

Platform Design Programme: Defining the Need

Construction Innovation Hub

January 2021



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About the Construction Innovation Hub

Funded by Government in 2018 with £72 million from UK Research and Innovation's Industrial Strategy Challenge Fund, the Construction Innovation Hub brings together world-class expertise from BRE, the Centre for Digital Built Britain (CDBB) at the University of Cambridge and the Manufacturing Technology Centre (MTC). We believe that collective innovation can catalyse the change needed for our built environment to deliver better outcomes for current and future generations.

We are enabling better decisions. Our Value Toolkit is a suite of tools to empower clients and policymakers to make value-based procurement decisions that will result in the environmental, social, and economic outcomes they want. Developed with Government, the Toolkit supports clients to comply with the policies in the Construction Playbook and to align with the United Nation's Sustainable Development Goals.

We are driving digital transformation by strengthening the business case for change and developing user-friendly guidance, training and tools to encourage more organisations to benefit from data-driven decision making and secure, resilient data sharing. Our resources support the adoption of the UK BIM Framework, Government Soft Landings, Digital Twins, Digital Estates and Security-Mindedness.

We are transforming construction delivery. Our Platform Design Programme is adapting proven manufacturing processes from other sectors for construction, to develop new rules and standards to improve the safety, assurance and interoperability of platform construction systems. We are developing proof of concepts with Government departments, including the Department for Education's Gen Zero schools programme, to create a platform construction system that offers clients the flexibility to create beautiful spaces and grow a strong pipeline of demand for standardised components.

Together, we are making a change. The Hub has partnered with over 100 organisations to build client and supply chain capability and capacity, to ensure our work delivers value to the sector and the nation long beyond the life of the programme. We are openly sharing programme outputs and the lessons we learnt along the way, so that businesses of all size stand ready to deliver the UK's future construction and infrastructure needs.

By working together, we will get there faster.

Partner with the Construction Innovation Hub and be part of the transformation.

Further information

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This project is a collaboration—we wish to take this opportunity to thank and celebrate the continued contribution of all our partners in driving transformative change.

Client executive



Industry



Foreword

Foreword by Sam Stacey, Transforming Construction Challenge Director

We need only look to the skies above us to see the truly transformative potential of standardised, repeatable platform systems. Pioneering sectors like aerospace have, for many years, applied the 'kit of parts' approach to designing and building the thousands of airliners which traverse the globe. In doing so, they have reaped the benefits, which range from increased productivity and efficiency to greater market willingness to invest in new solutions.

While platform construction systems are not entirely alien to UK construction, the industry lags far behind its peers in aerospace and automotive where it comes to adopting this approach at scale. For the most part, the methods we employ to build critical social infrastructure like schools, hospitals and homes are outdated and inefficient. There is far too much focus on capital cost, excessive waste and inefficiency and comparatively little attention given to whole-life value.

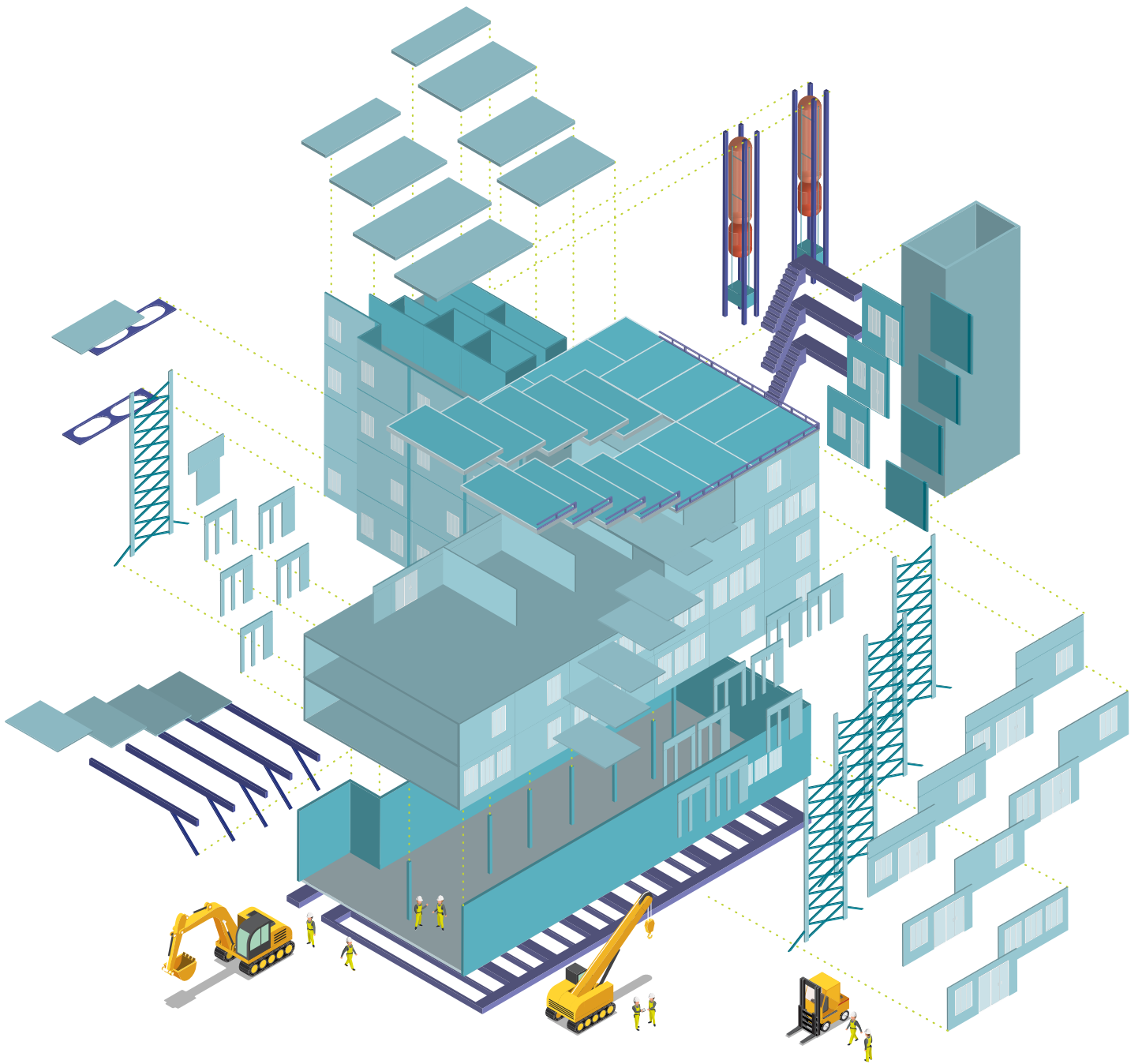
The Transforming Construction Challenge, which I am privileged to lead, was established to guide and support the sector on its transformative journey. Through the Construction Innovation Hub and its industry partners, we are developing a Platform Rulebook to enable the growth of a new market, which will deliver, at scale, across a pan-government pipeline of social infrastructure works from schools to hospitals to prisons.

This is not simply to reduce overall project cost and delivery time for buildings. Platform construction systems will help to cut lifetime carbon emissions, improve overall performance and increase whole life value. The benefits, therefore, will be felt well beyond

simply those who commission, design, build and use an asset. Our goal through the Platform Design Programme - and indeed the wider Transforming Construction Challenge - is to deliver tangible benefits for the economy, our environment and society as a whole.

The Platform Design Programme has taken on a new significance following the publication of the much-anticipated Construction Playbook. In addition to seeking to procure construction projects based on product platforms, Government is encouraging public bodies to explore ways in which cross-sector platform systems can be applied. Months of close collaboration with stakeholders across key departments has allowed the Hub to develop a platform hypothesis which is ideally placed to enable Government to deliver on the ambitions set out in the Playbook. With the scale of public sector pipeline identified by the Hub as suitable for delivery, in whole or in part, through platform construction systems, the transformative potential is both exciting and plain to see.

The publication of this report marks a critical milestone not only for the Construction Innovation Hub, but indeed for the wider journey of transformation which the sector is on. The Construction Playbook sets the ambition for what must be achieved, the Hub's Platform provides the means to achieve it and now, through Defining the Need, we have the evidence that we can achieve it.



Executive summary

The movement to bring standardised, repeatable platform systems found in the manufacturing sector to construction is growing. Both automotive and aerospace industries have shown that demand and standardisation give the market confidence to invest in new solutions, training and upskilling at scale.

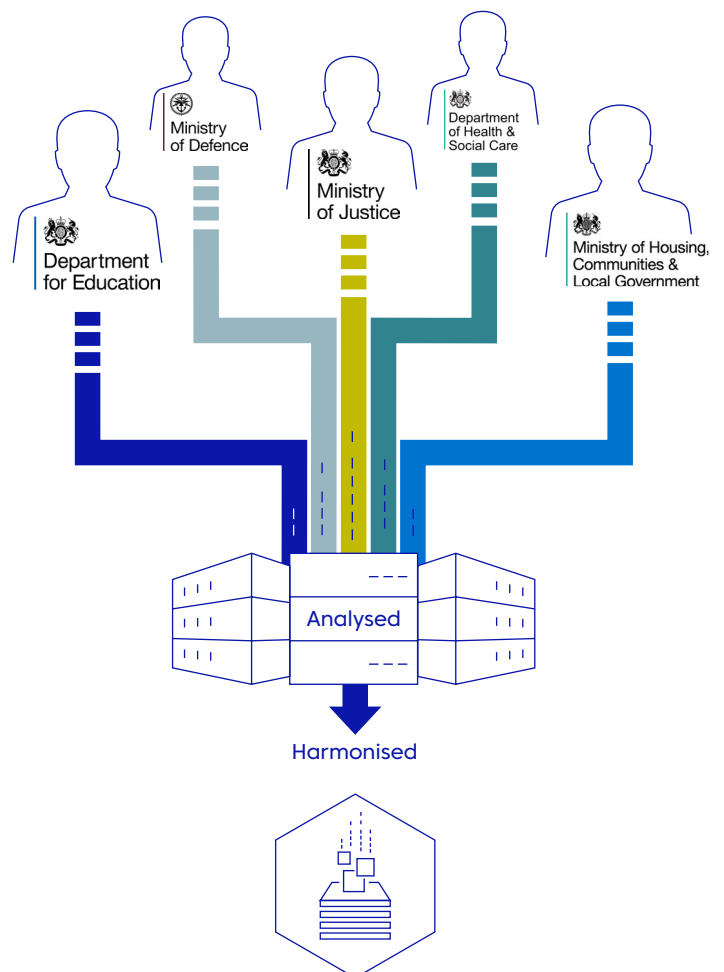
However, the construction sector has been held back by both a lack of consistent processes and standards that allow platform construction systems to be used flexibly to deliver a range of building types and low confidence in a forward pipeline of demand.

The government has created the right conditions to address this missing confidence and accelerate the market for platform construction systems through the new policies set out in the Construction Playbook. In parallel, the Hub's Platform Design Programme is working in partnership with industry and government clients to develop processes, standards and guidelines for designing, manufacturing and assembling platform construction systems, to ensure the market stands ready to deliver the future infrastructure pipeline.

The Construction Playbook is UK government's new Commercial Guidance on sourcing and contracting public works projects and programmes published in December 2020 to drive the government's commitment to 'better, faster, greener delivery'. The Playbook will be implemented on a 'comply or explain' basis for all government departments and arm's length bodies (ALBs).

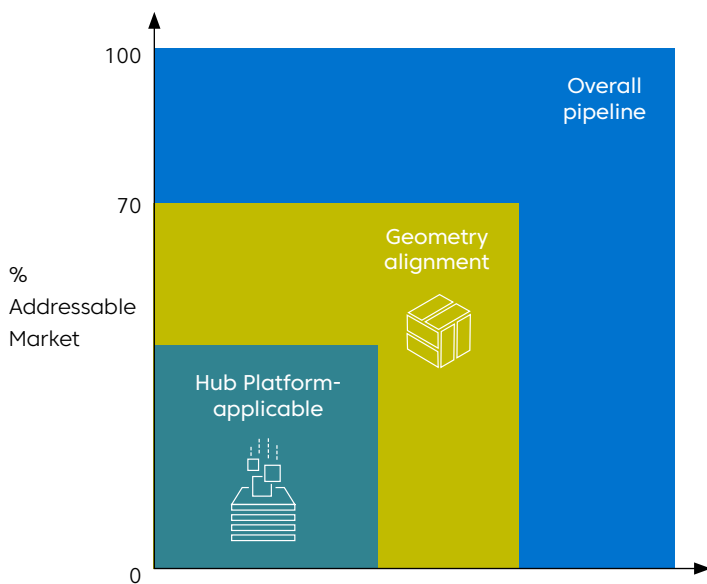
Its policies include:

- A call for pan-government harmonisation, standardisation and rationalisation of requirements across construction projects, programmes and portfolios to provide industry with a clear view of the future pipeline.
- Recommendations to look to procure construction product platforms comprising of standardised, interoperable components and assemblies.
- Enabling innovation and Modern Methods of Construction through aggregated and standardised demand.



Defining the Need

The Platform Design Programme is being developed through the application of a Systems Engineering approach, Defining the Need is a crucial first step. In 2020, the Hub's Platform team partnered with five of the government departments that will comply with the Playbook, Department for Education (DfE), Department of Health and Social Care (DHSC), Ministry of Housing, Communities and Local Government (MHCLG), Ministry of Justice (MoJ), and the Ministry of Defence (MoD) working collaboratively to collate a cross-departmental data set of future requirements across a £50 billion five-year new build pipeline. The findings will guide the Platform Design Programme and inform the design of the Hub Platform Construction System and the development of the Platform Rulebook.



Analysis of this data set, combined with stakeholder interviews with clients and end-users, has identified a clear and defined market opportunity for platform construction systems across social infrastructure.

