1. Introduction

The Global Infrastructure Hub (GI Hub) was established by the G20 with an assigned mandate that included to develop and disseminate a suite of 'leading practice' guidance documents for governments to use to improve the quality and quantity of their infrastructure programs. This particular guidance note (referred to as the 'Reference Guide') is designed to assist governments and public sector asset managers in developing output specifications to deliver Quality Infrastructure, as defined by the G20 Leaders at the Hangzhou Summit in September 2016.

The GI Hub engaged Mott MacDonald to help develop this Reference Guide with the aim to operationalise the definition of Quality Infrastructure agreed on at the Hangzhou Summit. This Reference Guide considers a wide range of Public-Private Partnership (PPP) models (under the broad definition of PPPs outlined in Chapter 4) and demonstrates, using real world examples, how output specifications support the delivery of Quality Infrastructure across a broad range of delivery modes using a life-cycle approach.

PPP projects are based on a collaboration between governments (as the procurers of infrastructure assets) and the private sector (as the designers, constructors, financiers, maintainers and sometimes operators of those assets). PPP projects have extended terms which often include the maintenance, rehabilitation/lifecycle and sometimes operation of the asset, in addition to the design and construction. The intent of PPP contracts is to achieve efficiencies and whole-life cost savings through the allocation of risk to the party best placed to manage it.

The core principle of an output specification is to specify the project in terms of measurable outputs, or 'performance requirements'; it focuses on what needs to be delivered, not how it should be delivered. This is in direct contrast to traditional technical specifications, where the design is developed by the public sector (typically with support from consulting firms) and documented in a specification for the project works that prescribes both what needs to be delivered and how, using 'prescriptive requirements'.

The intention is that output specifications provide an opportunity for the public sector to capitalise on private sector innovation, and align priorities by linking payment with contractual performance, to deliver a project that meets the public sector's objectives and values over the asset's life.

By adopting an output specification on a PPP project, the private sector team is incentivised to collaborate during the early stages of design to combine design, construction, maintenance and operations knowledge in making decisions on design solutions. This lifecycle approach to infrastructure design is considered a key driver in the achievement of quality outcomes and lifecycle efficiency.

On a PPP project, the output specification is arguably the most important contract document in delivering the project objectives, meeting stakeholder expectations and allocating project risk. There is a considerable body of knowledge that already exists regarding how to draft traditional prescriptive specifications, however there is an opportunity to further improve long-term infrastructure outcomes through properly drafted output specifications. This Reference Guide is designed to improve the global understanding of this subject to help governments provide their citizens with quality infrastructure assets and services.

In the context of this Reference Guide, Quality Infrastructure is an outcome that can be achieved through project outputs. Output specifications include the measurable project requirements (or outputs) that are informed by the project objectives or desired outcomes. Project outputs tend to be short term, discrete activities and initiatives which do not necessarily in isolation result in added value, or impact to the end user. Outcomes, on the other hand, are the medium- to long-term differences made to end users that can be influenced by the outputs or the relationship between multiple outputs. For example, the ability of the asset to withstand natural and other disasters is a project outcome, which can, in part, be achieved through an output specification that specifies the minimum seismic performance. Generally, the private sector is positioned to take the risk for the successful delivery of project outputs but has limited appetite to take the risks for project outcomes, as there are often external influences out of its control.

1.1 STRUCTURE OF THIS REFERENCE GUIDE

This Reference Guide consists of two parts:

- **Part A: Background information and lessons learned.** Provides the background principles and assumptions used in the development of this Reference Guide, including a definition of Quality Infrastructure, a definition of a PPP, a description of an output specification, an overview of a process to develop an output specification and a discussion on what makes a good output specification. This section also provides an overview of the methodology used to develop this Reference Guide and the case studies in Part B, and lessons learned and observations identified during the development of this Reference Guide.
- **Part B: Sector case studies and output specification examples.** This section contains a suite of case studies, across a range of jurisdictions and sectors, to provide real world examples of output specifications that deliver Quality Infrastructure.

This Reference Guide recognises there is no one global definition for a PPP, and the users of this tool will have a varying range of exposure to PPP projects. Sections 4 and 5 of Part A outline key principles so a reader who is not familiar with PPP projects can appreciate the relevance of the output specification and its role in project delivery. Where possible, definitions that are recognised by the World Bank PPP Knowledge Lab and APMG International's *PPP Certification Guide*[1], have been adopted to develop a document that is relevant to a range of jurisdictions.

1.2 ACKNOWLEDGEMENTS

This Reference Guide incorporates contributions from project Owners (government department or public sector authority), as well as Private Partners, who provided permission to use project content, commented on lessons learned, and identified examples to be included in the case studies.

Industry-recognised references such as the World Bank's '*PPP Knowledge Lab*'[2] and the '*4Ps A Guide to Contract Management for PFI and PPP Projects*'[3] supported the development of the definitions adopted in this Reference Guide, as did other GI Hub publications such as the *'Allocating Risks in Public-Private Partnership Contracts*'[4] and '*Managing PPP Contracts After Financial Close*'[5].

The GI Hub team was led by Morag Baird and Maud de Vautibault. GI Hub engaged a team of experts from Mott MacDonald, a global engineering, management and development consultancy, to help undertake research and development of the Reference Guide.

A workshop was held while this Reference Guide was in draft format. The workshop was attended by over 40 delegates from 10 countries, and questions, observations and feedback have informed the final structure and content of this document. The final draft of the Reference Guide was available for further comment and inputs for an open consultation period of four weeks.

1 The PPP Certification Guide can be downloaded here: https://ppp-certification.com/pppguide/download

2 Available at: https://pppknowledgelab.org/

3 Available at: http://archive.teachfind.com/ttv/static.teachers.tv/shared/files/10030.pdf

4 Available at: https://ppp-risk.gihub.org/

5 Available at: https://managingppp.gihub.org/

2. Development of this Reference Guide

The primary objective of this Reference Guide is to assist government and public sector asset owners in the development of Quality Infrastructure (QI). Specifically, this Reference Guide has considered the output specifications, performance measures, reporting and contractual mechanisms of 14 reference projects.

This Reference Guide focuses on commonalities and lessons learned which proponents and government stakeholders of PPP projects could utilise to further the Quality Infrastructure agenda. This section provides an overview of the process used to develop this Reference Guide.

Figure 1: Reference Guide development process

2.1 DEVELOP THE PROJECT LIST

This Reference Guide uses project examples to communicate the principles of good output specification development and how output specifications can contribute to the delivery of Quality Infrastructure. This Reference Guide includes case studies that were selected based on the following criteria:

- **Location:** The projects represent a range of jurisdictions to identify similarities, differences and best practices between different locations.
- **Asset class:** The projects cover the main infrastructure sectors – built environment (such as education, housing and healthcare), energy, information and communication technology (ICT), transportation, and water and waste.
- **Stage of development:** Projects are either in construction or operational, so lessons learned could be identified. This introduces some limitations as current best practice in emerging areas, such as building information modelling (BIM), climate change adaptation and mitigation, and flexibility to respond to disruptive technology, is unlikely to be fully reflected in the examples provided.
- **Information availability:** The project's output specification was required to be either publicly available or Owner permission was granted to include the project in this Reference Guide. Preference was given to projects where members of the Reference Guide development team had insights from past project involvement.
- **Alignment with Quality Infrastructure focus areas:** The project's output specification was required to demonstrate an active approach to address the Quality Infrastructure focus areas.

The project list and its alignment with the Quality Infrastructure focus areas are summarised in Table 1 over the page.

2.2 IDENTIFY QUALITY INFRASTRUCTURE FOCUS AREA EXAMPLES

After finalising the project list, a review was completed to identify potential Quality Infrastructure focus area examples for each project. The examples were then compared across the projects and selected for inclusion in the case studies where there were similarities between approaches to show trends and consistencies between asset class and location, or selected based on their novel approach to deliver Quality Infrastructure.

Each case study in this Reference Guide provides examples in three to five of the Quality Infrastructure focus areas. The exception to this is where a secondary case study was included to supplement examples in a primary case study. For example, the Presidio Parkway project was included to supplement the Central 70 Managed Lanes project to provide an example of seismic requirements on a highway project.

Case studies may not have an output specification example provided for every Quality Infrastructure focus area, however this does not mean that the project only delivered on some focus areas and not others; rather, examples of the demonstration and implementation of Quality Infrastructure focus areas were selected based on their strength, unique approach and leading practice elements. The intent of this Reference Guide is to provide a range of examples across a number of projects that collectively show how Quality Infrastructure can be delivered through intentional requirements in output specifications.

2.3 DEVELOP THE PROJECT CASE STUDIES

The project information has been collated via document review and interviews with the relevant project stakeholders, reviewed and case studies developed. Direct quotes from the output specifications have been included in the case studies where information was available and the examples were considered relevant. An alternative approach was to provide paraphrased requirements. Direct quotes are highlighted in italics text and project specific defined terms, which may be capitalised, have been kept. Although examples in the case studies may be applicable to other projects, the quoted and paraphrased text in the case studies alone is not considered sufficient to successfully implement the requirement on a project.

2.4 HOST A CONSULTATIVE WORKSHOP

A consultative workshop on this Reference Guide was held in Paris in partnership with Mott MacDonald on April 15, 2019. Over 40 delegates from 10 countries attended, including representatives from the European Union (EU) PPP Units or Ministry of Economy, in addition to the European Commission, the European PPP Expertise Centre (EPEC), the European Bank for Reconstruction and Development (EBRD), the Asian Development Bank (ADB), the Sustainable Infrastructure Foundation (SIF) SOURCE, the Private Infrastructure Development Group (PIDG), the Organisation for Economic Cooperation and Development (OECD), civil society organisations (CSOs) and private sector partners. Feedback from the workshop has been incorporated into the Reference Guide.

2.5 CREATE THIS REFERENCE GUIDE

This Reference Guide collates the background information on output specifications and Quality Infrastructure, and the project case studies, and presents lessons learned and observations. This Reference Guide adopts terminology, definitions and concepts from recognised global publications on PPPs and output specifications to develop a document that is not specific to one jurisdiction. This Reference Guide is not intended to be a substitute for proper technical due diligence. The Private Partners provided in the case studies are intended to reflect the team members at contract signing (prior to construction).

