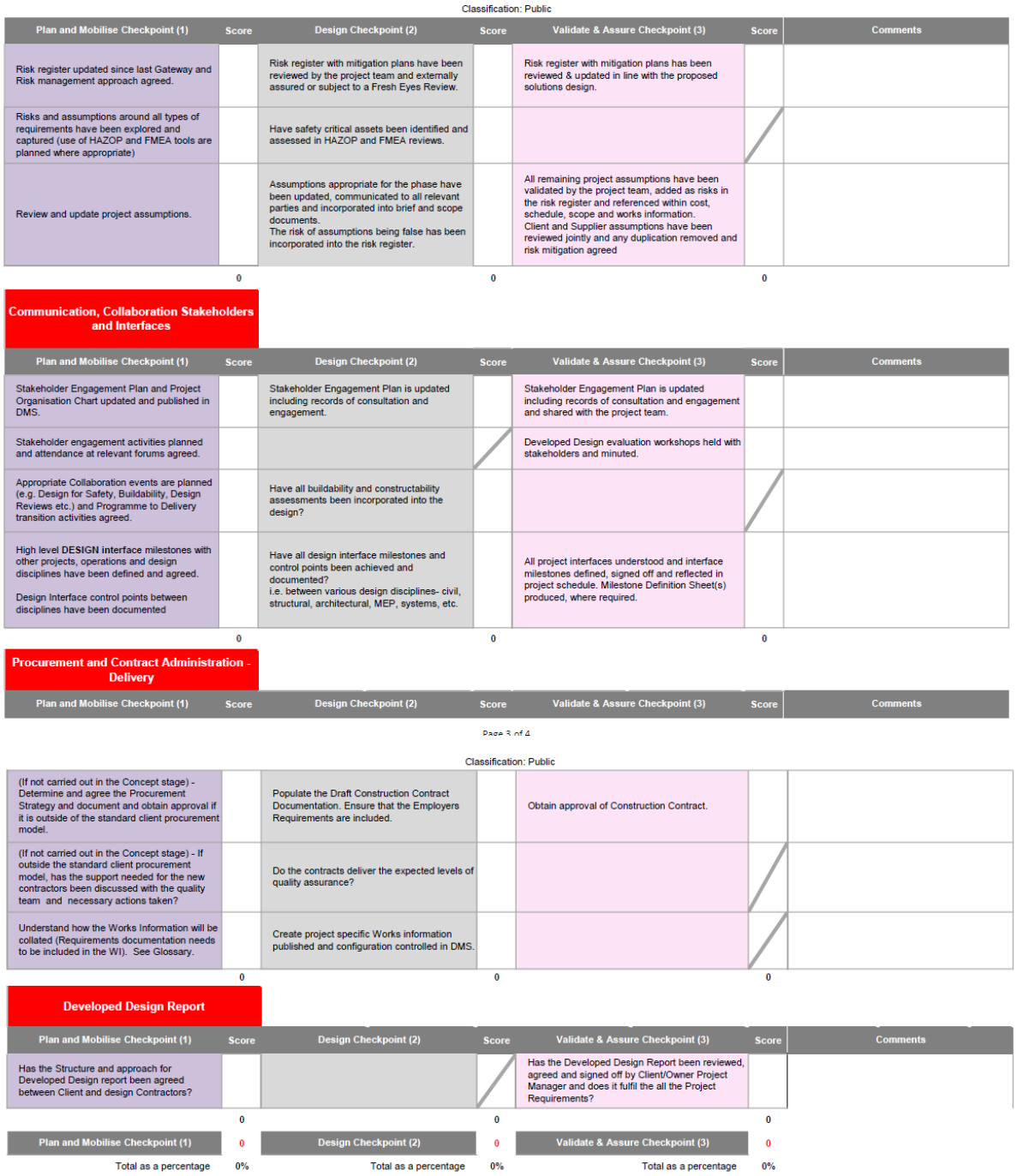
Plan and Mobilise Checkpoint (1)	Score	Design Checkpoint (2)	Score	Validate & Assure Checkpoint (3)	Score	Comments
Project Complexity assessment updated if required						
Project Management Plan reviewed and updated, signed and published in DMS.						
Detailed schedule for Developed Design in place, agreed with project team and Client/Owner. All contractor activities are integrated with external interface milestones identified.		Developed Design schedule, drafted in the Concept stage, to be updated to reflect the output of the developed design phase.		Delivery Contractor Schedule(s) provided, based on client agreed project WBS and accompanied by a narrative articulating risks, assumptions etc. (assumes early procurement of Delivery Contractor)		
A high level "end-to-end" project schedule in place aligned with the Client Project Process Guidance Understanding of the critical path.		High level "end-to-end" schedule updated to reflect the output of the developed design phase. Understanding of the critical path		High level "end-to end" schedule updated incorporating construction durations based on Delivery Contractor input. Understanding of the critical path		
A plan to develop and gain approval for a the Developed Design project cost estimates is in place? The level of accuracy required has been established and agreed?		Developed design costs estimates ready for validation		Developed design costs estimates have been validation Validate / assure the cost, schedule & risk.		
Revisit latest Lesson Learned from similar projects - reviewed and considered as required?		Lessons Learned review has been completed and LL incorporated into the developed design.				
Brief for Delivery Contractor Integration Services up to next gateway in place		Next Gateway readiness assessment events planned		Developed Design Gateway readiness assessment events held and actions completed		
Create Handover Plan and engage all stakeholders as required.		Have Engineering and Operations been fully engaged in line with the Handover Plan? (See Glossary)		Have Maintenance and Operations approved the Handover Plan?		
	0		0		0	