Key insights:

Across the £50 billion pipeline analysed:

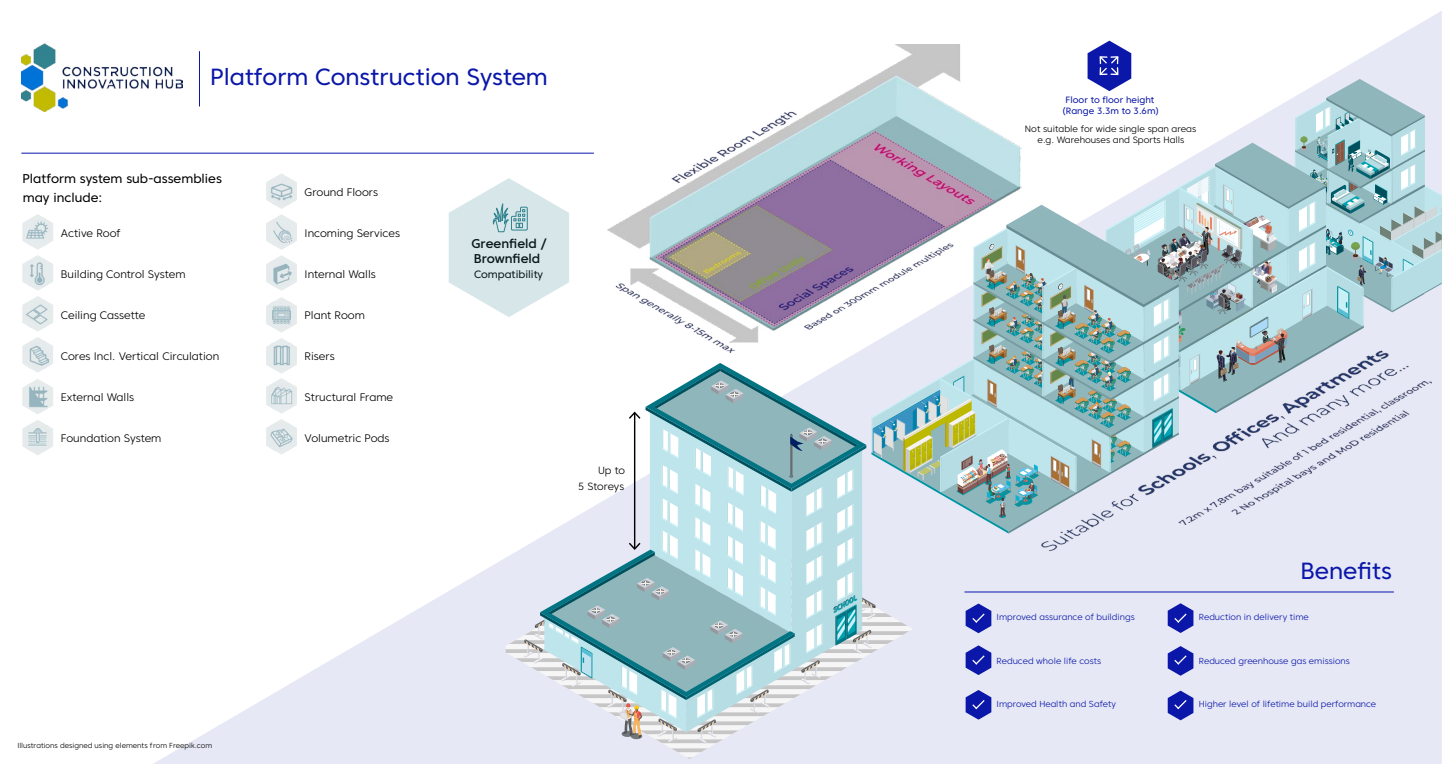
- 70% of those government spaces analysed share consistent geometrical characteristics – namely a mid-span framing system.
- Around £13 billion is estimated as suitable for delivery using the Hub's Platform Construction System, the majority applicable to the DfE, DHSC and MHCLG.
- 30% of spaces are general use areas, such as circulation, bathrooms and storage, with bedrooms the largest frequency of the government of estate at 13%.
- Departments shared an informed understanding of value drivers, not least the collective commitment and shift in focus towards driving a net-zero carbon agenda across all departments pipeline.

The data analysis extended beyond the National Infrastructure Pipeline, with a granularity level that has identified pan-government synergies. Harmonising, digitalising and rationalising these design fundamentals offers the potential to unlock pan-government efficiencies and allows each department to focus the resources on areas that deliver the greatest impact for their end-users. This will help ensure teaching spaces improve learning outcomes, clinical spaces enhance patient experience, and buildings meet strict environmental and design requirements.

To inform the Hub Platform Construction System's architecture a detailed functional review of 20% of selected room types across the Government estate was undertaken. This identified opportunities for harmonisation, but equally painted a picture of the variability of specified requirements. While the Construction Playbook encourages consistent structure, rules and language to facilitate shared

understanding and use of digital and automated solutions, the Defining the Need exercise has flagged that the status quo is somewhat different.

Departments use a combination of quantifiable and qualitative descriptors to articulate their requirements; with some criteria being machine-readable, whilst others remain open to subjective



interpretation. Performance characteristics often vary, with differing measurement scales (such as dB or NR for acoustic performance) and multiple cross-references. Furthermore, there is a mixture of both output and input-based specifications, with outcomes rarely defined. This analysis reaffirms the findings of academics who have previously concluded that public sector construction – be it schools, healthcare facilities or prisons – have a high degree of complexity, governed by numerous regulations containing a wide range of requirements.

Next Steps

The Hub has proactively assumed to build upon the data capture so far and prepare a maturity assessment and a route-map for improvement for each department, in supporting the development of consistent structure, rules and language pan-government in alignment with the Construction Playbook.

Similarly applying the pipeline data analysis, the project team will conduct further exercises to demonstrate the potential economies of scope and scale that can be unlocked for commodity items, such as lifts or bathrooms.

The project team has also developed principles of harmonisation to shape and mould the Hub Platform Construction System. A hypothesis specification, illustrated below, provides an overview of the initial principles. Over the forthcoming months, this will be further developed, with the project team progressing:

- **The Platform Rulebook** – with defined rules, quality processes and interface standards of how technologies and sub-assemblies can and will be integrated.
- **The value proposition** – defining the value characteristics, competitive differentiation, cost structure and life cycle of the platform construction system.
- **A kit of parts** – the components of the platform construction system (sharing similar features, functionality or lineage) that can be varied within certain constraints.
- **Enablers** – with evolving understanding of how platform solutions necessitate a change in organisational structure.

Opportunities for Industry

This report explains how platform construction systems could address a significant proportion of the social infrastructure pipeline and reveals potential private sector residential applications. The numbers show that there is enough demand to support a range of platform construction systems and that the economies of scope and scale will offer advantages to clients, contractors, and the supply chain.

The Platform Design Programme offers opportunities for the wider market at three distinct levels:

- In demonstrating the potential and applicability of platform systems for the construction sector.
- In stimulating the creation of new public and private sector marketplace for platform construction systems.
- Through learning of the process, enabling others to procure, develop and apply platform construction systems for better, faster and greener outcomes.

To learn more visit

www.constructioninnovationhub.org.uk.

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Introduction to Defining the Need

The Construction Sector Deal, published in 2018, set out a strategy to improve the industry's performance and help it fulfil its potential to deliver wide-reaching social, economic and environmental benefits. The Construction Innovation Hub (The Hub) is the catalyst to drive this transformation and central to this focus is the Platform Design Programme project.

Binding together over 40 of the best partners from industry, a collaborative project partnership (the Platform Design Programme) has been established to demonstrate the Government's ambition for platform-based design for manufacture and assembly in realising better outcomes.

To shape and share a better, more sustainable solution for UK Government's new build programme

Platform Principles

Design for Manufacture and Assembly (DfMA) is a broad term that describes the process by which building products, or components, are designed to facilitate manufacture and assembly, in unlocking a broad spectrum of benefits. A platform approach to DfMA (P-DfMA) seeks to extend this principle – applying a set of digitally designed common elements (components, rules and processes) across multiple types of built asset, minimising the need for bespoke.

Defining economies of scope, that unlock economies of scale – commonality, designed with competitive differentiation

In 2017 Bryden Wood, as part of the Digital Built Britain programme, issued a seminal paper that sought to leverage the scale of government's construction pipeline to transform the industry to deliver high-performing, high-quality, low-carbon assets through the development of advanced manufacturing capabilities, products and services.¹

This paper outlined the potential for a platform-based approach, most commonly associated with manufacturing industries, in which components could be brought together into defined sub-assemblies to create a range of high-performing products, unlocking:

- Economies of scale.
- Whole-life value.
- Product development efficiencies.
- Enhanced residual asset value.
- Facilitated mass customisation to adapt to a client's needs.

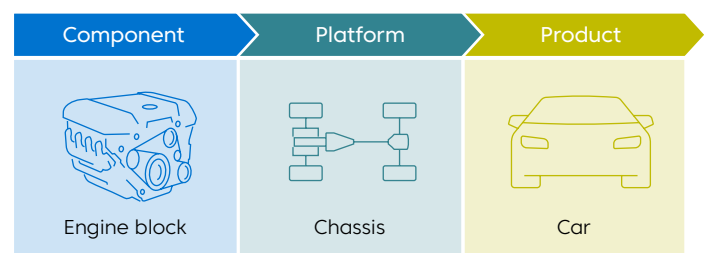


Figure 1: Credit Bryden Wood 'Platforms Bridging the gap between construction and manufacturing'

Platform team objectives

The recently published Government Construction Playbook outlines a policy towards “procurement of construction projects based on product platforms comprising standardised and interoperable components and assemblies”.

This moves forward the principles historically outlined by the Infrastructure Projects Authority² encouraging the adoption of:

- **Design for manufacture:** with design, procurement and construction of built assets using a defined set of standard and interoperable components.
- **Platform approach:** maximising the use of the same components across different types of infrastructure, designed by industry to have as wide a use as possible.
- **Open for manufacture, use and procurement:** with manufacture, use and procurement of components to be available to all.

Within their call for evidence, the IPA recognised the scale of the challenge of implementing this strategy – not least the challenges of co-ordinating a strategy across a fragmented sector and driving change. Providing positive leadership by example, the Platform Design Programme is a demonstrator.

To lead change across the industry by developing prototyping, testing and demonstrating platform solutions for social infrastructure, using common kit of parts from a diverse UK supply chain

Through the application of systems engineering and manufacturing techniques, the project team plans to develop, prototype, test and demonstrate a platform design and delivery concept that can:

- Be implemented at scale across a pan-government pipeline of social infrastructure works.
- Reduce cost, delivery time and lifetime carbon emissions.
- Boost productivity and increase the asset whole-life value.
- Offer an opportunity to integrate active renewable energy systems.

With the overall programme due to complete in September 22, the initial project stage has been to ‘Define the Need’ – to capture customer needs and objectives to inform development of a brief for future system concepts.

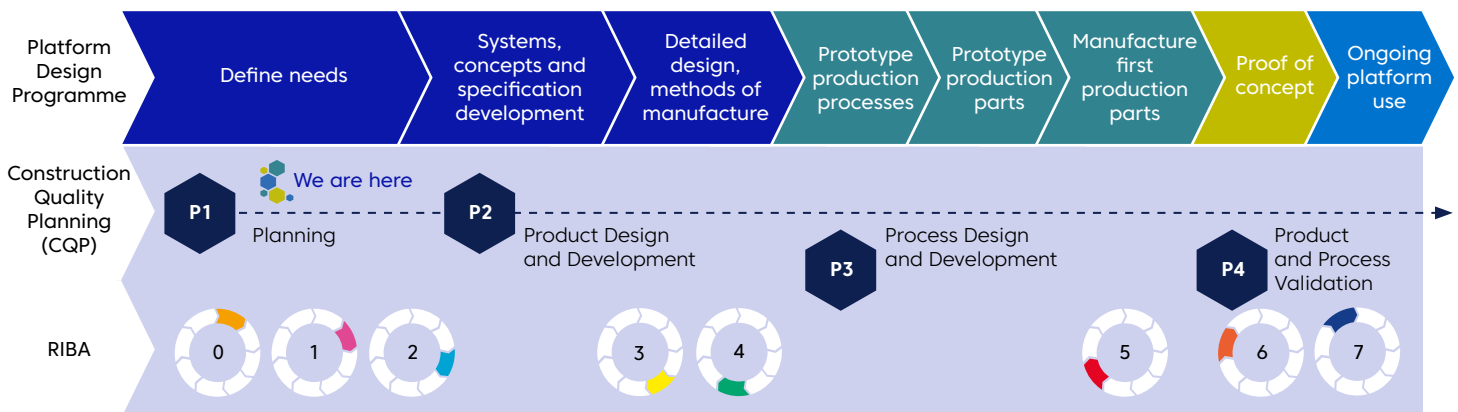


Figure 2: Phases of the Platform Design Programme

A platform requires a sensitive balance between commonality and distinctiveness. This project embodies all of the challenges of building design while adding the complexity of co-ordinating the demands of multiple departments, in an effort to increase commonality without compromising their individual performance requirements.

The complexities and organisational challenges associated with developing a platform is compounded by the diversity and breadth of project collaborators, with considerations including:

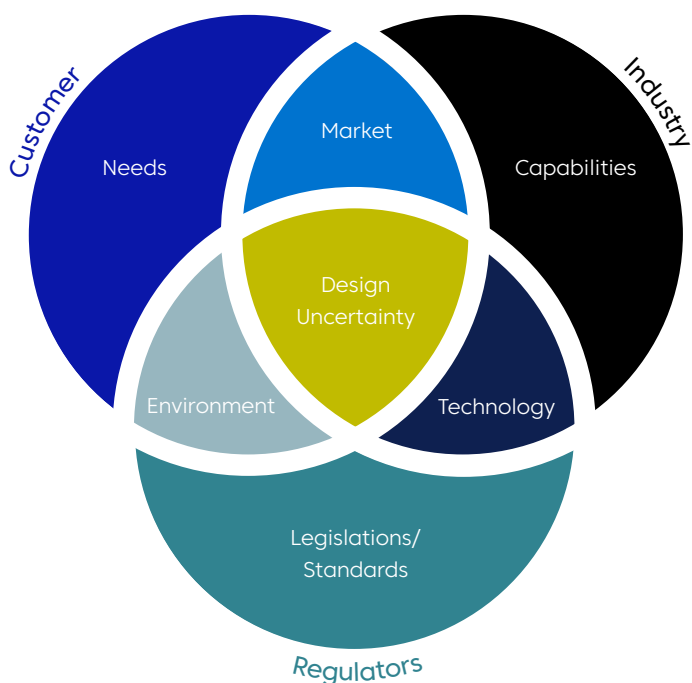


Figure 3: Adapted from Nadadur et al, 2012 'Strategic Product Design for Multiple Global Markets'

The underpinning of an effective platform is a clearly defined strategy and value proposition, which holds the potential to support multiple market segments as well as to meet multiple customer requirements.