Table 1: Summary of case studies and QI focus area examples

Project (PPP model)	Sustainability & longevity/ Expectations of end users	Health & safety	Withstand natural & other disasters
BUILT ENVIRONMENT			
Milton Hospital - Canada (DBFM)	●	●	●
Mersin Integrated Health Campus - Turkey (DBFOM)	●	●	●
Pan Am Athletes Village - Canada (DBF)	●		
Lewisham Grouped Schools - United Kingdom (DBFM)	●	●	
PPP Prisons Program (Lots 1-3) - France (DBFM)	●	●	
ENERGY			
John Hart Generating Station - Canada (DBFM)	●	●	●
INFORMATION & COMMUNICATION TECHNOLOGY (ICT)			
Plan France Très Haut Débit (rural highspeed broadband) – France (DBFOM)	●		
TRANSPORTATION			
Central 70 (I70) Managed Lanes - USA (DBFOM)	●		
Complementary case study: Presidio Parkway - USA (DBFOM)			●
Gautrain Rapid Rail - South Africa (DBFOM)	●	●	
Complementary case study: Melbourne Metro Rail Tunnel - Australia (DBFM)	●		●
Madinah Airport Expansion Phase 1 - Saudi Arabia (BTO)	●	●	
Mactan-Cebu International Airport - Philippines (DBFOM) (includes comparison to Japanese airport concessions)	●	●	
WATER AND WASTE			
Organic Resource Recovery Centre - Hong Kong (DBOM)	●	●	●
Agadir Mutualized Desalination Plant - Morocco (DBFOM)	●		●

Job creation, capacity building, transfer of knowledge	Social impacts & inclusiveness	Environmental impacts	Economic & development strategies/ Respond to changes
●		●	
●	●	●	●
	●		●
	●		●
●	●	●	●
●		●	
●		●	●
●	●		●
●			
	●	●	
		●	
	●	●	●
●		●	●
		●	●

3. Quality Infrastructure definition

The G20 Leaders stressed the importance of Quality Infrastructure (QI) investment to deliver high quality infrastructure projects at the Hangzhou Summit in September 2016[6], where it was defined as investment:

"which aims to ensure economic efficiency in view of life-cycle cost, safety, resilience against natural disaster, job creation, capacity building, and transfer of expertise and know-how on mutually agreed terms and conditions, while addressing social and environmental impacts and aligning with economic and development strategies".

Since then the G20 Leaders have endorsed a series of documents and initiatives, such as the '*Roadmap to Infrastructure as an Asset Class*'[7], which highlight the necessity to advance a shared understanding of "quality infrastructure" within the G20. Quality infrastructure has also been a G20 focus under the Japanese Presidency in 2019.

For the purposes of this *Reference Guide on Output Specifications*, the definition of 'Quality Infrastructure' from Hangzhou is broken down into several focus areas which are closely related to the G20 discussions under the 2019 Japanese Presidency of the G20. The table below elaborates on the G20 definition of Quality Infrastructure and the key infrastructure considerations when identifying and developing case studies in this Reference Guide.

Table 2: Quality Infrastructure focus area descriptions

Alignment to the QI Definition (Hangzhou)[8]	Quality Infrastructure Focus Area	Description[9] and Considerations
That which aims to ensure economic efficiency in view of life-cycle cost	**Economic efficiency** requires that the asset efficiently addresses a clear need and end users' requirements through its lifecycle. **Sustainability and longevity** of an infrastructure asset	The relationship between the decisions made during design and construction, and how they aim to minimise the whole-life cost of the asset and meet the end users' requirements. Considerations include: • How the need for the asset has been identified and project objectives defined, and how these are translated into measurable requirements; • Processes and requirements that support reliable operation and maintenance, and economic efficiency in view of whole life cost; and • Requirements that promote good practice asset management and support the continued maintenance of an asset to meet the handback requirements.

6 Available at: http://www.g20.utoronto.ca/2016/160905-communique.html

7 Available at: http://www.oecd.org/g20/roadmap_to_infrastructure_as_an_asset_class_argentina_presidency_1_0.pdf

8 Defined as per the G20 description in the Hangzhou Communiqué

9 Descriptions in italics have been developed based on publications from the Center for Strategic and International Studies: https://www.csis.org/analysis/quality-infrastructure

Alignment to the QI Definition (Hangzhou)[8]	Quality Infrastructure Focus Area	Description[9] and Considerations
Safety	**Health and safety** considerations during both construction and operation of the asset	A design approach that considers the health and safety of those who construct, operate, maintain, modify and demolish an asset, as well as those who work in or with it, use it or are in the proximity of it (i.e. the public). Considerations include: • How hazard identification and risk assessment methods are integrated into the design requirements, with the intention to eliminate or minimise the risks of injury throughout the life of the asset; and • The requirement to conform with appropriate health and safety standards and, if appropriate, go beyond these by developing a proactive health and safety culture.
Resilience against natural disaster	Ability of the asset to withstand **natural and other disasters**, including climate change	The ability for an asset to demonstrate resilience and safety against natural disaster, terrorism and cyber-attack risks. Considerations include: • Implementation of best design practice processes and procedures to identify location-specific hazards and aim to mitigate the impact of natural disasters on the asset's condition and its users through design. This could include design requirements above minimum standards and specifying the required level of performance following an event.
Job creation, capacity building and transfer of knowledge, expertise and know-how on mutually agreeable terms	**Job creation, capacity building, transfer of knowledge and expertise**	Promoting job creation, capacity building, and transfer of expertise and know-how to national and local communities to deliver on economic development objectives. Considerations include: • How the requirements support participation by smaller (and local) and minority-owned firms as part of the project delivery in both the construction and operation phases; and • Requirements aimed at transferring project knowledge and developing skills in the local community to support the long-term operations and maintenance of an asset, particularly relating to handback.
Addressing social impacts	**Social impacts and inclusiveness**	*Social impact is the effect a development's actions have on the well-being of the community.* Considerations include: • How the project considers the impact it has on the local community, and the requirements in the contract to provide positive impact or mitigate the negative impact during both the construction and operations phases. Further defined in the GI Hub's '*Reference Tool on Inclusive Infrastructure and Social Equity*'[10].

10 Available at https://inclusiveinfra.gihub.org/

Alignment to the QI Definition (Hangzhou)[8]	Quality Infrastructure Focus Area	Description[9] and Considerations
Addressing… environmental impacts	**Environmental impacts**	*Environmental impacts may present themselves as temporary or permanent changes to the atmosphere, water, and land due to any development or human activities, which can result in impacts that may be either reversible or irreversible.* • How the project considers the impact it has on the environment, and the requirements in the contract to mitigate the impact during both the construction and operations phases. • Consideration is given to the mechanisms used to reduce energy consumption over the life of the asset.
Aligning with economic and development strategies.	Alignment of the project with **economic and development strategies** (SDGs, national policy, etc) Ability of the asset to **respond to changes** in resource availability, population levels, demographics and disruptive technology	Ensuring alignment with economic and development strategies, and ability to respond to changing priorities or needs including aspects of climate change, population growth and disruptive technology at the national and regional levels. Considerations include: • Identifying how the projects align with economic and development strategies and reflecting these in the project objectives and performance measures; and • How the requirements either foresee potential changes or refer to contractual mechanisms that allow future changes to be adopted.

4. Public-Private Partnership (PPP) project definition

4.1 REFERENCE GUIDE PPP DEFINITION

There are numerous definitions for PPP projects, with variations depending on jurisdiction. However, there is also consensus among key international organisations of a broad definition of PPP that typically includes "government pays" arrangements as well as "user pays" concession style arrangements. The APMG PPP Certification Program[11], the World Bank's '*PPP Knowledge Lab*'[12] and the PPP Reference Guide[13] define a PPP as:

"a long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance".

This GI Hub Reference Guide has adopted this broad definition of a PPP, and considers examples across the following dimensions to develop a tool that is relevant to a wide audience, and to show how the specifications are influenced by the nature and scope of the project:

Figure 2: PPP dimensions

Asset class	**Social infrastructure**	**Economic infrastructure**
	Assets and services that typically support the delivery of social services such as healthcare, education, housing, and corrections and justice.	Assets and services that support the economic foundation of a city, region or country including transportation, energy, communications and water and waste.
Basis of payment	**Government pays**	**User pays**
	Payments (often termed "availability payments") are linked to the asset being available at a contractually-defined quality and services being provided in accordance with qualifiable performance metrics, regardless of level of use.	The Private Partner provides a service to users and generates revenue by charging users for that service, often under a concession contract. The Private Partner bears all or part of the "demand risk".
Current state of development	**New (Greenfield)**	**Existing (Brownfield)**
	A project where the Private Partner is responsible for the design and construction of a new asset and its related services.	Where the Private Sector assumes responsibility for the rehabilitation and/or maintenance of an existing asset and its related services. May also include components of a 'new' build.

11 Available at https://ppp-certification.com/

12 Available at https://pppknowledgelab.org/

13 Available at https://pppknowledgelab.org/guide/sections/83-what-is-the-ppp-reference-guide

This Reference Guide considers all types of PPP models that have long-term maintenance components, and recognises this is relevant for a broad range of jurisdiction specific contract structures, such as the '*Marché global de performance*'[14] contract in France, or the South African Public Finance Management Act Regulations (TR 16), concession contracts under specific local laws or regional definitions of PPP, such as 'P3' in Canada or private finance initiatives (PFI) in the United Kingdom.

4.2 PROJECT RESPONSIBILITIES AND PPP MODELS

The case studies in this Reference Guide consider a range of PPP procurement models based on the allocation of the following project responsibilities or functions:

- **Design** involves developing the project from initial concept and the development of the output specifications (typically the responsibility of the Owner) to the detailed design of an asset that is to be constructed in compliance with the specifications (typically the responsibility of the Private Partner).
- **Build** could be the construction of a new asset, or could be the rehabilitation of an existing asset, or a combination of both. The Private Partner is required to complete construction work in compliance with the output specifications. The build phase also includes the supply and installation of specified equipment.
- **Finance** is where the Private Partner is required to finance some or all of the construction of the asset, which is then repaid over the life of the asset through availability payments (government-pays model) or user-payments, or a combination of both. Private Partner financing supports risk transfer, as the Private Partner faces reduced financial return or financial loss if the services and scope are not delivered in compliance with the contract.
- **Operate** mainly relates to economic infrastructure and user-pays models and relates to operating an asset for its intended purposes to meet end user expectations (for example the delivery of clinical services in a hospital or driving trains in a transit system).
- **Maintain** can include a range of scope items aimed at maintaining an asset to a specified standard over the contract term. From the regular preventative and reactive maintenance of the physical asset to services that support the operations of an asset (such as cleaning, security and pest control). The 'maintain' component typically includes lifecycle and rehabilitation requirements, where elements of the asset are required to be replaced at the end of their useful life. The Private Partner may be responsible for maintaining all, or just specified elements, of the asset.