Requirements and Design Management

Classification: Public

Plan and Mobilise Checkpoint (1)	Score	Design Checkpoint (2)	Score	Validate & Assure Checkpoint (3)	Score	Comments
Have prior Gateway actions been resolved or plan in place (if applicable)?						
Has the Requirements Document been updated (with Developed Design level requirements and any changes to existing Client requirements and options requirements), approved by affected stakeholders ahead of design commencing, and published in DMS?		Change to requirements have been communicated formally via contract mechanisms Change has been incorporated in the Basis of Design as required		Have any last minute changes to requirements been communicated formally via contract mechanisms Last minute change to requirements has been incorporated in the Basis of Design as required. Have Benefits been quantified.		
Is a Design Management Plan in place including definition of the plan for BIM and a Common Data Environment (CDE), a Design Review Schedule and a design change approval process		All design changes have been approved				
The Design Brief is clear and unambiguous. Any assumptions that are needed have been specified.		Has appropriate buildability and constructability input/advice been sought? Have all relevant on-site surveys been carried out to inform the design?				
All the design deliverables are clear		Developed Design Report reviewed by Client/Owner Project Manager and agreed.		All design deliverables met		
Required technical specifications, models and drawings to the Client specified format are clear		All models and drawings are being prepared		All models and drawings have been delivered		
Has the optimisation of the design been agreed versus the time and cost? I.e. a low cost, quick design may lead to a heavily over-engineered solution. Save now but pay later.				Have the design optimisation targets been validated?		
Has the design schedule been updated with any delays incurred during the concept design?						
Basis of design aligns with Requirements.		QVP has been discussed and agreed with the Delivery Contractor. Have safety critical assets been incorporated into the QVP?				
All newly identified requirements loaded the into the QVP (Quality Verification Plan)		Updated QVP available		Updated QVP ready to be handed over to the production Design teams		
	0		0		0	

Risks / Assumptions



Classification: Public

Plan and Mobilise Checkpoint (1)	Score	Design Checkpoint (2)	Score	Validate & Assure Checkpoint (3)	Score	Comments
Risk register updated since last Gateway and Risk management approach agreed.		Risk register with mitigation plans have been reviewed by the project team and externally assured or subject to a Fresh Eyes Review.		Risk register with mitigation plans has been reviewed & updated in line with the proposed solutions design.		
Risks and assumptions around all types of requirements have been explored and captured (use of HAZOP and FMEA tools are planned where appropriate)		Have safety critical assets been identified and assessed in HAZOP and FMEA reviews.				
Review and update project assumptions.		Assumptions appropriate for the phase have been updated, communicated to all relevant parties and incorporated into brief and scope documents. The risk of assumptions being false has been incorporated into the risk register.		All remaining project assumptions have been validated by the project team, added as risks in the risk register and referenced within cost, schedule, scope and works information. Client and Supplier assumptions have been reviewed jointly and any duplication removed and risk mitigation agreed		
	0		0		0	

Communication, Collaboration Stakeholders and Interfaces

Plan and Mobilise Checkpoint (1)	Score	Design Checkpoint (2)	Score	Validate & Assure Checkpoint (3)	Score	Comments
Stakeholder Engagement Plan and Project Organisation Chart updated and published in DMS.		Stakeholder Engagement Plan is updated including records of consultation and engagement.		Stakeholder Engagement Plan is updated including records of consultation and engagement and shared with the project team.		
Stakeholder engagement activities planned and attendance at relevant forums agreed.				Developed Design evaluation workshops held with stakeholders and minuted.		
Appropriate Collaboration events are planned (e.g. Design for Safety, Buildability, Design Reviews etc.) and Programme to Delivery transition activities agreed.		Have all buildability and constructability assessments been incorporated into the design?				
High level DESIGN interface milestones with other projects, operations and design disciplines have been defined and agreed. Design Interface control points between disciplines have been documented		Have all design interface milestones and control points been achieved and documented? i.e. between various design disciplines- civil, structural, architectural, MEP, systems, etc.		All project interfaces understood and interface milestones defined, signed off and reflected in project schedule. Milestone Definition Sheet(s) produced, where required.		
	0		0		0	

Procurement and Contract Administration - Delivery

Plan and Mobilise Checkpoint (1)	Score	Design Checkpoint (2)	Score	Validate & Assure Checkpoint (3)	Score	Comments