The initial phase of the project was therefore to 'Define the Need' in establishing this strategy.

“While providing a high level of standardisation, it’s crucial that the [platform] approach builds in flexibility and facilitates the creativity of designers. The platform must be responsive enough to allow innovation where it can improve outcomes”

RIBA

Defining the Need methodology

In seeking to develop platform solutions for social infrastructure, our primary focus has been shaped with the following government departments in mind.



In Defining the Need, we have sought to understand the diversity of the departments' requirements and scale of pipeline to evaluate the co-equal imperative of economies of scope and scale. Informed by both data analysis and end-user engagement, our approach has been structured around five key steps:

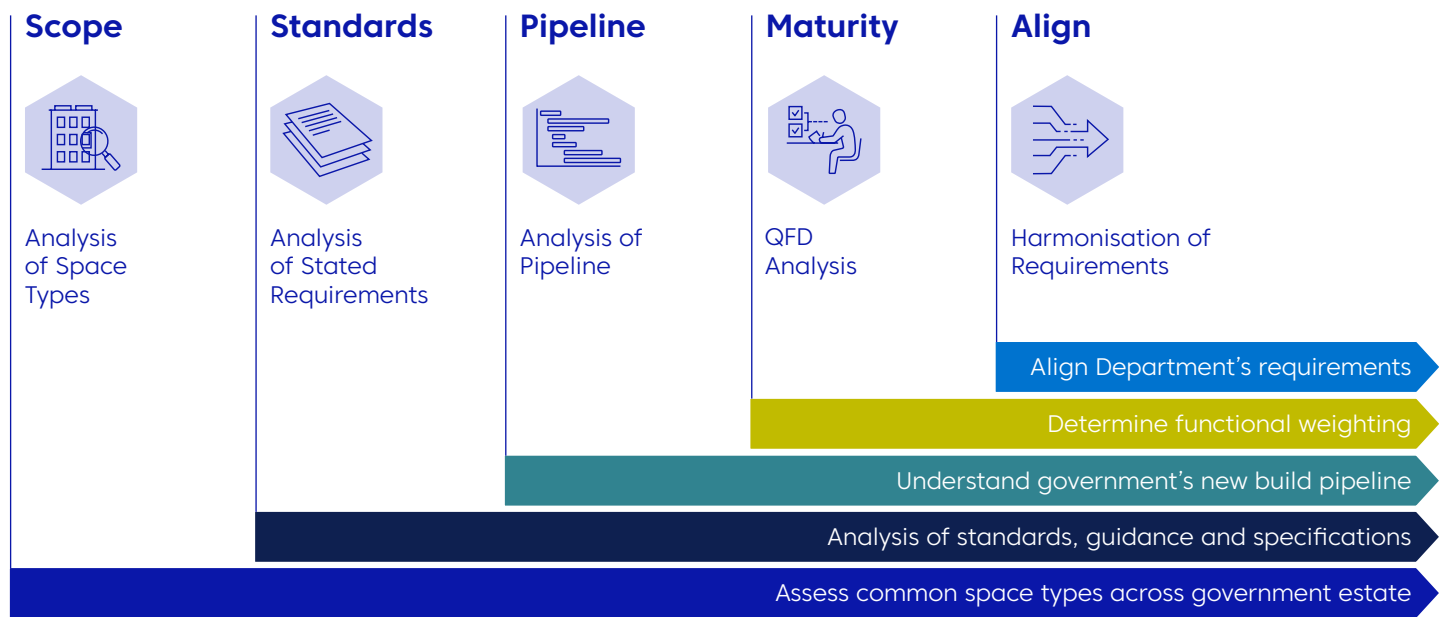


Figure 4: Defining the Need process overview

1. Analysis of pipeline

To define the scale of the new build pipeline (over the next five years) and the extent to which platforms could be applied. A number of sources were used to calculate each department's pipeline of new build works over the next five years. These included:

- Discussions with each government department as part of the engagement process.
- gov.uk pipeline data.
- IPA's National Infrastructure and Construction Procurement Pipeline (Summer 2020).
- Framework pipeline data, for example, DfE's spend projections via their MMC framework.
- Hub's platform design programme partners' knowledge of departments' forthcoming works.

From an MHCLG perspective, future pipeline was extrapolated from historical completions in 2018, adjusted to reflect spend only from Housing Associations and Local Authorities – respecting the breadth and autonomy of commissioning parties – to establish what may be within the scope of a platform solution.

2. Space type analysis

To define and assess the geometrical diversity and/or potential economies of scope across social infrastructure. Namely, a review of space types across:

- Department for Education (DfE).
- Ministry of Defence (MoD).
- Department of Health and Social Care (DfHSC).
- Ministry of Justice (MoJ).
- Ministry of Housing Communities and Local Government (MHCLG)³.

This assessment sought to identify the key space types across government departments, and the relative frequency of each. From this analysis, the most common space types were determined (i.e. education or bedrooms) and frequency of 'generic' non-departmental specific spaces, such as kitchens and circulation areas. The findings of the analysis of over 170 space types across government can be found in the common spaces analysis section of this report.⁴

3. Analysis of stated requirements (standards, guidance and specifications)

Extracted from review of department specific specifications (technical standards, guidance and requirements). Capturing the requirements of DfE, DfHSC, MoD and MoJ⁵, the platform team reviewed 144 specifications and standards, engaging with over 40 end users and client representatives over the three-month period.⁶

Specifications were assessed to determine departments' requirements for overall sites and buildings (referred to as entity-level requirements) and for specific rooms (referred to as space types).

4. QFD analysis

Translating 'Voice of the Customer' interviews to systematically test, inform and understand to what extent stated requirements truly reflect a 'defined need'.

To supplement the review of technical specifications and guidance documents, a sample set of end-user feedback has been captured and analysed for each of the government departments. The comments and requirements captured as part of this exercise have been input into departmental Quality Function Deployment analyses (QFD).

Quality Function Deployment is a method for translating the 'voice of the customer' into product characteristics. The method allows the engineering process to cascade qualitative customer requirements into quantitative criteria that can be cascaded into the subsystems, components, and ultimately manufacturing processes. The QFD process was applied to interview data collected from DfE, MoJ, and DfHSC end users using a tool called the 'House of Quality'.

As the Platform Design Programme moves to the next phase of system concepting, the findings from the departmental QFD analyses will be developed

into sub-assembly QFD assessments to inform manufacturing processes in a traceable way.

5. Harmonisation of requirements

Identifying and evaluating areas of commonality of requirements that may support the development of a 'top down' platform.

Following the review of departments' specifications at an entity level, data was grouped by performance category and assessed to determine synergies and differences between departments.

Requirements were grouped into the following categories:

- Configuration.
- Context.
- General building requirements.
- Philosophy.
- Sustainability.

Space type data was input into data visualisation software to undertake analysis by department and cumulatively. This was only possible for numeric and machine-readable data that was applicable across multiple departments. Entity requirements requiring interpretation were manually reviewed. The findings of this assessment can be found within the common spaces analysis section of this report, indicating a divergence of requirements across departments.

This holistic approach has been adopted to ensure that the platform specification addresses the maximum proportion of the government estate. The triangulation of technical requirements (at a departmental, building and space type level), understanding of each department's new build pipeline and assessment of 'the voice of the customer' ensures the platform specification effectively responds to these needs and parameters.

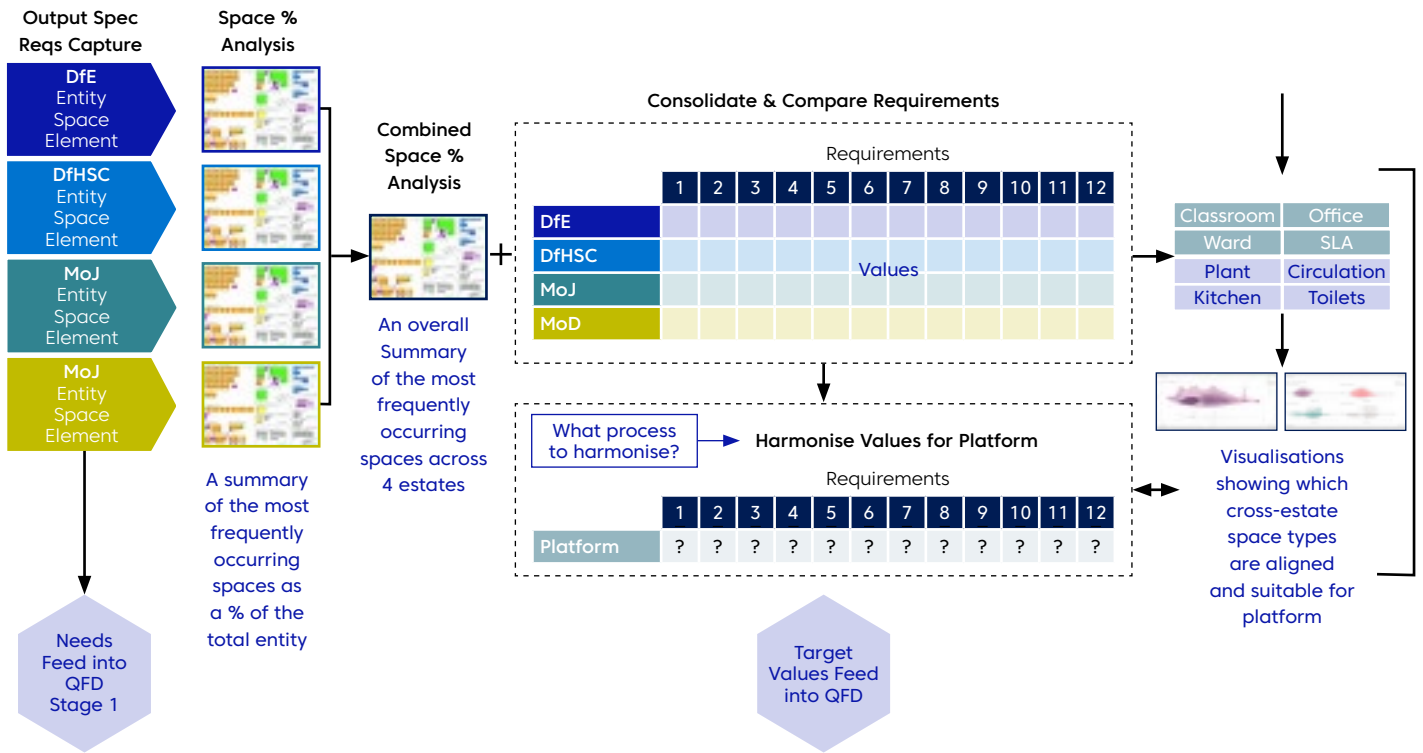


Figure 5: Process flow of Defining the Need Requirements Analysis

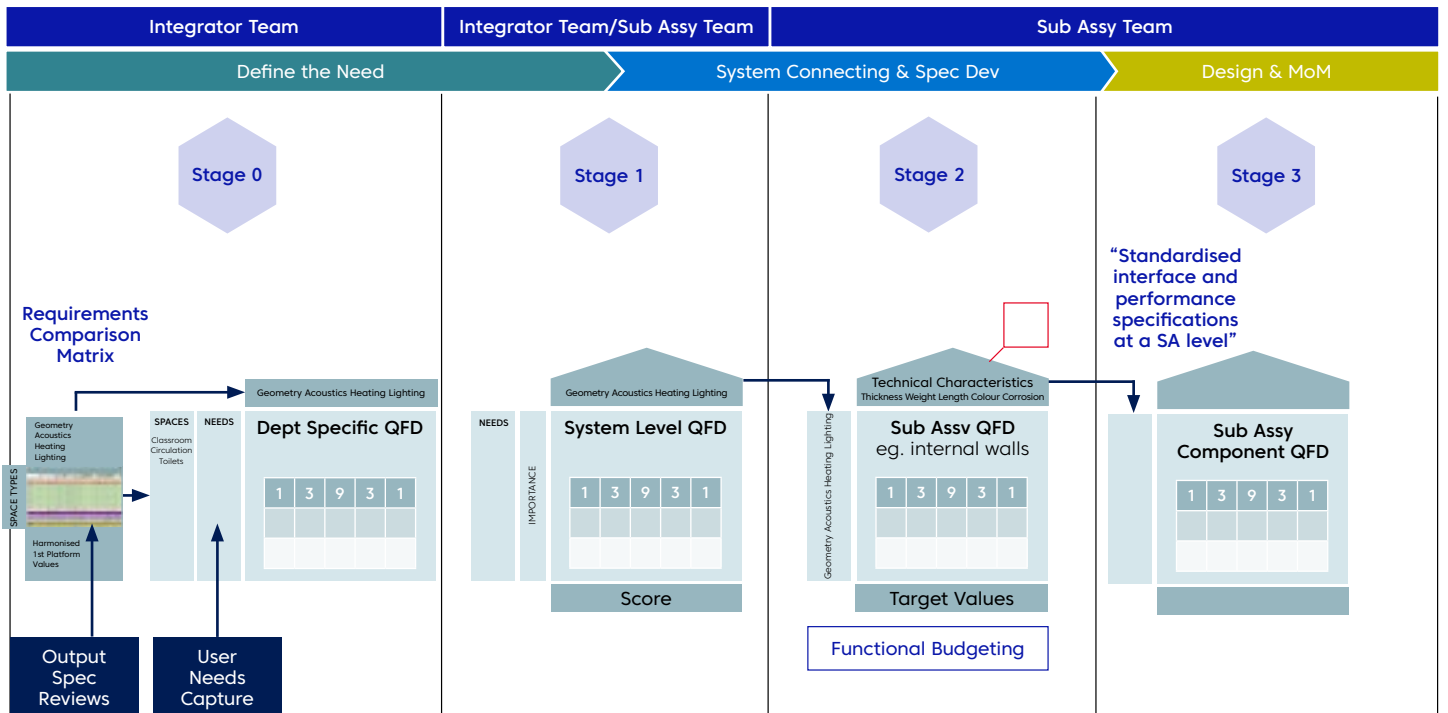


Figure 6: QFD analysis process flow

Hypothesis Specification

As a starting point for our analysis and research, the project team developed a high-level hypothesis specification for the platform against which the outputs were reviewed and tested.