The project responsibilities transferred to the Private Partner typically define the 'type' of PPP, such as design-build-maintain (DBM), design-build-finance-maintain (DBFM), and design-build-finance-operate-maintain (DBFOM or concession contract), and the key components of the output specifications will be informed by the specific aspects of the scope of works. For example, a concession contract where the Private Partner operates the service is likely to have different output specifications (related to the level and the quality of service) to a design-build-maintain project where the service is operated by the government.

This Reference Guide focuses on the output specifications and the typical allocation of responsibilities and functions to the private sector under a PPP model, rather than the specific detail of other contractual aspects, such as contract term, allocation of certain project specific risks (such as financial market risks or insurance risks) or the contractual mechanisms that govern how the eventuation of project risks are to be managed.

However, for technical risks, there will always be an overlap between the output specifications and the contractual allocation of risks. For example, the output specifications may describe the required performance of a road surface; however, the Private Partner may incur additional costs and require additional time to deliver the performance required because of the eventuation of a risk (such as the discovery of archaeological findings), and the contractual risk allocation will describe which party bears the time and cost implications of managing that risk. The GI Hub's *Allocating Risks in Public-Private Partnership Contracts* tool provides detailed guidance on contractual risk

14 In 2015, France created a new category of global contract called the 'Marché global de performance', with specific and measurable performance commitments. "The global performance contract combines operation or maintenance with the construction or design and construction of an asset in order to fulfil quantified performance objectives. These objectives are defined in terms of level of activity, quality of service, energy efficiency or environmental impact." Article L2171-3 Public Procurement Code

in a PPP contract allocation by sector, and further guidance on translating these to the contract can be found in the World Bank's *Guidance on PPP Contractual Provisions*.

A contract that combines the scope from design through to operation (e.g. a DBFOM scope) can help drive efficiencies by focusing on the entire lifecycle of the project. The private sector is better placed to influence the public sector outcomes over the life of the asset (sometimes referred to as a 'lifecycle approach') than in a traditional public procurement where the design, construction, operations and maintenance functions are delivered separately. The integration of the design, construction, operations and maintenance functions in a single contract shifts the needs and expectations of the public sector from the delivery and completion of the asset to the service and functionalities offered by the asset to serve the final end users.

In some jurisdictions, specific output-based performance procurement contracts exist, for example, in France with the "Marché Global de Performance" where the Private Partner is in charge of the design, build and maintenance of the infrastructure with output-based specifications and performance-based remuneration linked to the achievement of measurable performance commitments.

The ordinance of the 23 July 2015 (codified at the article L2171-3 and R2171-2 of the "Code de la Commande Publique") created a new category of global contract the "*Marché global de performance*", with specific and measurable performance commitments in terms of output specifications.

"*The global performance contract combines operation or maintenance with the construction or design and construction of an asset in order to fulfil quantified performance objectives. These objectives are defined in terms of level of activity, quality of service, energy efficiency or environmental impact. The global performance contract has measurable performance commitments.*"

5. Output specifications

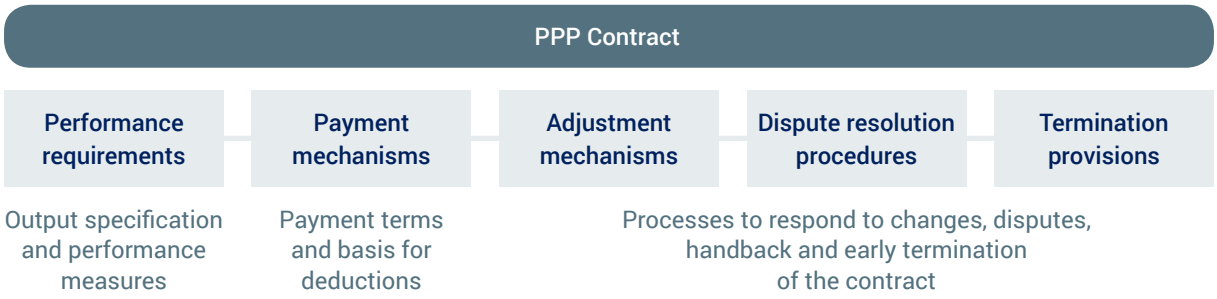
An output specification is a technical specification that predominantly adopts performance-based requirements to define the project scope. It is the technical foundation of both the procurement and delivery phases and is used to determine technical compliance. This section describes an output specification, provides an overview of a typical output specification structure, and presents a framework to identify requirements. It also describes the relationship between an output specification, the payment mechanism and the performance measures, and outlines the qualities of a good output specification.

5.1 WHAT IS AN OUTPUT SPECIFICATION?

The technical specifications are a component of the overall contract between the Owner and the Private Partner. The technical specification is the part of a contract that defines the performance requirements of the project: the functional requirements, the minimum technical requirements for the design and construction, and the scope and level of performance for services. It is the technical foundation of the procurement, delivery and – in a PPP – the operational phases of the contract, and is used to determine compliance at all phases of the project lifecycle.

Figure 3 demonstrates the relationship between the performance requirements and related key components of the contract (normally schedules to the contract) that should be developed in parallel.

Figure 3: Relationship between the output specification and PPP contract



Source: Adapted from the PPP Knowledge Lab 'Designing PPP Contracts'[15]

The requirements within a technical specification typically take two forms: prescriptive or performance.

Figure 4: Types of technical specification requirements

Prescriptive requirement	Performance requirement
Describes or defines, using written specifications and design drawings, **what** needs to be delivered and **how** it is to be delivered. It focuses on solutions rather than expected outcomes or results.	Defines the requirements in terms of measurable outcomes or objectives. The focus is on what needs to be delivered, but **does not detail how** or specific solutions.

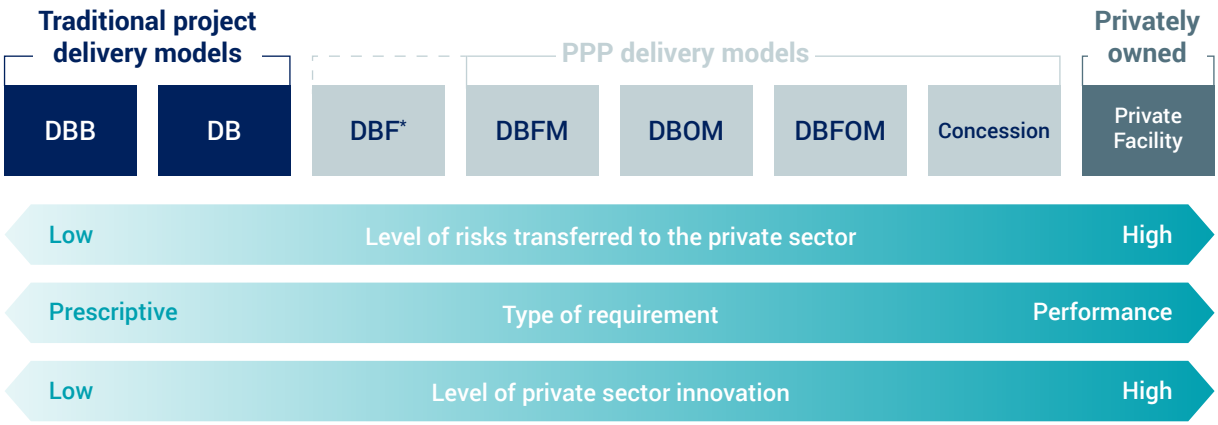
An *output specification* is a form of technical specification that intentionally adopts predominantly **performance requirements** to define the project scope for both the design-construct and operational phases of a project.

15 Available at https://pppknowledgelab.org/guide/sections/61-designing-ppp-contracts

A further defining characteristic of an output specification is the deliberate effort to deeply integrate operation, maintenance and handback performance requirements directly into the technical specifications, rather than aiming to accomplish these objectives *indirectly* through prescriptive design/construct obligations as is typical in traditional delivery models.

The type of specification is one key distinction between projects delivered as a PPP and projects delivered through traditional procurement models. Figure 5 demonstrates the relationship between project delivery models, the level of risks transferred to the private sector and the type of requirements in the specification to achieve innovative solutions.

Figure 5: Relationship between the project delivery model and type of requirements



* In some jurisdictions DBF is considered a PPP, but this is not included in the Reference Guide's PPP definition as it does not have a long-term contract.

Output specifications can also be adopted on design-build (DB) and design-build-finance (DBF) projects, however the level of prescriptiveness tends to be much higher than an output specification on a PPP project. The long-term maintenance risk is retained by the Owner, so prescriptive requirements are typically used to incorporate whole-life decision making into the design, and to manage construction quality risk.

Definitions of technical specifications by the law

In some jurisdictions, the technical specifications have been defined by the "law". The annexe VII of the procurement Directive 2014/24/EU of the European Parliament and the Council of 26 February 2014 on public procurement defined the technical specifications for a public work contract as: "*the totality of the technical prescriptions contained in particular in the procurement documents, defining the characteristics required of a material, product or supply, so that it fulfils the use for which it is intended by the contracting authority; those characteristics include levels of environmental and climate performance, design for all requirements (including accessibility for disabled persons) and conformity assessment, performance, safety or dimensions, including the procedures concerning quality assurance, terminology, symbols, testing and test methods, packaging, marking and labelling, user instructions and production processes and methods at any stage of the life cycle of the works; those characteristics also include rules relating to design and costing, the test, inspection and acceptance conditions for works and methods or techniques of construction and all other technical conditions which the contracting authority is in a position to prescribe, under general or specific regulations, in relation to the finished works and to the materials or parts which they involve (…)*"

5.2 OUTPUT SPECIFICATIONS ON PPP PROJECTS

Given the long-term nature of PPP contracts, the output specification includes both design and construction requirements, as well as lifecycle, maintenance and sometimes operations requirements. The transfer of responsibilities, and therefore risk, over an extended period incentivises the private sector to work in an integrated approach from early in the design to combine maintenance and operation into the design and construction of the project. The integration of both the design and construction and operating period requirements into a single specification suite is intended to promote the Private Partner to develop innovative solutions that minimise whole-life costs of the project.

Although an output specification aims to detail the scope of the project in terms of the desired performance requirements, the reality is an output specification for a PPP remains a balance between performance requirements and prescriptive requirements. Output specifications that are too prescriptive have been shown to dampen innovation and can be precluding to potential private sector partners, while those that are too vague are often associated with assets that do not meet the public sectors' needs or that cannot be effectively and competitively priced during the procurement process. A properly crafted output specification requires striking a balance between:

- having certainty that the procured solution aligns with the vision for the project and meets commitments made (internally and to end users and third parties) during the planning phase (prescriptive requirements); and
- allowing the private sector freedom to generate a value-for-money solution through effective management, team structure, financing and innovation in response to an appropriate risk allocation (performance requirements).