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Classification: Public

(If not carried out in the Concept stage) - Determine and agree the Procurement Strategy and document and obtain approval if it is outside of the standard client procurement model.		Populate the Draft Construction Contract Documentation. Ensure that the Employers Requirements are included.		Obtain approval of Construction Contract.		
(If not carried out in the Concept stage) - If outside the standard client procurement model, has the support needed for the new contractors been discussed with the quality team and necessary actions taken?		Do the contracts deliver the expected levels of quality assurance?				
Understand how the Works Information will be collated (Requirements documentation needs to be included in the WI). See Glossary.		Create project specific Works information published and configuration controlled in DMS.				
	0		0		0	

Developed Design Report

Plan and Mobilise Checkpoint (1)	Score	Design Checkpoint (2)	Score	Validate & Assure Checkpoint (3)	Score	Comments
Has the Structure and approach for Developed Design report been agreed between Client and design Contractors?				Has the Developed Design Report been reviewed, agreed and signed off by Client/Owner Project Manager and does it fulfil the all the Project Requirements?		
	0		0		0	

Plan and Mobilise Checkpoint (1)	0	Design Checkpoint (2)	0	Validate & Assure Checkpoint (3)	0
Total as a percentage	0%	Total as a percentage	0%	Total as a percentage	0%

The tool is available here [http://consig.org/wp-content/uploads/2021/05/Design-Stage-Quality-Best-Practice-v2.3-March-4-2021.xlsx].

The team

The team was assembled through our networks to get a good coverage of experience, geography and affiliations. The original team comprised:

Name	Country	Companies	Affiliations	LinkedIn address
David Myers	UK	Shirley Parsons ex Heathrow Airport	CQI	www.linkedin.com/in/david-myers-3535591
Anita McReynolds- Lidbury	USA	Arcadis; now Austin Transit Partnership	ASQ	www.linkedin.com/in/anita-m-aa7a9a11
Greg Wennerstrom	Canada	Lusail LRT Project, QCVC Alstom Consortium	ASQ	www.linkedin.com/in/gregwennerstrom
Martin Andrew	Australia	Ex AECOM and URS	AOQ	www.linkedin.com/in/martinhandrew
Helen Soulou	UK	Heathrow Airport	CQI	www.linkedin.com/in/helen-soulou
Jonny Montgomery	UK	Shirley Parsons	CQI	www.linkedin.com/in/qualityinconstruction
Zoran Stojanovski	Australia	AECOM		www.linkedin.com/in/zoran-stojanovski-305095b
Filipe Maya	UK	BRE Construction Innovation Hub		www.linkedin.com/in/luisfelipemayaduque/
Once the Tool was fully drafted, John Morrison (a construction rework expert) joined the team to help promote the Tool in Australia and NZ				
John Morrison	Australia	Frontline Coach Pty Ltd		www.linkedin.com/in/john-morrison-15101923/

The team was assembled through our networks to get a good coverage of experience, geography and affiliations.

The process used

The team worked virtually. They met first in early December 2020 and discussed a draft of the tool commissioned by David Myers whilst working at Heathrow Airport in the UK. The team was led by Helen Soulou based with much input from Arup, Atkins and Jacobs.

We refined this over several meetings in early 2021, each of us providing detailed feedback on successive drafts which David Myers collated as input to our meetings, where we discussed and agreed the changes.

We also received input from Ed McCann, Co-Founder of the Get It Right Initiative. Ed is also the incoming President of the UK Institute of Civil Engineers, one of the foremost civil engineering bodies (www.ice.org.uk).

In Australia, Zoran convened a workshop of AECOM construction design engineers, quality team members and delivery excellence practitioners. This generated rich feedback.

The current version, which is the result of rigorous peer validation and testing, is now sufficiently refined to benefit from wider testing and feedback. To that end we have created a LinkedIn page for the Tool, Quality in Construction Design Tool https://www.linkedin.com/groups/9062991/

Endorsements

The Tool has received strong support already. Senior professionals from the Institute of Civil Engineers (ICE), the UK High Speed Rail project (HS2, currently the biggest construction project in UK and Europe) and the Get It Right Initiative plan to promote this at a conference in September; this will involve other major bodies such as Institute of Builders, Association of Design Management, Highways England, and Network Rail. GIRI are also going to seek clients to use the tool as early adopters. If successful, that will generate excellent feedback and data.

The North America (and globally), the ASQ's Construction Division has endorsed the tool.

The future

The team plans to review this tool annually in December, in the light of feedback received. If you are experienced in construction, please try the Tool and give us your feedback via the LinkedIn group.

We have launched this as a 'Best Practice' Tool as that allows for easier adoption and refinement. Even in its current form, we firmly believe that applying this tool will help construction projects minimise rework and come in more on-time, on-budget and safely.

Our hope is that eventually the Tool will gain enough traction that it can be formalised into a Standard, perhaps part of the ISO 9000 Quality Management series.

Acknowledgement

Thanks to Martin Andrews, Zoran Stojanovski, John Morrison and Jeff Ryall for a developing and reviewing this paper.