The outline specification proposed a platform be developed for use across the government portfolio that could:

- Achieve a building height of up to 5 storeys.
- Cover structural spans of up to 12m long.
- Include floor-to-ceiling height up to 3m.
- Contain an active roof for positive energy generation.

- Incorporate building control system, ceiling cassettes, internal and external walls, foundation system, services generation and distribution and structural frame

The technical standards and requirements of the departments were consistently reviewed relative to the hypothesis specification to inform potential points of conflict or homogeneity. In the following sections of this report we outline in further detail the methodology adopted in Defining the Need, the outputs of the analysis and the recommended actions in response to the departments' needs.

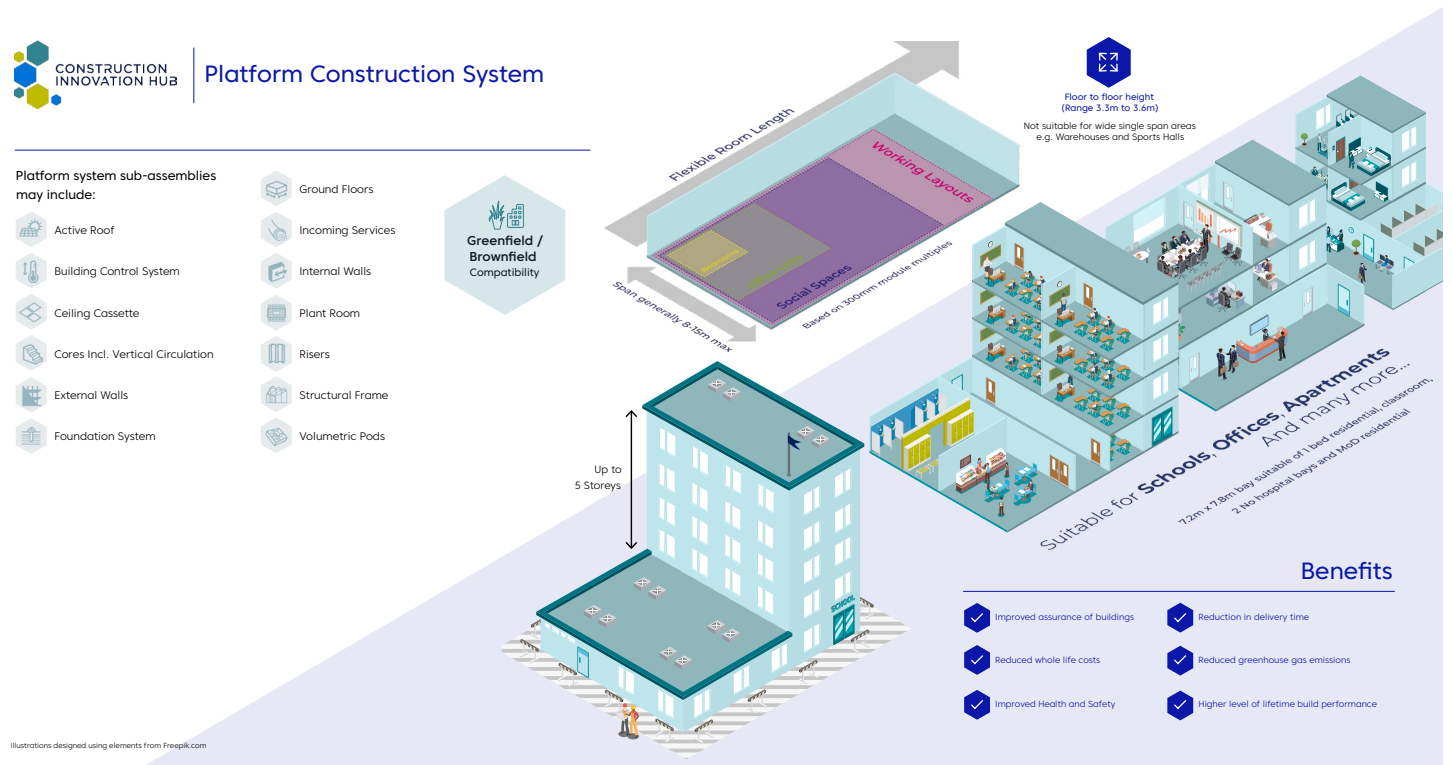


Figure 7: Hub's Platform Design Programme hypothesis specification

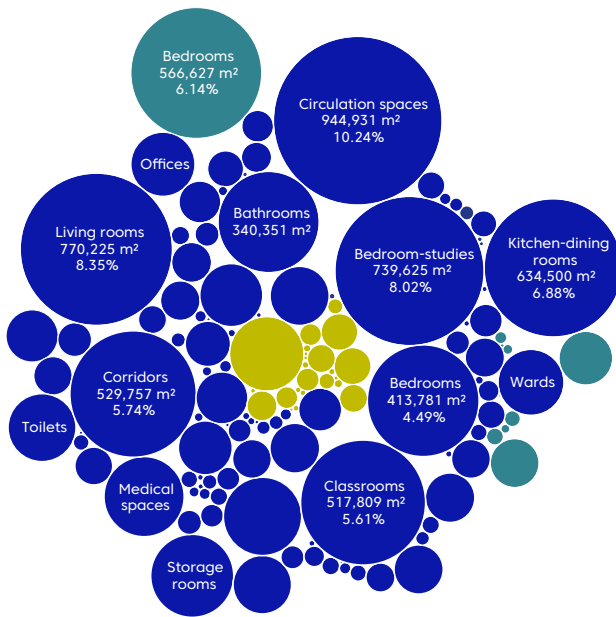
Outputs

Between the five participating government departments, a new build pipeline of works worth c.£50bn is anticipated over the next five years (£9.85bn- £11.2bn per annum). This provides significant opportunity to drive a new manufacturing mindset to social infrastructure delivery.

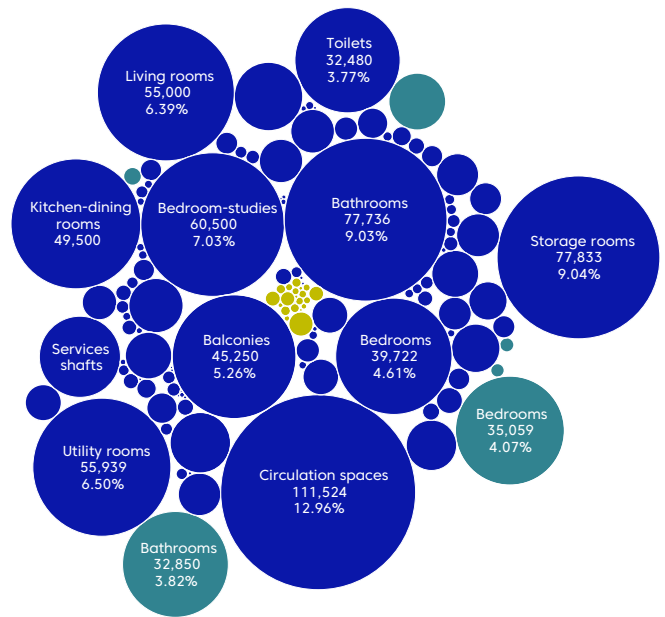
An analysis of the distribution of this pipeline spatially suggests that the most frequent space types across these departments are mid-span

areas, which represent c.70% of space types. This reflects a predominance of general space types, nominally: circulation, bathrooms, storage areas, as well as classrooms and educational spaces. Whilst the hypothesis specification’s proposal to utilise a superstructure spanning up to 12m broadly aligns with this, the analysis undertaken suggest the hypothesis specification can be further refined to a superstructure spanning c.8m.

Area of spaces



Frequency of spaces



- Large
- Mid
- Small

Figure 8: All Departments area vs frequency by structural span

When teasing out trends between departments, as the platform call has enabled, alignment can be found in the following building-level requirements:⁷

- **Adaptability:** Buildings to be highly adaptive and allow for interface with new or old buildings.
- **Site-specific constraints:** Be that in relation to foundation philosophy or Local Planning Authority requirements regarding aesthetics.
- **Service life:** Buildings to be designed for 60 years.
- **Storey height:** Each department requires building types between 2 and 5 storeys in general, with some exceptions for inner city sites.
- **Services distribution:** To be distributed via circulation routes.
- **Circulation:** Staircases require a minimum width of 1500mm for two-way traffic.
- **Energy philosophy:** Based on grid supply with option for local generation.
- **Sustainability:** a zero carbon agenda has been set for each department, supplemented by BREEAM Excellent or Outstanding⁸.

This enables potential harmonisation in the following areas:

- **General spaces:** Across each department, general spaces - such as circulation, bathrooms / sanitary accommodation, plant and storage – constitute over 50% of the overall pipeline. Harmonisation of these generic spaces, could then enable departments to focus on their specific areas.
- **Small-span residential areas:** From an increasing use of single occupancy ensuite bedrooms across the healthcare estate, to prison cells and MoD single living accommodation, bedrooms and bathrooms equate to 36% of space types across the MoJ, MoD and DfE's new build pipeline.

- **Grid sizes:** Where specified by Departments, noting that some remain silent on the point, the general request is for mid-span spaces ~8m.
- **Building philosophy:** At an entity level, there are significant synergies and scope for harmonisation in the departments' collective requests for: adaptability, life span, compliance, low-carbon technologies and energy strategies (grid supplied).

When applied to the hypothesis specification, the outputs of the 'defining the need' assessment would suggest:

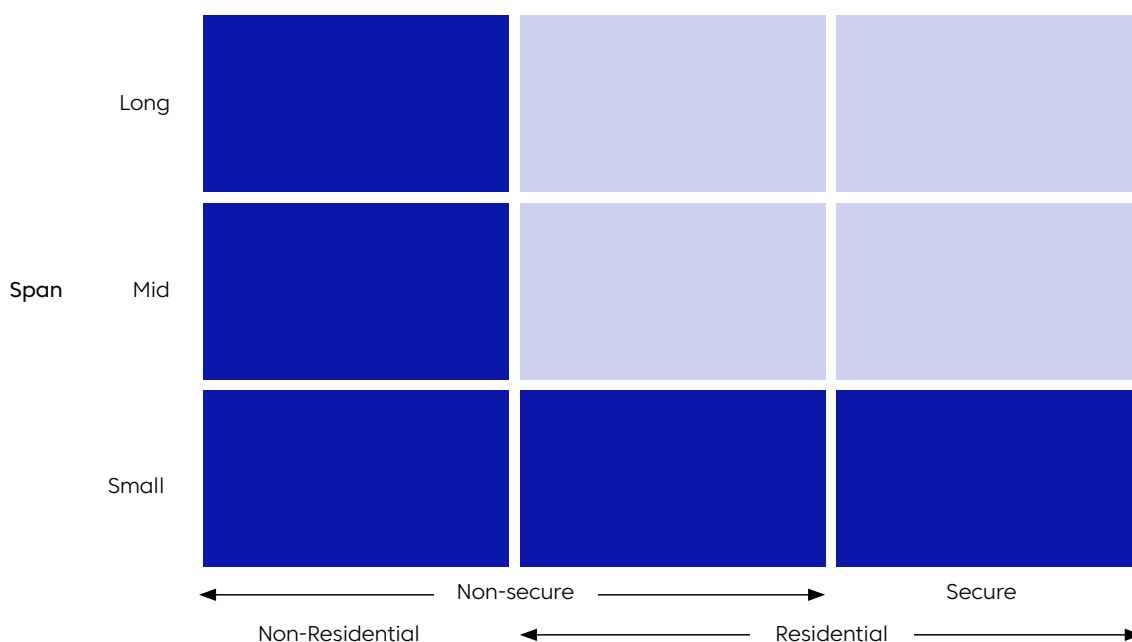
- As with other building types, minimum standard requirements will need to be met in line with CIBSE standards, HSE requirements and Building Regulations and respond to site specific constraints such as Local Planning Authority requirements and ground conditions.
- Mid-span framing system of c.8m spans would address up to 70% of the government estate suggesting the hypothesis specification grid of between 9-12m spans is reduced.
- Whilst each department may not yet have conveyed their sustainability policies into updated technical specifications, for the Hub's Platform Design Programme to meet the future trajectory of clients' requirements, a holistic approach to achieving net zero in operation will be required, beyond the hypothesis specification's current inclusion for an active roof.
- Adaptability needs to be considered with regard to whether sub-assemblies can meet the divergence requirements of each department, for example: security and robustness detailing for MoD and MoJ assets; anti-ligature requirements of DfHSC and MoJ.

- In debating the fine line between a platform that offers flexibility yet seeks to standardise, consideration should be given to the potential number of structural platforms that may be needed to meet the addressable market of the government estate. As has been observed in the automotive industry, whilst scalable platform architectures are for many viewed as the panacea to match production and demand, this approach needs to first be developed from the creation of a number of platform designs to meet specific market segments.
- As such, the findings of the work undertaken to date would suggest an initial five possible platform systems to meet the government's pipeline:
 - Small-span, residential secure
 - Small-span, residential non-secure
 - Small-span, non-residential
 - Mid-span
 - Large span

- The methodology applied to determining the Hub's platform could in turn be rolled out to provide a consistent approach to platform development across the government estate.