Most of the case studies in this Reference Guide demonstrate output specifications that have a combination of both performance and prescriptive requirements.

Input requirements may be adopted where an owner has an interest in delivering a specific solution to mitigate risk. For example, permit requirements, physical interfaces between new and existing structures, interfaces with third parties, or highly specialised or regulated areas where an owner may have more knowledge than the private sector (e.g. finishes and equipment).

Output requirements would then be developed for all other elements including structural design, mechanical and electrical systems and energy performance where the private sector has more knowledge and can develop innovative, long-term solutions.

The level of prescriptiveness in the output specifications and performance indicators vary across jurisdictions. For example, the Mersin Integrated Health Campus Project (and more generally in Turkish PPP and Latin American PPP projects) are more prescriptive than other European or Canadian PPP projects. The case studies provided demonstrate the range of prescriptiveness currently seen in PPP output specifications.

5.3 STRUCTURE AND CONTENTS OF AN OUTPUT SPECIFICATION

Although the overall contract structure may be similar from project to project, the output specifications should be actively tailored to be project-specific to ensure that key project objectives, functional requirements, minimum technical requirements and performance parameters are detailed to meet the end user requirements and recognise what is affordable within the project budget.

While the structure of output specifications varies across projects and jurisdictions, the typical components would include: 1) functional/development requirements, 2) management requirements required throughout the contract term, 3) design and construction requirements, 4) maintenance, lifecycle and handback requirements, and 5) operations requirements (if the contract transfers operations scope).

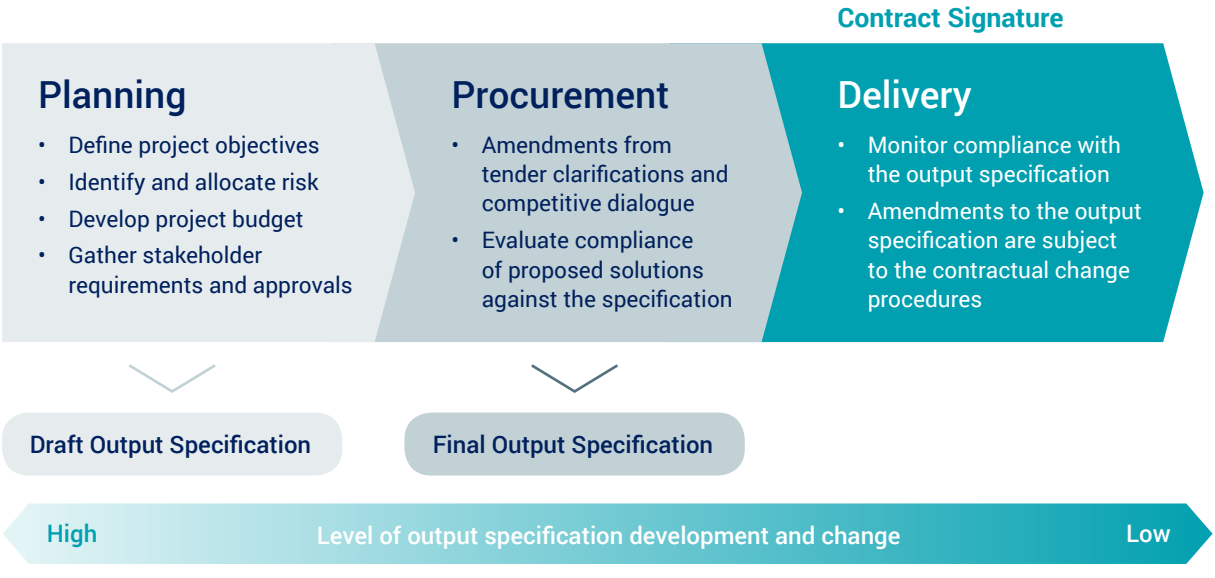
Figure 6: Components of an output specification

Functional/development requirements	• Project description, vision and objectives • Functions, purpose and objectives of the asset • Operational/functional interfaces
Management requirements	• Health and safety, communications, information, risk, quality, and sustainability and environmental requirements
Design and construction requirements	In addition to the design and construction scope, requirements may include: • Phasing, access and scheduling • Management and reporting • Permitting and third party requirements • Commissioning and testing
Maintenance, lifecycle, handback requirements	In addition to the maintenance scope, requirements may include: • Asset condition inspections • Management and reporting • Maintenance planning • Performance measures • Handback process
Operations requirements	The operations scope define the minimum level of service and how service will be measured.

5.4 A PROCESS TO IDENTIFY REQUIREMENTS AND DEVELOP AN OUTPUT SPECIFICATION

The output specifications are drafted by the public contracting authority, often with support from their consultants, during the planning stage of the project. A draft of the output specification forms a core component of the procurement documents and will form the basis for the private sector to develop their technical and financial offer. Throughout the procurement process, the output specification may be amended through private sector clarifications, and it is finalised prior to contract signature as permitted by the terms of procurement process.

Figure 7: Output specification development process



The planning phase is where the requirements are identified and the output specification formed. The amendments to the output specifications during the procurement and delivery phases typically clarify uncertainty and afford flexibility, rather than change core requirements or objectives. Changes following contract signature must be managed through change mechanisms (or variation procedures) within the contract.

The procurement strategy is developed alongside the output specifications and is informed by the project objectives, scope, requirements and risk allocation. An owner may develop response requirements and select proponent evaluation criteria based on the project objectives to promote alignment between the proponent proposals and the project priorities. The aim of the procurement process is to select a project partner that has the skills and experience to not only build an asset that is compliant with the output specification, but also has the skills and experience to effectively deliver the services and manage end user interfaces during the operating period.

Adopting a structured approach to developing project requirements in the planning phase helps facilitate knowledge transfer throughout project delivery and the contract term by clearly documenting both performance priorities and minimum standards, which are informed by the intended outcomes or project objectives. Engaging a range of stakeholder perspectives during the requirement development process helps to mitigate risks from inconsistent end user expectations, complex interface management challenges, and incompatibility between expectation and overall project affordability. Figure 8 outlines a progressive approach to develop requirements.

Figure 8: Requirement development process

It should be anticipated that the eventual Private Partner will aim to propose the solution with the lowest whole-life cost necessary to satisfy the output specification requirements (subject to the weighting of the bid evaluation scoring criteria[16]). When reviewing the output specification in advance of procurement, if the hypothetical lowest cost option does not meet the Owner's, end user's or third-party expectations, the project objectives, or introduces new risks, the requirement should be refined to limit the acceptable solutions. Additional performance criteria should be considered prior to adopting a prescriptive requirement.

As mentioned in Section 5.2, prescriptive requirements have their purpose, and should be used with intent. Prescriptive requirements are valuable, for example, where it is important to manage a critical interface with adjacent infrastructure or operations, a mandatory regulatory or permitting requirement, or a complex stakeholder interface.

A structured requirement development approach also allows the consideration from an early stage of other opportunities to facilitate quality infrastructure outcomes in project delivery, such as building information modelling (or 'BIM').

BIM and beyond – better information, quality outcomes

Building Information Modelling (BIM) brings vast benefits across the lifecycle of an asset from conceptual design optioneering to informed operations. BIM is a process, enabled by technology, that enables the efficient production, sharing and management of digital asset information which leads to improved whole-life performance, cost reduction and better risk management. However, establishing this approach as "business-as-usual" can be challenging, requiring new ways of working, unfamiliar processes and deployment of new technology. Policy makers are increasingly recognising that the value of information as a resource is driving the opportunity for more efficient infrastructure. To achieve this, governments and project procurers are seeking to apply the latest principles and thinking that drive collaboration and openness whilst retaining robust data security. BIM will increasingly become the industry standard and benefit every participant in the process, but its true value will only be achieved if stakeholders develop and follow consistent approaches and use a common language.

BIM adoption has grown in the last decade, particularly in the past five years. Many nations have opted to mandate its use through public procurement mechanisms, strengthening relationships across the many supply chains to drive genuine alignment through information. Challenges have often stemmed from the varied nature and maturity of the parties involved, mutual understanding has been mixed and capability has been fragmented. A focus upon technology has long been perceived as the priority, yet more effort is essential towards the people and process aspects. The advent of a new global standard for information management – ISO 19650 – now provides clearer direction and structure.

There are five steps to successfully realising the benefits of BIM:

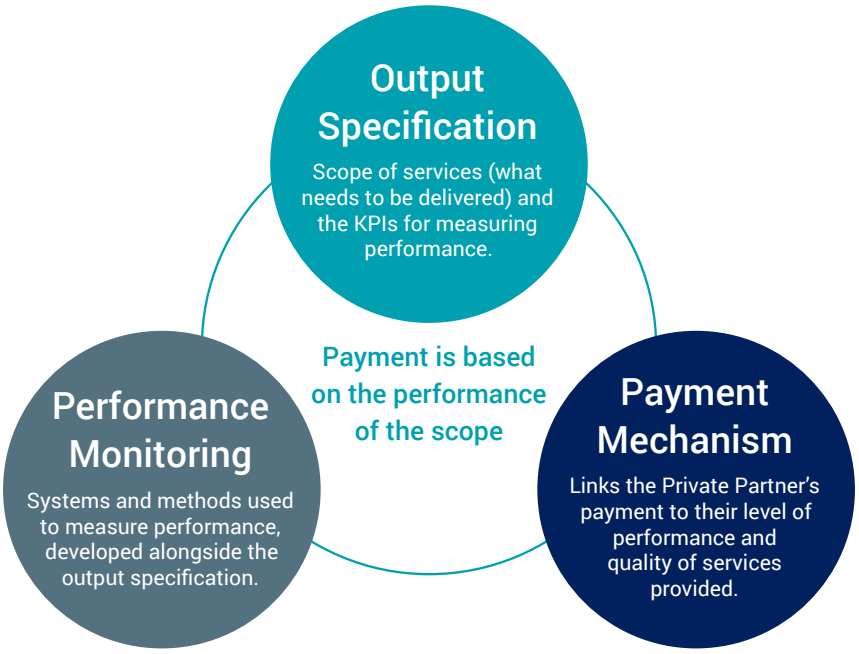
1. **Shape** – informed by overall business plan objectives, a bespoke strategy sets the vision, acknowledges the current position and outlines the actions needed to deliver the change.
2. **Define** – articulate the governance standards and protocols to clearly capture the requirements, putting the strategy into practice across project delivery and asset operations.
3. **Embed** – put the plan into practice through structured pilots, testing and iterating to ascertain an approach that achieves the best fit and results in the biggest impact.
4. **Perform** – operating with a new business-as-usual, building capacity across teams and realising the benefits at scale.
5. **Optimise** – feedback, measure and scale operations further across the enterprise, checking for progress against the goals of the strategy.