However, the overarching finding of the Defining the Need work undertaken to date is the degree of variance between departments: from the specifics of their technical requirements, to the metrics and phraseology used to define their performance attributes. As a next phase step, the Platform has proactively assumed to develop a routemap, informed by analysis, for specification standardisation - to harmonise, digitise and rationalise, to unlock ability to drive efficiency and effective across the estate.

See the [specification and guidance section](#) for more details.



Pipeline maturity analysis

Process

To establish the new build pipeline for each government department; individual departmental engagement sessions were held to:

- Understand the nature of buildings and spaces to be constructed.
- Forecast spend profiles aligned to building and space types.

Departmental engagement was supplemented by the following sources to determine a pan-government pipeline assessment:

- gov.uk pipeline data.
- IPA's National Infrastructure and Construction Procurement Pipeline (Summer 2020).
- Framework pipeline data, for example DfE's spend projections via their MMC framework.
- Hub's platform design programme partners' knowledge of departments' forthcoming works.

From an MHCLG perspective, this assessment only included projected spend from Housing Associations and Local Authorities due to broader commissioning parties being more autonomous and hence 'one-step-removed' from the influence of central government to roll-out platform-based designs.

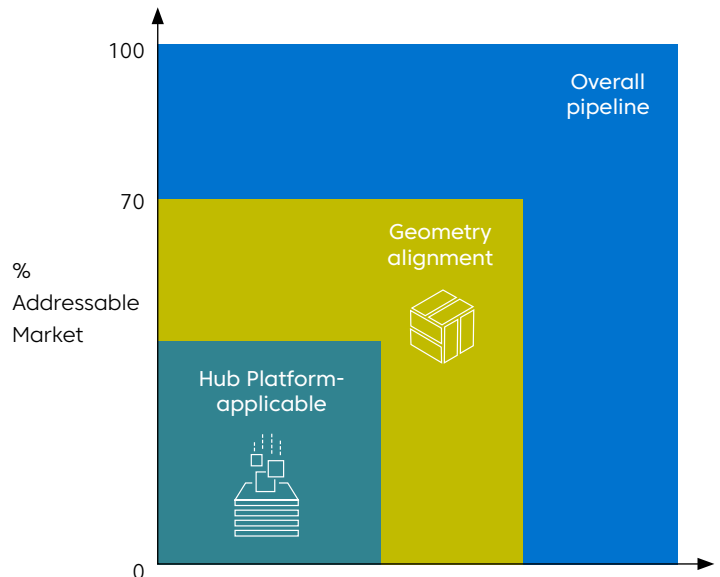
Given each government department's construction portfolio is at a different stage of development, it is important to note the limitations in:

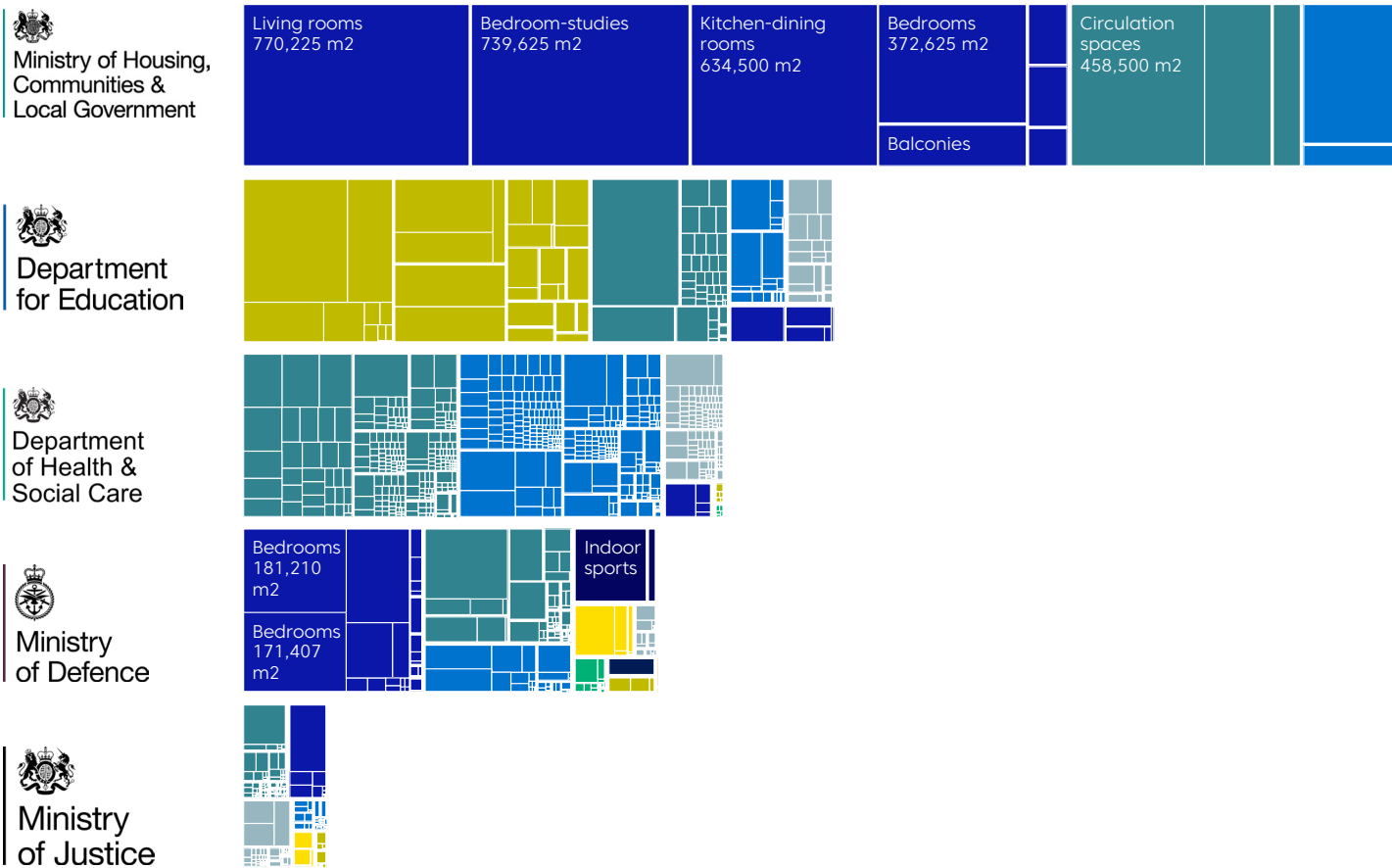
- Potential accuracy of the data – given spend forecasts are subject to change.
- Differing levels of granularity of data available.
- Certainty of pipeline – schemes in the early feasibility stages cannot confirm scale and scope of space types so assumptions have needed to be made [see the common spaces analysis section for further details surrounding assumptions used to inform analysis].

Findings

On a departmental basis, the largest pipeline of new build works by area resides with MHCLG, whose pipeline consists of more than 3.2million square metres of accommodation over the next five years. MHCLG are in turn followed by DfE, DfHSC, MoD and MoJ.

An assessment has been undertaken by the platform team to determine that the Hub's platform design could be applied to c.30% of the government's new build portfolio; with the majority of this relevant pipeline being across the Departments for Education and Health and Social Care and the Ministry of Housing, Communities and Local Government. This assessment, whilst rather conservative in its estimate, would see an addressable market of c.£13bn per annum over the next five years.





- ◆ Administrative, commercial and protective service spaces
- ◆ Communications, security, safety and protection spaces
- ◆ Cultural, education, scientific and information spaces
- ◆ General spaces
- ◆ Heating, cooling and refrigeration spaces
- ◆ Industrial spaces
- ◆ Medical, health, welfare and sanitary spaces
- ◆ Recreational spaces
- ◆ Residential spaces
- ◆ Sport and activity spaces
- ◆ Waste disposal spaces and locations

Figure 9: Departmental Pipeline of New Build Works – Area per Department by “Higher Level” Uniclass



The assessment was based on the current hypothesis specification, assuming:

- Hypothesis specification was not developed to provide for departmental specific characteristics, such as anti-ligature, security and robustness detailing.
- The platform would only be applicable to new build construction, not works combining remodelling/refurbishment.
- If assessed based on geometry alone, the applicability of the platform could increase to c.70%.

Departmentally, this equates to the following new build pipeline, which could be addressed by a Platform Design Programme:

Government new build pipeline over the next 5 years addressable by the Platform Design System

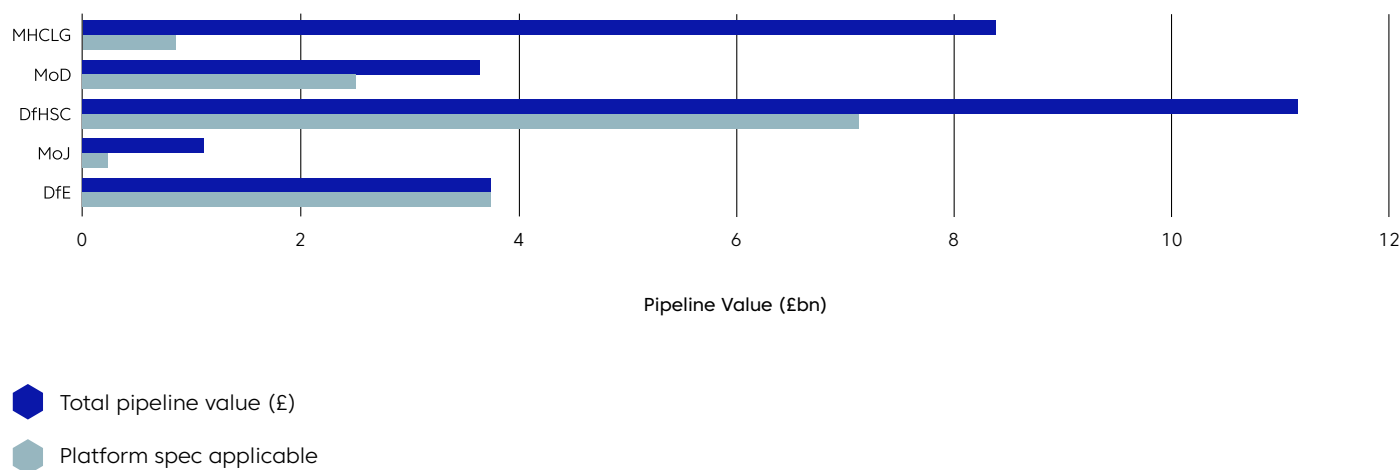


Figure 10: Departmental Pipeline and Addressable Market for Hub's Platform

Common spaces analysis

Process

Engaging with each of the government departments, a process was undertaken to sub-divide their estates into functional and dimensional space types. Spaces were grouped into the following categories:

Functional	Spatial
Reception and waiting areas	Small non-residential spaces
Circulation - vertical and horizontal	Small residential spaces
Cleaning and stores	Mid-span spaces
Plant	Larger volume spaces
Toilets and bathrooms	
Learning spaces	
Welfare and changing	
Food preparation	
Secure spaces	
Repeated core provision	
Miscellaneous	

This assessment provided an analysis of pipeline by function and space. Functionally, a detailed review of 20% of room types across the government estate was undertaken by the Hub platform partners, as indicated in Figure 11.

In following a pattern similar to Pareto, this represents an average of 72% of spaces, in terms of frequency used, and 78% of space utilisation. The findings of this specification review are included within the specification and guidance of this report.

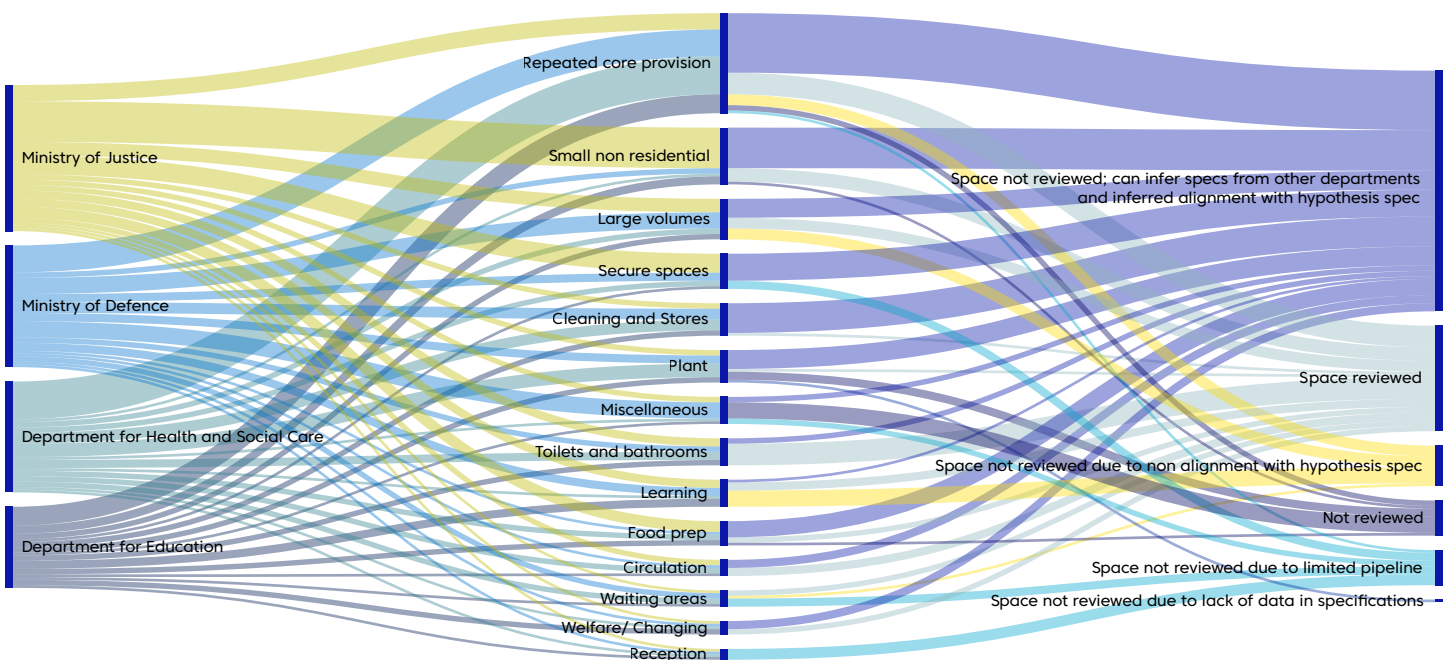


Figure 11: Analysis of technical requirements across government space types

Findings

From a functional perspective, the most common space type by frequency is circulation spaces, followed by bathrooms. Due to the likely adjacencies involved with such space types, the influence of this finding on the superstructure of the Hub platform will be dictated as much by their adjacent spaces

as these space types in isolation. Bedrooms, for example, constitute the largest overall area of the government departments' estates at 13% (19% if considered with MHCLG also) and are often adjacent to both circulation and bathroom areas.