16 The bid evaluation scoring criteria can influence the quality of the responses. For example, if the evaluation rewards the lowest price then the quality is likely to be the lowest whole-life cost, compliant solution. However, if the evaluation is more qualitative where the proponents have to provide the best solution within an affordability threshold, or if points for innovation are weighted so they could influence the outcome of the evaluation, then the proponents may provide solutions that exceed the minimum standards.

5.5 THE RELATIONSHIP BETWEEN THE OUTPUT SPECIFICATION, PAYMENT MECHANISM AND PERFORMANCE MONITORING

Performance requirements describe the scope in terms of outputs or performance requirements and should be measurable using objective, quantifiable metrics in order to be enforced through the contract. By defining quantifiable requirements in the output specification, performance can be measured, and objectively linked to payment such that the Private Partner's compensation is commensurate with the quality of the service performed. Figure 9 demonstrates the three components of the contract that should be developed in parallel to implement an effective performance-based contract.

Figure 9: The relationship between the output specification, performance monitoring and payment mechanism



Source: Adapted from the 4Ps Contract Managers Guide[17]

The output specifications should be developed alongside the performance monitoring regime and the payment mechanism to align public sector and Private Partner priorities. When priorities are aligned, the performance monitoring and payment mechanism regimes can reduce the need to prescribe requirements. When developing integrated contract documents the following questions should be considered in parallel:

- **Output Specification:** Is the requirement a priority to deliver a project objective? How does the priority relate to other requirements? What is the impact if the requirement is not achieved?
- **Performance Monitoring:** How and when will compliance be assessed or measured? What evidence is required to assess compliance and monitor performance? What are the contractual mechanisms that can be used to incentivise compliance?
- **Payment Mechanism:** What are the financial deductions or bonuses that will incentivise the Private Partner to meet the output specification requirement? How are they calculated?

Achieving energy performance using performance monitoring and the payment mechanism: Canadian social infrastructure approach

At bid stage, proponents are required to provide an energy consumption target that is considered in the price evaluation.

Energy consumption is measured against the target throughout the operating term.

The costs and savings of energy consumption above or below the target are shared between the Owner and the Private Partner.

Aligned priorities limit the need for specific performance requirements.

17 Available at: http://docplayer.net/9794015-A-guide-to-contract-management-for-pfi-and-ppp-projects.html

For example, the volume and water quality KPIs for the Agadir Mutualized Desalination plant are tracked daily from a remote service station. Any deviation from the production quality and quantity immediately impact revenues. Repeated deviations, both in terms of gravity and of length in time, may lead to warning, and replacement of the Operator if needed (see case study).

In the US Central 70 Managed Lanes project, a Baseline Asset Condition Report formed the basis for maintaining the existing asset during construction and post-construction at a more onerous standard than that applied for the output specification requirements for the operating period to maintain the longevity of the asset (see case study for examples of the requirements in the contract). The performance measures are combined with a payment mechanism that assigns non-conformance points for defects to calculate financial deductions. Non-compliance points are only incurred where the defect is not rectified within the remedy period. There are two classifications of output specification defects which have corresponding defect remedy periods depending on how significant or severe the defect is.

5.6 QUALITIES OF A GOOD OUTPUT SPECIFICATION

There are common qualities of good output specifications. In summary these are:

- **Outcomes focused:** The requirements respond to the project objectives and functional requirements of the asset. The desired outcomes are clearly articulated so the Private Partner understands the end user objectives and their relative priorities.
- **Refer to codes and standards:** Owner, local, national, industry or international codes and standards should be used to specify the minimum level of compliance. Codes and standards should be cited rather than quoted or paraphrased and listed in order of precedence. Exceptions to codes and standards should be clearly articulated in the output specification, including the rationale for the exception. Time should be invested during the planning stage to select codes and standards based on their relevance and the performance they can deliver, rather than listing all potential codes and standards which could limit the possible solutions. In addition to looking at international codes, countries can look at which other national codes from other jurisdictions may be relevant and could offer good practice beyond their existing minimum requirements.
- **Achievable:** Requirements need to be constructible and feasible, and there is at least one solution that can realistically be delivered within the affordability threshold. The requirements, informed by background studies and investigation, recognise the starting position of the project (greenfield versus brownfield), the operational interfaces, and specific project risks. The requirements do not rely solely on "innovation" to solve an intractable challenge.
- **Quantifiable:** Describe the vision, objectives and requirements in a manner that the outputs (project solution) can be measured. Where key performance measures (KPIs) are used, they should be specific, measurable, achievable, realistic and time bound (or 'SMART').
- **Observable compliance:** Where a requirement is not quantifiable, there is a clear understanding of what evidence is required to prove the solution is compliant with a requirement, and how a reasonable agreement between the Owner and Private Partner can be developed. For example, an option would be to define the studies and their methodology that should be completed by the Private Partner to prove compliance, alongside appropriate price adjustment measures.
- **Simple:** Present objective requirements, in simple language, in as few words as possible. Each requirement should focus on a single aspect of the project as compound requirements are more difficult to adjudicate. Requirements should be coordinated across different sections to avoid conflicts within the document.
- **Coordinated:** The output specification is coordinated with other contract documents, including the glossary of definitions. It adopts logical structuring that considers how the output specification will be used to administer the contract throughout the operating term.

Reliance on standards

Industry standards and codes, which vary between locations, are typically used to define the minimum standard. The output specifications are then used to define requirements above standards, or to specify standards from other jurisdictions. The common International Standards (ISO) adopted across asset classes and jurisdictions include:

- **ISO 9001:** Quality management systems
- I**SO 14001:** Environmental management systems
- **ISO 55000:** Asset Management management systems
- **ISO 10002:** Quality management – customer satisfaction
- **ISO 14064 and ISO14065:** Greenhouse gas quantification, validation and verification
- **ISO 19650:** Information management
- **ISO 39001:** Road traffic safety management systems

Some jurisdictions may have their own best practice guidelines on the development of output specifications as demonstrated in the example below from the European Union.

Example: European Union Public Procurement Directive 2014/24/EU 26 February 2014

The following is quoted from Article 42 'Technical specifications':

1. The technical specifications as defined in point 1 of Annex VII shall be set out in the procurement documents. The technical specification shall lay down the characteristics required of a works, service or supply.

   Those characteristics may also refer to the specific process or method of production or provision of the requested works, supplies or services or to a specific process for another stage of its life cycle even where such factors do not form part of their material substance provided that they are linked to the subject-matter of the contract and proportionate to its value and its objectives.

   The technical specifications may also specify whether the transfer of intellectual property rights will be required.

   For all procurement which is intended for use by natural persons, whether general public or staff of the contracting authority, the technical specifications shall, except in duly justified cases, be drawn up so as to take into account accessibility criteria for persons with disabilities or design for all users.

   Where mandatory accessibility requirements are adopted by a legal act of the Union, technical specifications shall, as far as accessibility criteria for persons with disabilities or design for all users are concerned, be defined by reference thereto.

2. Technical specifications shall afford equal access of economic operators to the procurement procedure and shall not have the effect of creating unjustified obstacles to the opening up of public procurement to competition.

3. Without prejudice to mandatory national technical rules, to the extent that they are compatible with Union law, the technical specifications shall be formulated in one of the following ways:

   a. in terms of performance or functional requirements, including environmental characteristics, provided that the parameters are sufficiently precise to allow tenderers to determine the subject-matter of the contract and to allow contracting authorities to award the contract;

continued...

b. by reference to technical specifications and, in order of preference, to national standards transposing European standards, European Technical Assessments, common technical specifications, international standards, other technical reference systems established by the European standardisation bodies or - when any of those do not exist - national standards, national technical approvals or national technical specifications relating to the design, calculation and execution of the works and use of the supplies; each reference shall be accompanied by the words 'or equivalent';

c. in terms of performance or functional requirements as referred to in point (a), with reference to the technical specifications referred to in point (b) as a means of presuming conformity with such performance or functional requirements;

d. by reference to the technical specifications referred to in point (b) for certain characteristics, and by reference to the performance or functional requirements referred to in point (a) for other characteristics.

4. Unless justified by the subject-matter of the contract, technical specifications shall not refer to a specific make or source, or a particular process which characterises the products or services provided by a specific economic operator, or to trade marks, patents, types or a specific origin or production with the effect of favouring or eliminating certain undertakings or certain products. Such reference shall be permitted on an exceptional basis, where a sufficiently precise and intelligible description of the subject-matter of the contract pursuant to paragraph 3 is not possible. Such reference shall be accompanied by the words 'or equivalent'.

5. Where a contracting authority uses the option of referring to the technical specifications referred to in point (b) of paragraph 3, it shall not reject a tender on the grounds that the works, supplies or services tendered for do not comply with the technical specifications to which it has referred, once the tenderer proves in its tender by any appropriate means, including the means of proof referred to in Article 44[18], that the solutions proposed satisfy in an equivalent manner the requirements defined by the technical specifications(…).

18 Article 44 Test reports, certification and other means of proof
Contracting authorities may require that economic operators provide a test report from a conformity assessment body or a certificate issued by such a body as means of proof of conformity with requirements or criteria set out in the technical specifications, the award criteria or the contract performance conditions.

Where contracting authorities require the submission of certificates drawn up by a specific conformity assessment body, certificates from equivalent other conformity assessment bodies shall also be accepted by the contracting authorities.

For the purpose of this paragraph, a conformity assessment body shall be a body that performs conformity assessment activities including calibration, testing, certification and inspection accredited in accordance with Regulation (EC) No 765/2008 of the European Parliament and of the Council.

6. Lessons learned and observations

For a project to deliver Quality Infrastructure outcomes, it should have a clearly defined project objective that is supported by the project sponsor. The project objectives should inform the project requirements, performance measures and the payment mechanism to align the private and public sector priorities. The output specifications can be used to deliver Quality Infrastructure by aligning expected project requirements with measurable performance requirements to harness private sector innovation and deliver solutions that respond to the project objectives. This section summarises the lessons learned on the output specification development process documented in Section 5, as well as those from the case studies.

An output specification is a technical specification that predominantly adopts performance-based requirements to define the project scope. However, the reality is an **output specification for a PPP project remains a balance between performance requirements and prescriptive requirements**. As outlined in section 5.2, a properly crafted output specification requires striking a balance between performance requirements that allow the private sector the freedom to innovate and drive value-for-money through life-cycle efficiencies; and more prescriptive requirements that may be effective in providing certainty on specific commitments made during the planning stage for some parts of the scope. Where prescriptive requirements are used, it should be with a specific intent and rationale.