Area of spaces

Frequency of spaces

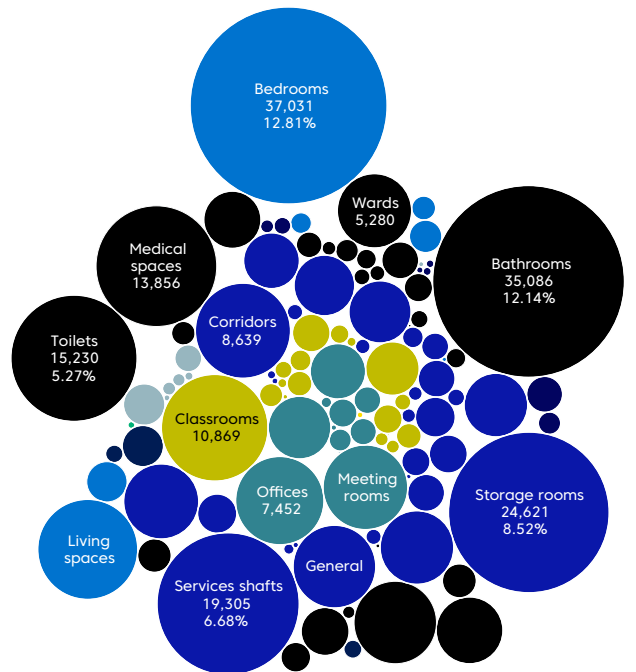
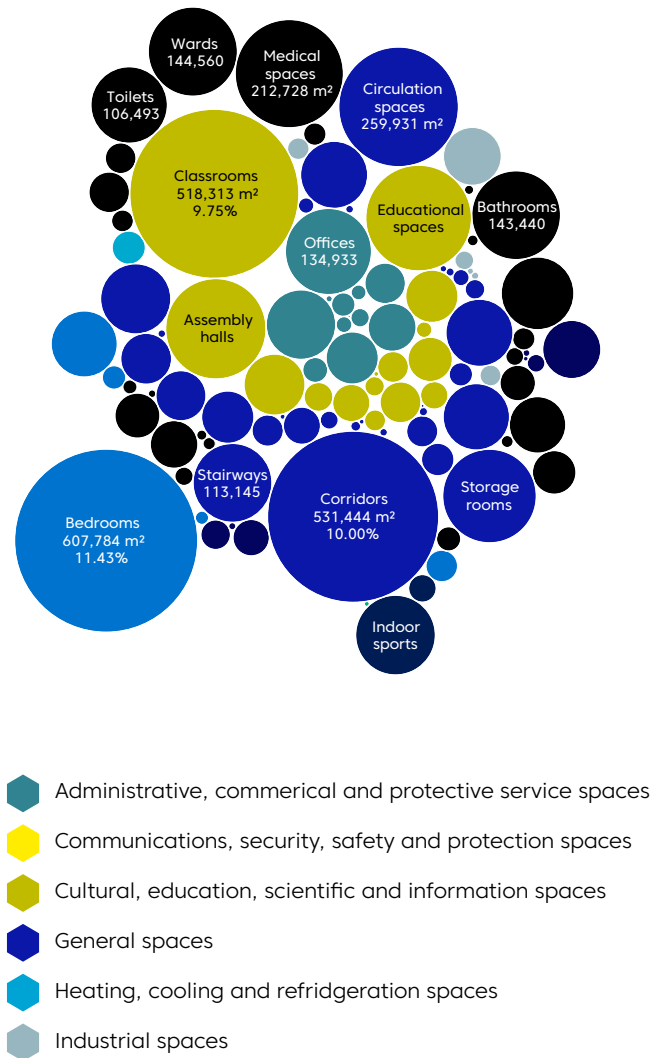


Figure 12: Analysis of government space type by function (MoJ, MoD and DfE)

Whilst bedrooms constitute 18% of the overall area of the government new build pipeline, as a small span volume they are actually in the minority spatially. Triangulating spatial data with each department's pipeline data illustrates that c.70% of space types across government's collective pipeline require a mid-span framing solution:

This shows the role of geometry, specifically span, as a common denominator to determine synergies across government departments.

Area of spaces

Frequency of spaces

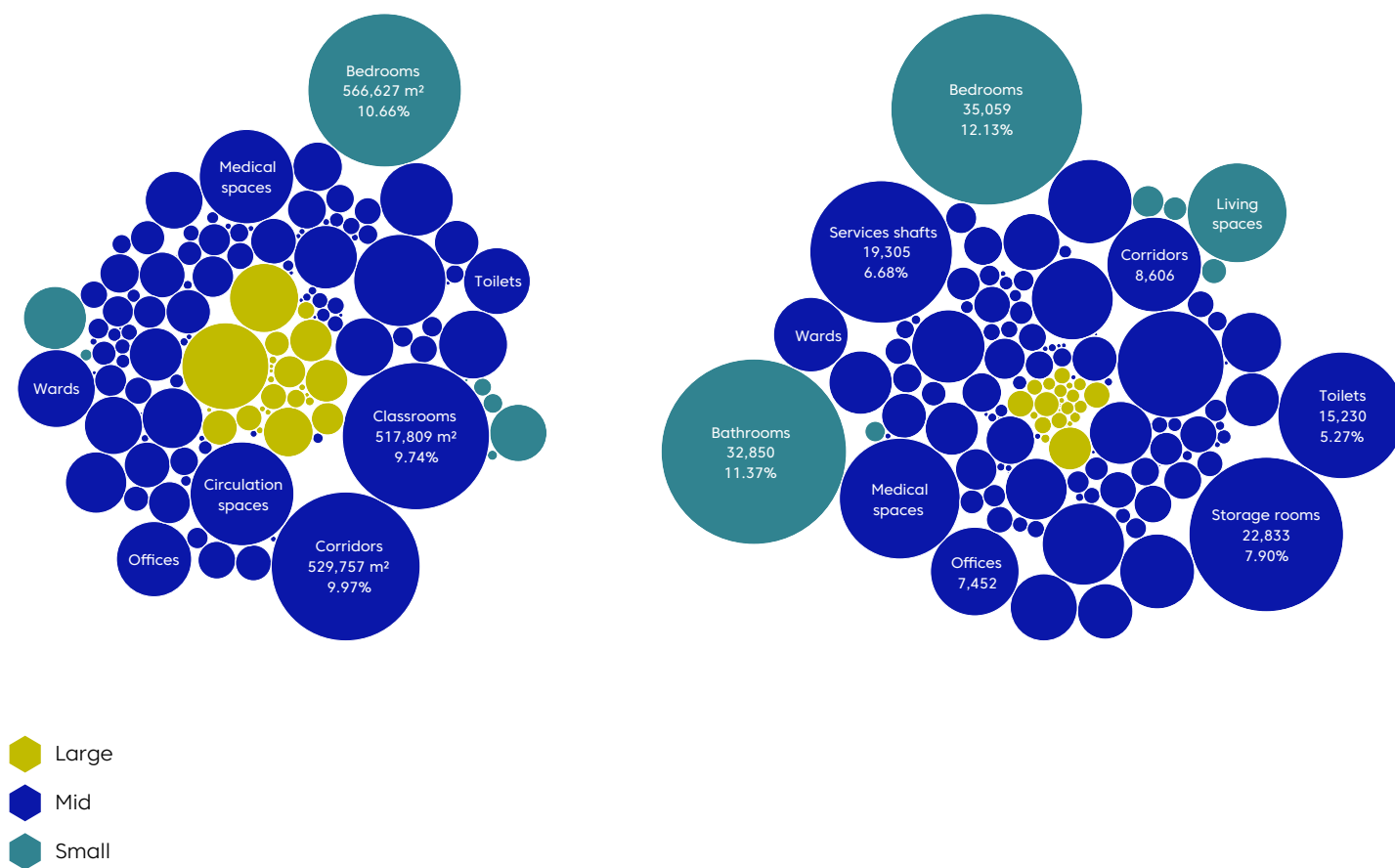


Figure 13: Government pipeline categorised by span size

Specification and Guidance

Process

Each government department's specifications have been assessed at three levels¹⁴:

- 1) **Those relating to assets at an entity-level** – building and site focused.
- 2) **Those pertaining to space types** – requirements for specific rooms.
- 3) **Elemental level** – technical requirements for building elements such as walls, doors etc.

At an entity-level, data from departmental specifications was grouped by performance category and assessed to determine synergies and differences between departments.

Requirements were grouped into the following categories:

- Configuration.
- Context.
- General building requirements.
- Philosophy.
- Sustainability.

The graphic below highlights each entity-level performance category and the requirements underpinning each:

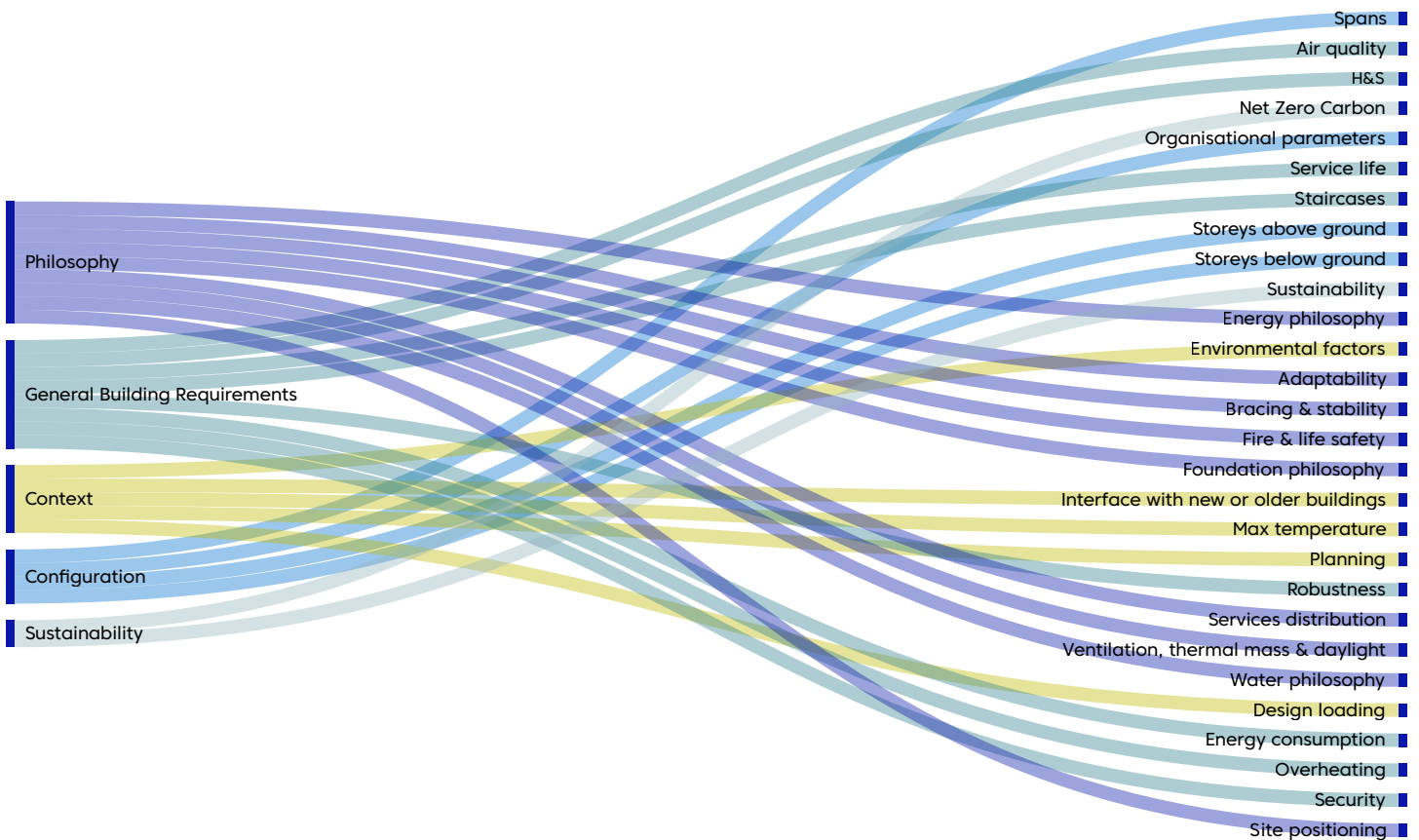


Figure 14: Entity-level performance characteristics

Following the identification of 170 space types, 37 of these were selected for detailed analysis with respect to departmental specifications and related guidance documents:

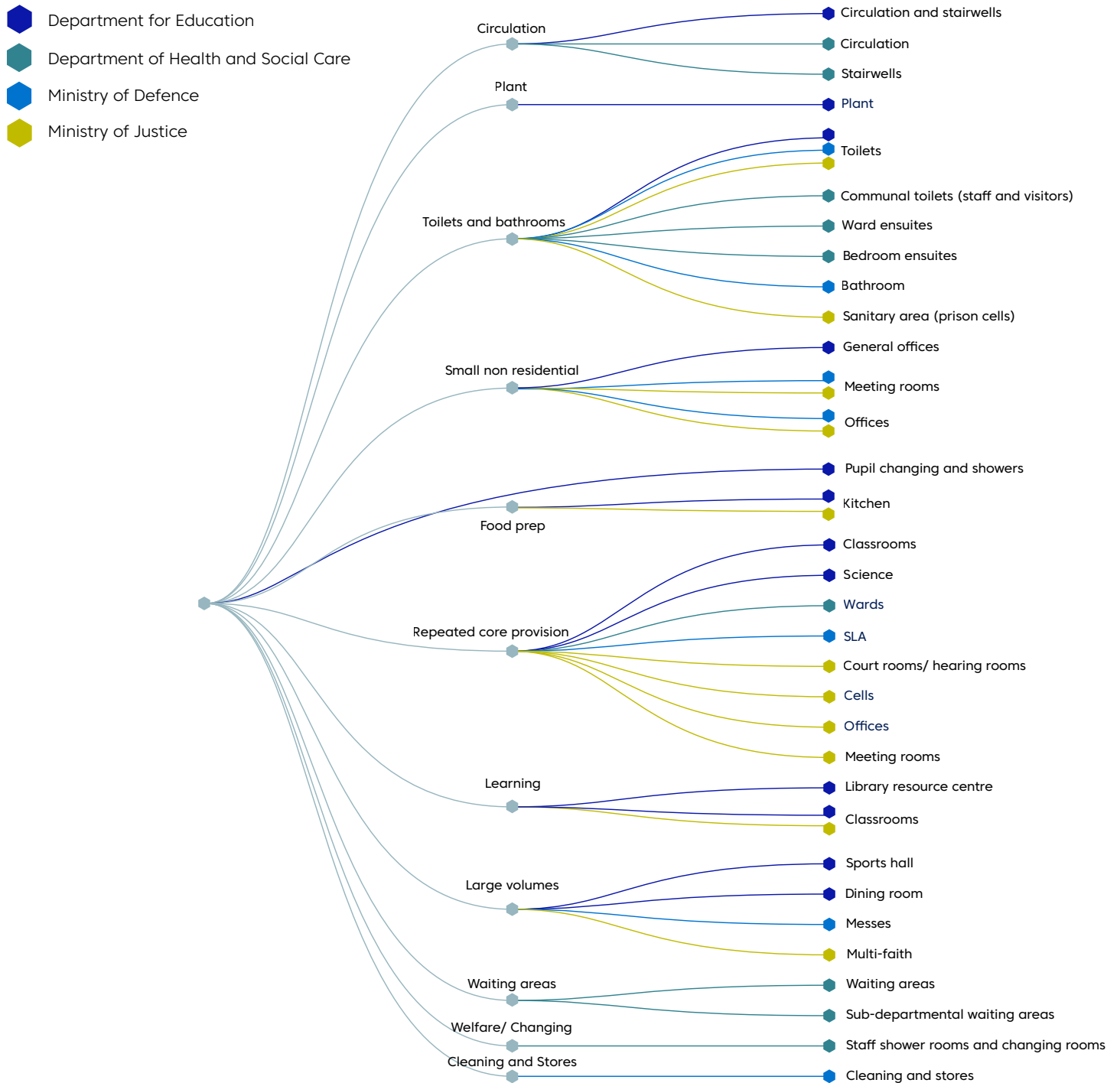


Figure 15: Detailed space-level performance analysis by department

The aforementioned space types were selected for further detailed analysis based on a number of criteria:

- Departments' repeated core space types.
- Review of space types most closely aligned to the hypothesis specification.
- Capturing a cross-section of functional space types.

Technical requirements were captured for these spaces based on a number of performance characteristics, derived from context diagrams provided by the Hub Platform Sub-Assembly teams. Additional parameters were added as detailed within clients' specifications, for example, robustness:

Upon collation of the relevant information for each space type, cross-departmental analysis took place. Where information was machine readable, i.e. provided in numerical format, such as geometry, this information was input into data visualisation software to undertake an analysis of alignment and divergence of performance requirements across departments. However, upon collation of performance information, it became evident that the majority of departmental specifications are open to interpretation, and so required manual review in order to determine data trends and differences:



Figure 16: Performance requirements categories

Initially, attempts were made to convert all departmental requirements into quantifiable entries, however this resulted in a loss of data and the exercise halted. This exercise did, however, highlight the complexity of technical requirements and gaps in data. These gaps have been categorised into three main areas:

- 1) Department is silent on a point, or refers to Building Standards/Regulations for specification
- 2) Platform team could not access data, for example may be contained in a specification not available to the platform team for security purposes
- 3) Data not analysed. Not all specifications were analysed due to time constraints and hence data points could have been missed

An elemental analysis commenced across the MoD and MoJ estates for the following aspects:

- Doors
- Windows
- Floors
- Walls
- Ceilings
- Roofs



Acknowledging that this elemental exercise is not complete across all departments, it is recommended that this be concluded in partnership with the sub-assembly teams as part of the next phase of system concepting.

Category	Criteria	Measurable	Harmonised	All	DfE	DfHSC	MoD	MoJ
Geometry	Occupancy	██████████	██████████	53%	9%	36%	77%	91%
	Max Occupancy	██████████	██████████	6%	0%	10%	0%	4%
	Required level (if applicable)	██████████	██████████	1%	9%	0%	0%	0%
	Grid Type (m2)	██████████	██████████	17%	64%	0%	54%	0%
	Min Usable height (m)	██████████	██████████	66%	82%	33%	92%	100%
	Max height (m)	██████████	██████████	12%	9%	21%	0%	4%
	Min Ceiling Service Void (m)	██████████	██████████	44%	0%	97%	0%	0%
	Max Ceiling Service Void (m)	██████████	██████████	3%	0%	8%	0%	0%
	Min Area per person (m2)	██████████	██████████	12%	0%	23%	8%	0%
	Max Area per person (m2)	██████████	██████████	19%	9%	5%	46%	30%
	Min Area (m2)	██████████	██████████	51%	27%	23%	85%	91%
	Max Area (m2)	██████████	██████████	20%	27%	15%	8%	30%
	Min Width (m)	██████████	██████████	51%	18%	31%	77%	87%
	Max Width (m)	██████████	██████████	15%	18%	8%	77%	35%
	Min Depth (m)	██████████	██████████	55%	36%	26%	8%	100%
Max Depth (m)	██████████	██████████	20%	36%	10%	0%	35%	
Corridor width (m)	██████████	██████████	3%	9%	3%	0%	4%	
Visual	Spatial Daylight Autonomy (min% time 300lux min)	██████████	██████████	20%	36%	28%	8%	4%
	Useful Daylight Illuminance (min% time 100-3000lux)	██████████	██████████	55%	45%	100%	15%	4%
	Light colour type (Min K)	██████████	██████████	72%	18%	100%	8%	87%
	Light colour type (Max K)	██████████	██████████	49%	27%	100%	0%	0%
	Colour rendering index (Ra)	██████████	██████████	55%	18%	100%	46%	0%
	Min Horizontal Task Illuminance (lux)	██████████	██████████	99%	91%	100%	100%	100%
	Max Horizontal Task Illuminance (lux)	██████████	██████████	48%	0%	100%	0%	9%
Thermal	Normal Operating temperature (°C)	██████████	██████████	40%	82%	5%	92%	48%
	Maximum Operating temperature (°C)	██████████	██████████	88%	73%	100%	46%	100%
	Min Operating temperature (°C)	██████████	██████████	79%	0%	100%	46%	100%
	Min humidity	██████████	██████████	26%	0%	8%	46%	57%
	Max humidity level	██████████	██████████	21%	0%	8%	8%	61%
	Min Thermal conductivity (W/m2K)	██████████	██████████	40%	82%	38%	0%	43%
	Max Thermal conductivity (W/m2K)	██████████	██████████	29%	91%	38%	0%	0%

Figure 17: Categorisation of measurable vs subjective performance characteristics (continued on p. 30)

Category	Criteria	Measurable	Harmonised	All	DfE	DfHSC	MoD	MoJ
Air Quality	Ventilation Requirements	██████████	██████████	55%	0%	100%	54%	4%
	Filtration Grade / Air Quality	██████████	██████████	45%	0%	100%	0%	0%
	Room Pressure Requirement (+/- pa)	██████████	██████████	45%	0%	100%	0%	0%
	Supply / Extract	██████████	██████████	45%	0%	100%	0%	0%
	Min Air Change / hr	██████████	██████████	33%	0%	0%	62%	87%
	Max Air Change / hr	██████████	██████████	22%	0%	0%	46%	57%
	Actual air change / hr	██████████	██████████	58%	45%	100%	46%	0%
	Rate (l/s/person)	██████████	██████████	73%	45%	100%	46%	57%
	Min Co2 (ppm)	██████████	██████████	13%	0%	21%	0%	13%
	Max Co2 (ppm)	██████████	██████████	6%	18%	0%	0%	13%
Permeability (m3@50Pa)	██████████	██████████	17%	91%	5%	0%	13%	
Acoustic	Acoustic (DnT,w (dB))	██████████	██████████	35%	82%	21%	92%	4%
	Noise Rating (NR)	██████████	██████████	69%	0%	100%	0%	87%
Vibration	UNL (LAeq,30min dB(A))	██████████	██████████	34%	82%	21%	21%	52%
	Reverberation time (s (max))	██████████	██████████	12%	82%	0%	0%	4%
	Floor natural frequency (Hz)	██████████	██████████	9%	64%	3%	3%	0%
	Response factor	██████████	██████████	14%	82%	8%	8%	0%
Functional	Gas supply	██████████	██████████	12%	36%	3%	8%	17%
	Gas Supply O2	██████████	██████████	3%	0%	8%	0%	0%
	Gas Supply N2O/O2	██████████	██████████	3%	0%	8%	0%	0%
	Gas Supply MA4	██████████	██████████	3%	0%	8%	0%	0%
	Gas Supply SA7	██████████	██████████	1%	0%	3%	0%	0%
	Gas Supply VAC	██████████	██████████	2%	0%	5%	0%	0%
	Gas Supply AGSS	██████████	██████████	1%	0%	3%	0%	0%
	Gas Supply He/O2	██████████	██████████	1%	0%	3%	0%	0%
	Gas Supply AVSU	██████████	██████████	3%	0%	8%	0%	0%
	Gas Supply Alarm	██████████	██████████	3%	0%	8%	0%	0%
	Drainage	██████████	██████████	74%	91%	100%	62%	30%
	Water supply	██████████	██████████	72%	64%	100%	92%	17%
	Min Hot WaterTemp (°C)	██████████	██████████	45%	0%	100%	0%	0%
	Max Hot WaterTemp (°C)	██████████	██████████	45%	0%	100%	0%	0%
	Power supply	██████████	██████████	85%	91%	100%	100%	48%
	Internet connection (Gbps)	██████████	██████████	51%	0%	100%	0%	4%
Nurse Call System	██████████	██████████	45%	36%	100%	0%	0%	
Comms (VOI)	██████████	██████████	64%	73%	100%	46%	9%	
Fire	Min Fire Resistance (mins)	██████████	██████████	37%	91%	26%	0%	52%
	Max Fire Resistance (mins)	██████████	██████████	22%	91%	23%	0%	0%
	Fire detection (F/S/CM)	██████████	██████████	44%	91%	26%	8%	74%
Robustness	Robustness	██████████	██████████	24%	91%	3%	0%	43%
Functional	Static Loading (kPa/Kn)	██████████	██████████	19%	0%	3%	0%	65%
Security	Ligature	██████████	██████████	1%	0%	0%	0%	4%
	Access	██████████	██████████	35%	91%	41%	0%	17%
	Access control	██████████	██████████	42%	91%	23%	46%	48%
	Security	██████████	██████████	29%	0%	18%	62%	43%

Figure 17: Categorisation of measurable vs subjective performance characteristics (continued from p. 29)

Findings

The aim of the cross-departmental specification review was to demonstrate a consistent approach to data capture and analysis. Whilst every effort was taken to achieve consistency of data capture, consistent analysis has been harder to achieve based on departmental variances. As outlined above, departments use a combination of quantifiable and qualitative descriptors to articulate their requirements. This therefore necessitates a combination of quantifiable and language-based analysis.

As an example, the graphic below illustrates the number of variants of each performance characteristic across the government departments. These variances can range from: differing measurement scales, i.e. dB or NR for acoustic performance, to cross-referencing multiple documents to convey requirements.