The output specification is composed of a series of documents within a PPP contract that define the functional requirements, minimum technical requirements for the design and construction and the scope and level of performance of services during the operating term. Although the overall contract structure may be similar from project to project, **the output specification should be actively tailored to be project-specific** to ensure that key project objectives are detailed to meet the end user requirements and recognise what is affordable within the project budget.

The output specification is the technical foundation of both the procurement and delivery phases and is used to determine technical compliance. During the planning phase, the public sector will identify their requirements and develop the output specifications which are included in the procurement documents. The amendments to the output specifications during the procurement and delivery phases are typically minor. **The output specification is typically finalised prior to contract signature** and any subsequent changes to it would be administered through the change mechanisms in the contract.

Adopting a structured approach to develop project requirements in the planning phase helps facilitate knowledge transfer throughout project delivery and the contract term by clearly documenting both performance priorities and minimum standards. **Engaging a range of stakeholder perspectives during the requirement development process helps to mitigate risks** from inconsistent end user expectations, complex interface management challenges, and incompatibility between expectation and overall project affordability.

It is essential the output specification is well-developed, clear, measurable and technically feasible. **A good output specification will have the following qualities** (detailed in Section 5.6 of this Reference Guide):

- **Outcomes focused:** responds to the project objectives and functional requirements of the asset;
- **Refers to codes and standards:** owner, local, national, industry or international codes and standards specify the minimum requirements;
- **Achievable:** the requirements are constructible and feasible and are informed by background studies and investigations;
- **Quantifiable:** the vision, objectives and requirements are described in terms of measurable outputs;
- **Observable compliance:** where a requirement is not quantifiable, there is a clear understanding of what evidence is required to prove the solution is compliant with a requirement;
- **Simple:** requirements are communicated using simple language and as few words as possible; and
- **Coordinated:** the structure considers how the output specification will be used and is coordinated with other project documents.

In addition to developing well defined and achievable output specifications, they should be **linked to payment mechanisms and termination provisions** to incentivise the greatest level of service delivery.

6.1 LESSONS LEARNED ON QUALITY INFRASTRUCTURE FOCUS AREAS

The G20 Leaders stressed the importance of Quality Infrastructure (QI) investment to deliver high-quality infrastructure projects at the Hangzhou Summit in September 2016[19], where it was defined as investment: "*which aims to ensure economic efficiency in view of life-cycle cost, safety, resilience against natural disaster, job creation, capacity building, and transfer of expertise and know-how on mutually agreed terms and conditions, while addressing social and environmental impacts and aligning with economic and development strategies*". This Reference Guide adopts this definition of Quality Infrastructure, and has broken it down into seven focus areas:

1. **Sustainability and longevity** of an infrastructure asset. Ability of the asset to address the needs and meet the expectations of end users.
2. **Health and safety** considerations during both construction and operation of the asset.
3. Ability of the asset to withstand **natural and other disasters**, including climate change.
4. **Job creation, capacity building, transfer of knowledge and expertise.**
5. **Social impacts and inclusiveness.**
6. **Environmental impacts.**
7. Alignment of the project with **economic and development strategies.** Ability of the asset to **respond to changes** in resource availability, population levels, demographics and disruptive technology.

Development of this Reference Guide identified observations and lessons learned that can be applied to PPP projects regardless of the asset class or location. This section defines the Quality Infrastructure focus areas and presents lessons learned that align with the focus areas, with relevant examples (cited as sub-bullet points) from the Part B case studies.

1 Economic efficiency in view of life-cycle cost - Sustainability and longevity of an infrastructure asset, while addressing the needs and meeting the expectations of end users.

The relationship between the decisions made during design and construction, and how they aim to minimise the whole-life cost of the asset and meet the end users' requirements. Considerations include:

- How the need for the asset has been identified and project objectives defined, and how these are translated into measurable requirements;
- Processes and requirements that support reliable operation and maintenance, and economic efficiency in view of whole life cost; and
- Requirements that promote good practice asset management and support the continued maintenance of an asset to meet the handback requirements.

- **Ensure that performance measures reflect the project objectives and the end user priorities:** Developing a clear vision and defining objectives through stakeholder engagement during the planning phase improves the quality of the output specification. Where this had been completed, the output specification, performance measures and the payment mechanism clearly communicated the project priorities, either through measurable key performance indicators or through payment mechanisms that incentivised the private sector to focus on the project priorities.

19 Available at: http://www.g20.utoronto.ca/2016/160905-communique.html

- **Plan France Très Haut Débit (Rural Highspeed Broadband):** The performance measures focus on meeting end user requirements. The main end user requirements are: 1) 'Access', where any internet service provider shall be able to use the network to commercialise internet subscriptions to the end users, and 2) 'Level of Service', where the network must provide satisfactory access to the internet. There are key performance indicators for each performance measure which are linked to payment if they are not achieved.

- **Consider customer satisfaction surveys:** Satisfaction surveys are good practice and are a common approach across asset classes and locations to evaluate whether the Private Partner is meeting the end user's expectations. Stakeholder feedback suggests it can be difficult to hold the Private Partner to measurable performance criteria as the surveys can be insufficiently prescribed and subjective. Adopting an industry recognised process to complete the surveys is one option that could improve the implementation of the customer survey, for example the Mactan-Cebu International Airport referenced an industry standard.
  - **Mactan-Cebu International Airport:** The Private Partner is required to undertake a passenger satisfaction survey every quarter. The industry benchmark for customer satisfaction surveys is the Airport Service Quality (ASQ) survey which has been developed by Airports Council International (ACI). It is a standardised survey which is completed by passengers at the airport once they have completed their journey through the terminal.
- **Be clear on handback requirements and condition assessments:** The handback requirements and condition assessments throughout the operating term are key mechanisms to support the longevity of the asset. In addition to regular lifecycle condition reviews, handback condition inspections typically commence five to seven years ahead of the end of term and will often be conducted by an independent third party. Depending on the jurisdiction, there will typically be a mechanism of financial retention leading up to handback to incentivise an acceptable handback condition.

  Recent projects have had more detailed requirements for the asset condition at the end of term and prescribing the residual life of key asset components is one way the output specification can promote asset quality beyond the end of the contractual term.
  - **Mersin Integrated Health Campus:** Prior to handback, an independent building survey shall be completed to assess the outstanding works required to meet the handback standards. On this project, it shall take place up to three years prior to the expiry date and involves the Owner and the Private Partner appointing a third party to undertake a condition survey of the facilities.
  - **Hong Kong Organic Resource Recovery Centre:** The project has a 15-year operating period term which is shorter than typical solid waste management PPP projects which are usually closer to 25 years. The Owner specified both the design life and residual life to promote long-term decision making during the design and construction phases.
- **Consider international standards for asset and information management:** International standards are increasingly being used to specify requirements for information quality and consistency and asset management. The introduction of these requirements points to the value of information in monitoring performance on an asset and administering a contract, and the need for a structured approach to plan, implement and review the asset management activities to promote a whole-life approach. Building information modelling (BIM) and emerging information management practices will continue to provide opportunities to improve asset delivery. The process starts by defining organisation (rather than project) objectives and developing governance standards and protocols to support implementation.

2 Health and safety considerations during both construction and operation of the asset.

A design approach that considers the health and safety of those who construct, operate, maintain, modify and demolish an asset, as well as those who work in or with it, use it or are in the proximity of it (i.e. the public).

Considerations include:

- How hazard identification and risk assessment methods are integrated into the design requirements, with the intention to eliminate or minimise the risks of injury throughout the life of the asset.
- The requirement to conform with appropriate health and safety standards and, if appropriate, go beyond these by developing a proactive health and safety culture.

- **Local law and regulations typically form minimum standards:** Local law and regulations typically form the minimum health and safety requirements, although there is the opportunity in the output specifications to include requirements above the minimum standards. When a project includes private finance, the private financing party may choose to impose their own minimum requirements to mitigate the risk of delay if a serious health and safety incident were to occur.
  - **Mactan-Cebu International Airport:** The output specification cited national legislation, however since the Asian Development Bank (ADB) was one of the lenders, the Private Partner was also required to comply with the ADB's safeguarding policy which includes occupational and community health and safety provisions.
- **Ensure proactive monitoring and intervention:** Owners typically prioritise health and safety planning and performance monitoring. Safety management plans are typically required to be in place within a defined period (dependant on the project schedule) after contract signature, and prior to construction commencing and are typically subject to Owner review. Depending on the Owner's project delivery experience, it is common for them to appoint external consultants to review the safety management plans. Persistent poor health and safety performance is typically linked to a contract default and which is monitored through monthly reporting. The Owner typically retains the right to audit health and safety performance at any point during construction and operations.
  - **Gautrain Rapid Rail:** Although the responsibility for health and safety is transferred to the Private Partner, the Owner takes a proactive interest in monitoring health and safety performance and the implementation of the health and safety management systems. A Safety Management Plan is required to reflect good industry practice. The Private Partner is then required to report on performance against the management plan.
- **Safety by design:** Where the Owner retains responsibility for the operation of an asset, there is an opportunity to incorporate "safety by design" requirements. The output specification can describe the operating functions and define constraints with the intent to reduce or eliminate long-term occupational hazards through decisions taken during the design process.
  - **John Hart Generating Station:** The Owner identified ways to incorporate "safety by design" principles into the project requirements. As an example, the design and construction requirements included general and specific requirements for operability and maintainability, confined spaces, isolation and lockout, isolation of mechanism apparatus, work at height, limits of approach, electromagnetic field, arc flash and constructability.

- **Consider requirements for system redundancy:** Output specifications can use performance requirements to specify the level of system redundancy required to ensure the healthy and safe operation of an asset. This is particularly relevant on healthcare projects, as the ability to deliver quality patient care is directly dependent on the reliability of the building systems. Under contract, the outage of critical building systems is typically subject to financial deductions in order to incentivise the private sector to prepare a resilient design and to undertake preventative maintenance to mitigate the likelihood of a system outage.
  - **Milton District Hospital Expansion Project:** The output specification includes provisions for selected equipment, devices or systems to be provided in sufficient quantity and capacity such that should the largest unit fail, the design load of the system served will still be met.

Additional industry example: Transport Infrastructure Safety Standards

In support of the United Nations (UN) Sustainable Development Goals to halve road deaths and injuries (Goal 3.6) and build Safe and Sustainable Cities (Goal 11.2), UN Member States have agreed on 12 Global Road Safety Performance Targets[20]. Targets three and four relate to transport and road infrastructure safety standards including the specification for all new roads to meet a three-star or better star rating for all road users.

Governments around the world have now adopted Star Rating targets for new and existing roads. The targets are being used for both public and private sector infrastructure including the Wellington Gateway Project in New Zealand where a minimum four-star standard was specified; Highways England with a target of 90% of travel on three-star or better roads; Concession Roads in Brazil where three-star or better standards are being specified and Indonesia where toll increases will be subject to meeting a four-star standard.

Development institutions are also encouraging client countries to meet the UN targets with the World Bank, Asian Development Bank, Millennium Challenge Corporation, Caribbean Development Bank and others including three-star or better targets on transport and road projects.

In 2018 the online Star Rating for Designs (SR4D) tool was released to "empower designers and road engineers to assess the road safety of a design and improve its safety star rating before the implementation of civil works"[21]. The SR4D tool can also "strengthen the road safety audit process, complementing it with an objective and repeatable qualification of road user fatality and serious injury risk and support the wider and more immediate application of Star Ratings as a safety performance metric" and could be considered as a requirement when developing output specifications for highway projects.

Further information can also be found at https://www.irap.org/ and a 'Business Case for Safer Roads' is found at https://www.vaccinesforroads.org/business-case-for-safer-roads/

20 https://www.who.int/violence_injury_prevention/road_safety_status/2018/en/ (page 19)

21 Further information available at: https://www.irap.org/2018/11/new-star-rating-for-design-sr4d-tool-set-to-revolutionise-road-design-safety/ An example of the application of the iRAP standard can be found at: http://www.saopaulo.sp.gov.br/spnoticias/governo-de-sp-lanca-maior-concessao-rodoviaria-do-pais/

3 Ability of the asset to withstand natural and other disasters, including climate change.

The ability for an asset to demonstrate resilience and safety against natural disaster, terrorism, and cyber-attack risks. Considerations include:

- Implementation of best design practice processes and procedures to identify location-specific hazards and aim to mitigate the impact of natural disasters on the asset's condition and its users through design. This could include design requirements above minimum standards and specifying the required level of performance following an event.

- **Understand the site-specific risks:** During the planning phase, owners have the ability to mitigate the impact of natural disasters by considering the potential exposure when selecting a project site. The Owner is typically required to complete background research and site investigations to identify risks that can then be translated into requirements in the output specification. If the risks can be quantified, the Owner then has the option to transfer the risks to the private sector through an appropriate risk sharing model.
  - **Presidio Parkway:** The Private Partner is responsible for the first USD10 million of extra work and delay costs (in aggregate during the project term) incurred to repair or replace tangible property damage caused by seismic events. All un-insured costs above this will be borne by the Owner. By sharing the risk, the Private Partner is incentivised to develop a design that mitigates repairs for a minor (and more likely) event.
  - **Melbourne Metro Rail Tunnel:** The Owner has identified and documented projections and scenarios in a Climate Change Risk Assessment and Climate Change Adaptation Plan. The output specification includes climate resilience requirements that respond to the location specific risks. The Private Partner is responsible for delivering a design that "*must include measures for all high and extreme climate change risks to ensure the infrastructure, stations and precincts are resilient to the projected impacts of a changing climate over the relevant asset's Design Life.*"

- **Performance-based seismic requirements:** The **John Hart Generating Station** and **Presidio Parkway** case studies demonstrate how seismic requirements can be incorporated in the output specification using performance-based criteria. By adopting a performance-based design approach, the Private Partner has the flexibility to design a solution that best mitigates the risk. The output specification describes the required level of performance, depending on the defined seismic event. Typically, the seismic requirements refer to location-specific industry standards, for example the Presidio Parkway seismic requirements consisted of industry requirements (American Association of State Highway and Transportation Officials Load and Resistance Factor Design (AASHTO-LRFD) Standard), Owner requirements (Caltrans Seismic Design Criteria) and project requirements.

Best practice is evolving

The projects documented in the case studies were selected based on their current stage of development (typically either operational or nearing construction completion), and therefore do not necessarily represent current best practices to respond to climate change risks. Transportation projects in North America now increasingly refer to a base design level (for example, a one-in-100 year event) and then require a supplemental allowance for sea level rise and flooding (for example, an additional two feet). The allowance for sea level rise and flooding is based on site specific analysis of the risk and will vary between projects. There are also jurisdictions that have developed their own design guidelines to respond to climate change risks, for example:

- **British Columbia (Canada) Ministry of Transportation and Infrastructure (MoTI):** MoTI requires the potential impacts of climate change be considered during the design stage of a project. In March 2019, MoTI issued a Technical Circular providing guidance to the engineering community on how climate change risks should be considered on maintenance, rehabilitation and new construction projects.

4 Job creation, capacity building, transfer of knowledge and expertise

Promoting job creation, capacity building, and transfer of expertise and know-how to national and local communities to deliver on economic development objectives. Considerations include:

- How the requirements support participation by smaller (and local) and minority-owned firms as part of the project delivery in both the construction and operation phases.
- Requirements aimed at transferring project knowledge and developing skills in the local community or Owner to support the long-term operations and maintenance of an asset, and particularly relating to handback.

- **Consider job creation and local business targets:** Quantifiable performance measures (linked to financial deductions) are the typical way for projects with job creation objectives to align the Owner and Private Partner priorities. Good practice is to include requirements for both the construction and operating term, and to have a monitoring program in place to measure performance.
  - **Gautrain Rapid Rail:** Socio-economic development (SED) was a main objective of the project. The Owner developed a SED strategy which identified 22 elements, with targets, for the project and developed a specific schedule to document the requirements. To achieve the targets in the strategy, the Owner used the output specification to align their priorities with the Private Partner's priorities. Measurable requirements were included in the specification and independent reviews were required to determine if the objectives had been achieved and a penalty and reward regime was included to promote performance above the minimum requirement.
  - **John Hart Generating Station Replacement Project:** During the project planning phase the Owner entered into impact benefit agreements with local First Nations (traditional inhabitants of the land). The output specifications reflect this priority with the inclusion of a specific First Nations output specification schedule and requirements for Private Partner reporting, as well as potential financial deductions or contract default for non-compliances with the requirements.
  - **The Central 70 Managed Lanes project** provides another example of construction and operations period local business targets that promote job creation.
- **Ensure project knowledge is documented in plans and procedures:** Clear and current project documentation is an important element of effective knowledge transfer. The private sector is typically required to document their operating policies and procedures as well as maintenance plans prior to construction completion. The specifications typically describe the intent and content of the policies, plans and procedures, the development process (due dates and need for stakeholder input) and how and when the documents need to be updated. Typically, policies, plans and procedures are updated annually to capture lessons learned and are subject to Owner review.
- **Include a handback/handover plan:** The requirement for a 'Handback Plan' is typically included on most PPP projects, with asset documentation a key part of this. Increasingly, there are requirements for building information models (BIM) to be maintained throughout the operating term to improve asset management and the transfer of knowledge at handback.
  - **Hong Kong Organic Resource Recovery Centre:** The output specification includes requirements for BIM to mitigate construction risks and improve asset management and transfer of knowledge. At an organisation level, the Owner has defined their requirements for BIM, which in turn inform the project requirements. The Private Partner shall adopt BIM during the design, construction, and operations stages of the facility.

5 Social impacts and inclusiveness

Social impact is the effect a development's actions have on the well-being of the community. Considerations include:

- How the project considers the impact it has on the local community, and the requirements in the contract to provide positive impact or mitigate the negative impact during both the construction and operations phases. Further guidance is provided in the GI Hub's '*Reference Tool on Inclusive Infrastructure and Social Equity*'[22].

- **Establish social inclusiveness initiatives during the project planning phase:** A common approach is for an owner to engage with stakeholders to identify priorities and develop social inclusiveness initiatives during the planning stage that can then be translated into requirements in the output specification. Meaningful social initiatives take time to implement. Without the Owner leading the initiative development during the planning phase, the Private Partner is unlikely to have adequate time between contract award and construction commencement to develop meaningful programs and to deliver the project on schedule.
  - **Pan Am Games Athletes' Village:** The project addressed job creation and social inclusiveness through cooperation with the Waterfront Toronto Employment Initiative (WTEI). The Owner took a proactive approach and set out initiatives that the Private Partner could take advantage of. The project worked with WTEI, who was committed to connecting un/under-employed Torontonians with the employment and training opportunities that were generated through this revitalisation.
- **Ensure accessibility provisions:** From healthcare facilities to transit systems, current relevant standards and codes are typically used to specify the minimum accessibility provisions. For example:
  - **Mersin Integrated Health Campus:** The facility must comply with the Turkish disability legislation, and the Private Partner is required to "*ensure access routes comply with disability legislation*". More specifically, the output specifications highlight that the facility must "*include access provisions for cars or minibuses to set down disabled or elderly people at entrances, safely and without hindrance*".
  - **Pan Am Games Athletes' Village:** All accessibility requirements listed in the *International Paralympic Committee, Accessibility Guide July 2009* and the *Ontario Building Code 2006* were required to be met. In the case of conflicting requirements, the most stringent applied.

6 Environmental impacts

Environmental impacts may present themselves as temporary or permanent changes to the atmosphere, water, and land due to any development or human activities, which can result in impacts that may be either reversible or irreversible.

- How the project considers the impact it has on the environment, and the requirements in the contract to mitigate the impact during both the construction and operations phases.
- Consideration is given to the mechanisms used to reduce energy consumption over the life of the asset.

- **Use of Environmental Management Systems:** Globally ISO 14001 accreditation is a commonly used standard for environmental management. ISO considers adopting a standardised approach can have an effective role in support public policies[23]. It is worth noting that in some jurisdictions the full accreditation is required, whereas in other jurisdictions the Private Partner is required to comply with ISO 14001, but is not contractually required to obtain the formal accreditation. This distinction can be due to the depth of local knowledge in the implementation of the standard, or an assessment of the relative cost and value of pursuing certification.

22 Available at: https://inclusiveinfra.gihub.org/

23 Additional information available at: https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/iso_action_plan_2016-2020_en_ld.pdf

- **Consider requirements for third party certification:** Industry recognised third party certifications are a common approach to promote energy efficiency and asset sustainability. The available certifications vary by location. The certifications referenced in the case studies include LEED[24], ENVISION[25], EDGE[26] and BREEAM[27].

  A good practice approach is to define in the output specification the credits that the Private Partner must achieve to ensure that the certification achieved aligns with the Owner's objectives. Alternatively, Owners (or governments) may have their own green building standard, for example:

  - **Hong Kong Organic Recovery Centre:** The output specification includes a requirement to comply with the Government of Hong Kong's '*Green Building Performance Framework set out in the Development Bureau Technical Circular (Works) No 2/2015*'.
  - **North American Airport:** A current airport redevelopment project in North America requires both LEED Silver Certification (for design and construction and the operations and maintenance) and ENVISION Gold certification. The same project also references international standards (ISO14064 and ISO14065) for greenhouse gas quantification, validation and verification.
  - **Milton District Hospital Expansion:** The output specifications require the Private Partner to achieve the LEED 'New Construction' Silver rating certification. There is an onerous CAD2 million penalty in the form of liquidated damages to the Owner if the Private Partner fails to achieve the LEED certification within 24 months of substantial completion.

- **Consider energy targets:** Energy efficiency can be promoted by linking energy consumption to the payment mechanism. Rather than prescribing requirements, an energy painshare/gainshare approach can promote the private sector to incorporate energy saving measures into their design. Typically, the proposed energy consumption is considered during the bid evaluation process (part of the financial assessment). During the operating term the private sector performance is then measured against the target. It is essential that the Owner invests in developing their understanding of the energy usage of their asset during the project planning phase to establish a realistic energy benchmark.
  - **Infrastructure Ontario model:** In the Infrastructure Ontario model, the energy unit pricing is a risk borne by the Owner, however the energy consumption risk is shared using a painshare/gainshare mechanism. On this basis, actual energy consumption is measured annually against the energy target for that year.
  - **Agadir Mutualized Desalination Plant:** The output specification requires the energy that powers the asset to be generated from renewable sources. The Owner also desires to minimise energy consumption and the output specification incentivises the Private Partner to optimise the plant and minimise energy use by linking payment to energy consumption; the Private Partner can increase their profit by reducing their energy consumption. This approach allows the Private Partner to make trade-offs between energy costs over the term and a design solution which exceeds minimum requirements. As a result, the Private Partner decided to include an energy harvesting turbine which reduces the overall energy use of the facility.

24 Further information available at: https://www.buildinggreen.com/leed

25 Further information available at: https://sustainableinfrastructure.org/

26 Further information available at: https://www.edgebuildings.com

27 Further information available at: https://www.breeam.com

7 Alignment of the project with economic and development strategies (SDGs, national policy etc) Ability of the asset to respond to changes in resource availability, population levels, demographics and disruptive technology.

Ensuring alignment with economic and development strategies, and ability to respond to changing priorities or needs including aspects of climate change, population growth and disruptive technology at the national and regional levels.

- Identify how the projects align with economic and development strategies and reflect these in the project objectives and performance measures.
- How the requirements either foresee potential changes or refer to contractual mechanisms that allow future changes to be adopted.

- **Ensure that output specifications define capacity requirements:** The scale and scope of the asset is developed by the Owner during the planning stage and is informed by studies and assessments. The output specification then details the scale and scope in terms of measurable outputs. One approach to respond to growth and expansion is to develop mechanisms in the contract (rather than the output specification) that describes the process to deal with specific changes, and how those changes will be priced if they were to occur. An alternative approach is to build in additional capacity during the initial construction project. The approach will depend on the project and on the understanding of the likelihood and impact of demographic changes.
  - **Mersin Integrated Health Campus:** The design objectives indicate provision of a total capacity of 1,259 beds within the campus. The expectation was that the facility would not operate at full capacity in the earlier years but would allow for population growth. Volume-related services were provided under the payment mechanism with a guaranteed minimum capacity (70%) with occupancy above that level managed through a monthly adjustment and an annual reconciliation of actual occupancy. Expansion is to be managed through the variation procedure in the contract.
  - **Plan France Très Haut Débit (Rural Highspeed Broadband):** The Private Partner is required to take into account potential demographic growth providing an additional capacity of 20% in the design of the network and is also required to check with local authorities if real estate developments are planned in the area.
- **Consider both proven and emerging technologies:** For projects that have a critical technology component, such as waste, water and energy projects, it is common for the output specifications to require proven technology. The contract then typically incorporates mechanisms to allow changes in the future to incorporate new solutions at the Owner's cost.
  - **Agadir Mutualized Desalination Plant:** The Private Partner can propose new technologies throughout the project term to allow the Owner to incorporate new and emerging technologies. This is accommodated in the contract, not in the output specifications.
- **Consider flexibility in rapidly changing areas, such as by the Owner retaining the ICT risk:** To address technology developments associated with services in the built environment, a current approach is for the Owner to retain the ICT, or a short-term contract is awarded, often three to five years, during which the needs are more predictable.
  - **Lewisham Grouped Schools:** The Private Partner's involvement with ICT is limited to provision and maintenance of the infrastructure, while the Owner retains control of hardware (initially provided by the Private Partner through the equipment schedule, but maintained and replaced by the Owner), software and internet provision.
  - **PPP Prisons Program (Lots 1-3):** For the new prisons contracts, the expected performance levels for rapidly evolving technology equipment (such as CCTV or security) have been reformulated to allow private partners more flexibility in defining technical characteristics so they can focus on performance objectives for each equipment.

The SDGs were published in 2015 and given that the case studies selected were nearing construction completion or in operation, the specifications reviewed do not explicitly mention the SDGs. The alignment of output specifications with the SDGs and other global agencies is an appropriate area for further study as discussed in the conclusion.

Figure 10: Summary of QI focus areas and lessons learned

7. Conclusion and areas for further development

The Reference Guide focuses on leading practices in establishing output specifications to deliver quality infrastructure through harnessing the advantages of long-term contracts that adopt a life-cycle approach. While most case studies reviewed are projects delivered under a broadly defined PPP approach, many of the lessons learned will also be applicable to other types of long-term contracts.

The output specification is central to ensuring the government policies aimed at developing quality infrastructure are translated into the contractual documents to be delivered at a project level. However, a quality, project specific output specification is only one element that supports successful project delivery. The output specification should be considered alongside other elements that, when combined, will improve the infrastructure quality and project success. These include:

- **Business case development:** a robust approach that promotes project appraisal where project objectives and outcomes are defined, affordability thresholds are established, and sponsor support is received.
- **Stakeholder engagement:** a structured approach throughout project planning and delivery to identify the end user requirements, and promote buy-in.
- **Risk based approach:** identifying, analysing and evaluating risks and using the knowledge of the risks to inform project decisions throughout project delivery.
- **Project governance:** structured to align with the organisation's governance and appropriate for the stage of project delivery, with clear roles and responsibilities, communication protocols, issues management and ultimately a single point of accountability.
- **Procurement approach:** selection of the procurement model is informed by an unbiased view of the project risk and the procurement evaluation process supports the selection of a capable Private Partner.
- **Contract structure:** the payment terms (including progress payments, completion payments, performance-based payments) will influence the Private Partner's priorities, so should be aligned with the Owner's project objectives.
- **Performance monitoring:** Owner contract administration, including commissioning and compliance checks, audits and reviews, and condition assessments, is required to confirm the Private Partner is delivering the scope they are contracted to deliver.
- **Asset and information management:** how the asset will be operated and maintained should be a focus of the planning phase and should be reflected in the risk identification process, the procurement process and evaluation and the output specification development.

While the Reference Guide focuses on output specifications as a driver of private sector innovation, efficiency and alignment with government aims, the case studies also highlighted that there are times when more prescriptive requirements are appropriate. In short, if prescriptive requirements are used, they should be used with intent - for a specific reason and a rationale that delivers value-for-money rather than as a default position. The use of prescriptive requirements should be informed by the project objectives, risk identification and allocation, the procurement model and contract term.

The research for the Reference Guide also highlighted that some areas of good practice have emerged more recently, such as on information management, climate adaptation, and adoption of the SDGs. The following paragraphs present some areas for further development, to promote greater alignment with economic and development strategies and deliver more and better quality infrastructure. The GI Hub hopes that this Reference Guide will be a stimulus to further operationalising the principles of quality infrastructure investment and welcomes any reader feedback and suggestions.

7.1 AREAS FOR FURTHER DEVELOPMENT

Further alignment with economic and development strategies including the SDGs: The United Nations' SDGs are a current approach to spearhead sustainable development and help support consistency in the way projects and governments promote alignment with economic and development strategies. The SDGs were published in 2015 and there is now industry guidance, such as the United Nations Economic Commission for Europe (UNECE) international PPP standards[28], that align with and promote the SDGs. Given the projects were selected based on the stage of development (nearing construction completion or operation), the specifications reviewed do not explicitly mention the SDGs, and this is an area which could be further explored[29].

Establishing data management, benchmarking and measurement for quality infrastructure: While the G20 has made progress in defining and developing principles for quality infrastructure, metrics of quality infrastructure that could be used to inform KPIs at the project level are still in the early stages of development. Improvements in data management and analytics offer the potential to strengthen the measurement and implementation of performance requirements. A consistent approach for the development and implementation of metrics could enable stakeholders at the project level to benchmark performance, which, in turn, could feed into improved lessons learned at a policy level.

Using established and emerging information management approaches to improve project outcomes: Over the past five years, a number of jurisdictions have begun to use BIM in a more consistent and strategic way to enable the efficient production, sharing and management of digital asset information which leads to improved whole-life performance, cost reduction and better risk management. Progress is underway on the development of international standards and the implementation of programs that aim to capitalise on the benefits of BIM adoption. For example, the UK Foreign and Commonwealth Office (FCO)[30] is currently (as of January 2019) delivering the BIM Pathfinder Programme. The program is delivered with partner countries including Colombia, Vietnam, Indonesia, Brazil, Mexico and Peru, and will conclude with the rollout of BIM on selected pilot projects which will form the case study for BIM adoption in each country.

Mainstreaming of resilience, environment and climate: In recent years, countries have become increasingly aware of the interrelationship between environment, climate and infrastructure and a number of countries have declared a climate emergency. This policy imperative is starting to feed more explicitly into contract requirements and best practice is evolving. As outlined above, some jurisdictions have developed their own design guidelines to respond to climate change risks, for example the Ministry of Transportation and Infrastructure in British Columbia, Canada, which has recently issued a new Technical Circular providing guidance to the engineering community on how climate change risks should be considered regarding maintenance, rehabilitation and new construction projects. We expect the output specifications to be increasingly aligned to the new policy objectives and sharing of approaches could help strengthen their broader adoption.

Consideration of broader contract models with flexibility to future change: The speed of change and uptake of certain disruptive technologies, such as in ICT, has led Owners to adopt a range of approaches to maintain flexibility, such as retaining the ICT components or adopting shorter term contracts. This Reference Guide has focused largely on projects adopting a range of PPP approaches, and while the lessons learned are broadly applicable, it could be useful to further explore other types of innovative contractual models that allow more flexibility to respond to change.

28 Further information available at: https://www.uneceppp-icoe.org/about-us/

29 Examples and further context can be found at: https://www.globalgoals.org/

30 Further information available in the downloadable report at: https://www.thenbs.com/knowledge/national-bim-report-2019