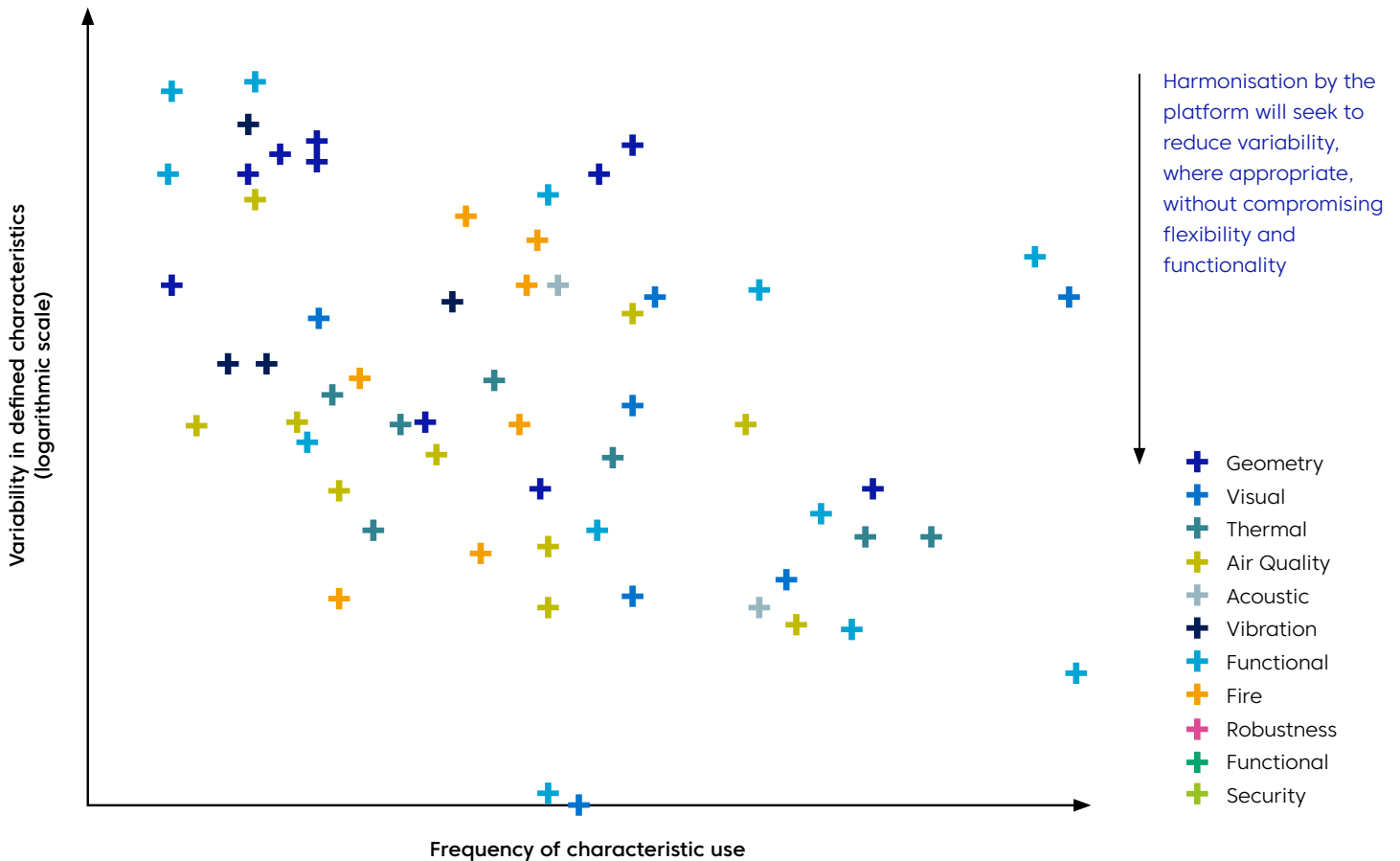


Figure 18: Variances in performance requirements

At an entity-level, significant synergies were identified between departments, as illustrated in the graphic below:

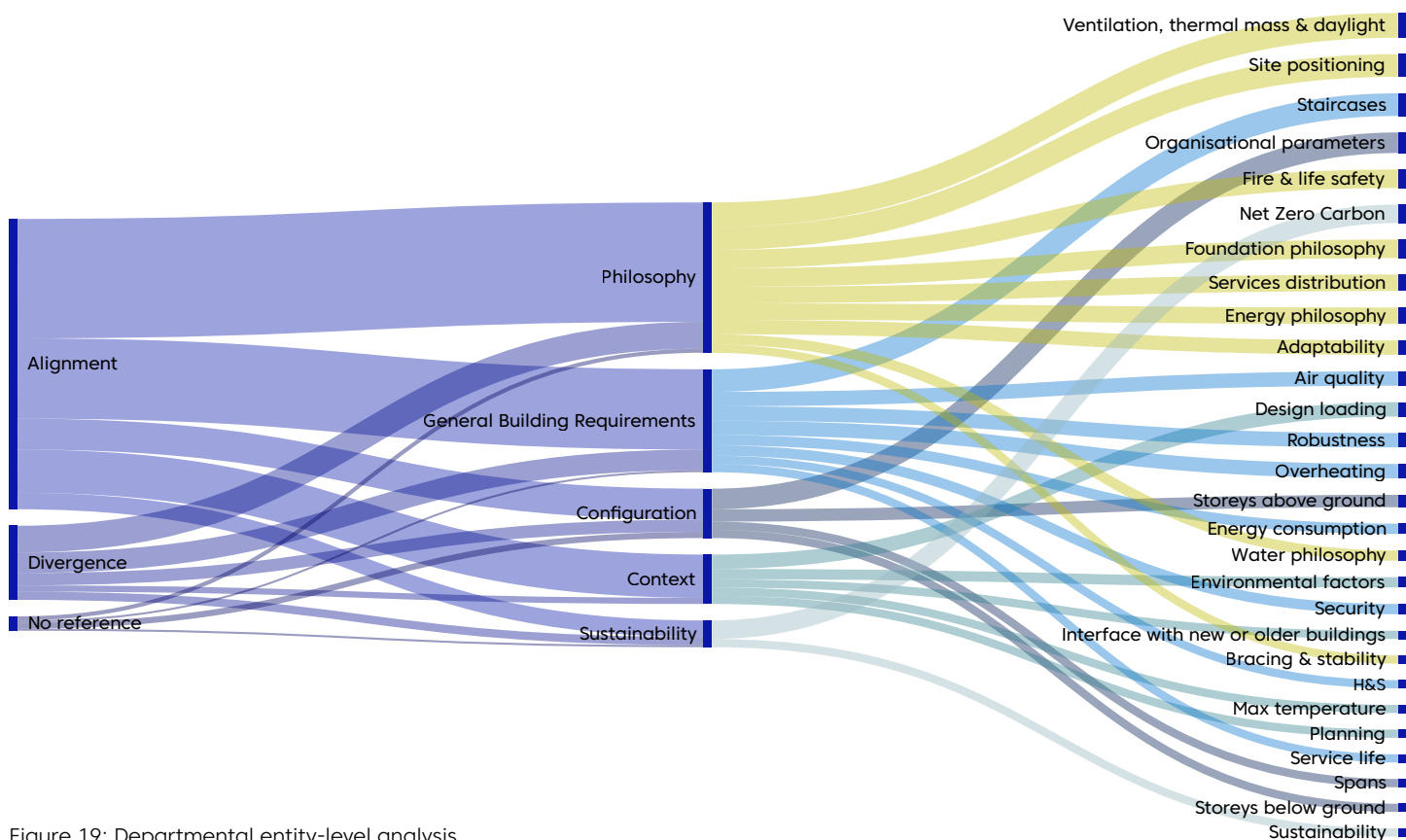


Figure 19: Departmental entity-level analysis

“In order to encourage the adoption and implementation of the P-DfMA approach, each relevant government department must first examine its own technical standards. Having a consistent and streamlined set of standards and components in this way would enable the market to respond more effectively, particularly if the industry is brought into the process early. A framework approach to procurement across appropriate programmes can also provide a further incentive for transformation throughout the supply chain.”

Institution of Civil Engineers

These findings would suggest that multiple government departments request the following parameters, which should be taken forward to develop the hypothesis specification for maximum relevance to the government estate:

Category	Requirement	Detail
Configuration	Storeys above ground	Between 2 and 5 storeys
	Storeys below ground	0
	Organisational parameters	Applicable to multi-block sites; with departmental/room clustering
Context	Design loading	Adapt to relevant location; design to Building Regulations and Standards
	Environmental factors	Design to Building Regulations and Standards
	Interface with new or old buildings	Allow for interface with new or old buildings
	Building aesthetics	Adapt to Local Planning Authority requirements
General building requirements	Air quality	Design to Building Regulations and Standards; allow for natural and mechanical ventilation
	Energy consumption	Allow for 15 kWh m ² for offices per annum; design to Building Regulations and Standards
	Health and Safety	Work to HSE requirements
	Overheating	Design to CIBSE guidance
	Robustness	Ensure low level cladding is robust
	Security	Design with security in mind, particularly in relation to building position and fence requirements
	Service life	60 years ¹¹
	Staircases	Design for 1000mm for one-way traffic; 1500mm for two-way traffic
Philosophy	Adaptability	Highly adaptable
	Bracing & stability	Cross-bracing, shear walls and diaphragm floor
	Energy philosophy	Grid supply with option for local generation ¹²
	Fire and life safety	Design to Building Regulations and Standards; ensure fire and life safety risk assessments
	Foundation philosophy	Site specific; platform solution to accommodate different foundation options
	Services distribution	Plant room(s) with distribution via circulation routes
	Site positioning	Design to respond to local environment; with consideration to security
	Ventilation, thermal mass & daylight	Prioritise natural ventilation; design to Building Regulations & Standards; mechanical ventilation can be provided
	Water philosophy	As per local authority requirements
Sustainability	Sustainability	BREEAM Excellent
	Net zero carbon	Zero carbon agenda with a particular focus on near zero carbon in operation

However, the note of caution to the above, as evidenced by astronomer Adolphe Quetelet; to seek opportunities of scale often tends towards aggregating clients' needs; however, it is equally important to recognise points of divergence.¹³ Notable points of divergence across government departments at an entity level include:

Category	Requirement	Detail
Configuration	Storeys above ground	Up to 10 storeys
Context	Design loading	Design for live load from heli-pad
General building requirements	Air quality	Measure temperature, CO2 and air changes
	Energy consumption	Allow for 104 kWh/m2 per annum (for operating theatres)
	Overheating	Design for underfloor heating
	Robustness	Design for disproportionate collapse; must be resistant to attack
	Security	Full building lockdown security required
Philosophy	Energy philosophy	2nr sources required; UPS and generator back-up required
	Site positioning	Passivhaus design - north / south windows; east / west corridors
	Ventilation, thermal mass & daylight	Prioritise natural ventilation; design to Building Regulations & Standards; mechanical ventilation can be provided
	Water philosophy	Pipework to be concealed and anti-climb
Sustainability	Sustainability	BREEAM Excellent

R

In recognition of the complexity and variance of government specifications, it is recommended that:

- A further review of the remaining specifications be undertaken to form a comprehensive overview of clients' needs
- Each criterion is ranked in order of importance by the Platform sub-assembly teams to inform the analysis of elemental specifications
- Departmental specifications be updated to remove cross-referencing of requirements, in order to provide a single-source articulation of performance needs

QFD analysis

Process

Quality Function Deployment (QFD) analysis is a process that involves the collation of data from end users to reflect the ‘voice of the customer’ and cascade this through the design and manufacturing of a product. This process allowed the Define the Need activity to capture softer and more general qualitative requirements that are typically not expressed in government specifications. This took the form of obtaining data from interviews, reports and previous project work with end users, such as teachers, doctors and prison governors.¹⁴

The raw data collected through interviews was analysed and clustered so that common themes could be grouped. These themes were considered to be the ‘voice of the customer’ and were therefore populated on the left-hand side of the House

of Quality (HoQ). Where there was a consensus that certain themes were not relevant to the strategy and objectives of the Hub, that data was removed. Each ‘voice of the customer’ datapoint i.e. a “clustered theme”, was then scored against performance criteria at a space level (see Figure 13) collaboratively by a group of 20 industry partners. The scoring of end user needs in conjunction with analysis of technical characteristics enables the Platform Construction Programme to triangulate needs across a cross-section of key stakeholders and thereby deliver a solution that encompasses a holistic set of requirements. Figure 20 illustrates the process described whereby raw data (at the left) was clustered (middle) and then scored (at the right).

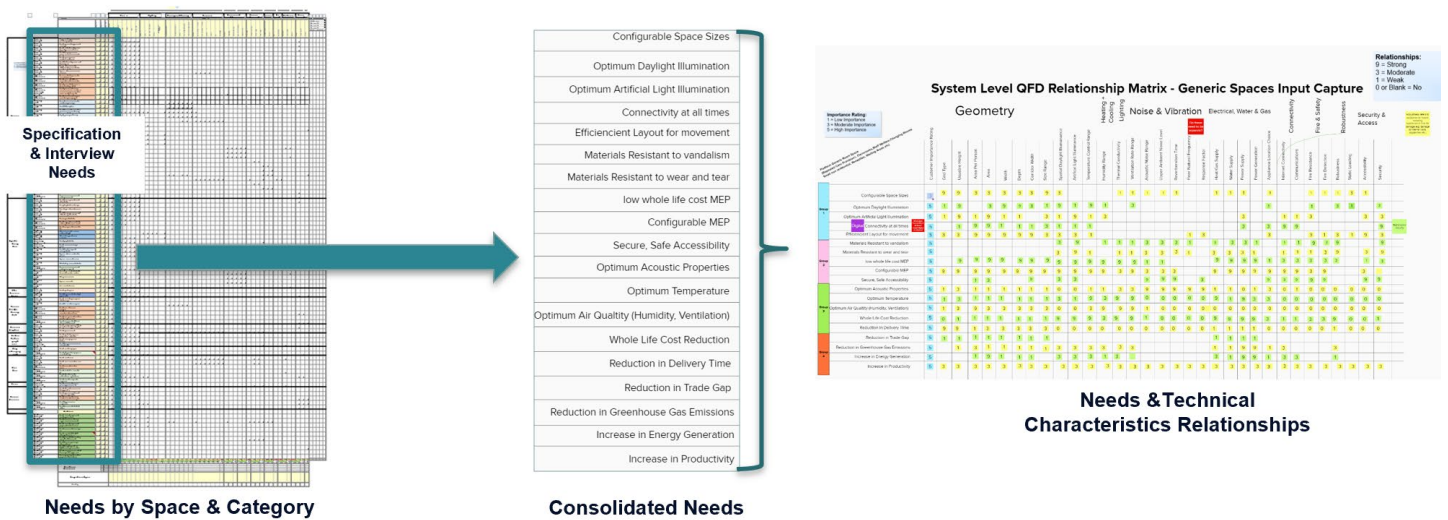


Figure 20: First phase of QFD analysis: Departmental assessment

In the next phase of the QFD process, the findings from the first set of HoQs i.e. one for each of the government departments, will be cascaded to inform the system and sub-assembly QFD analyses, see Figure 21. This approach allows the programme to maintain sight of the sources of requirements and provide traceability such that there is a rationale for design and manufacturing decisions for the platform system.

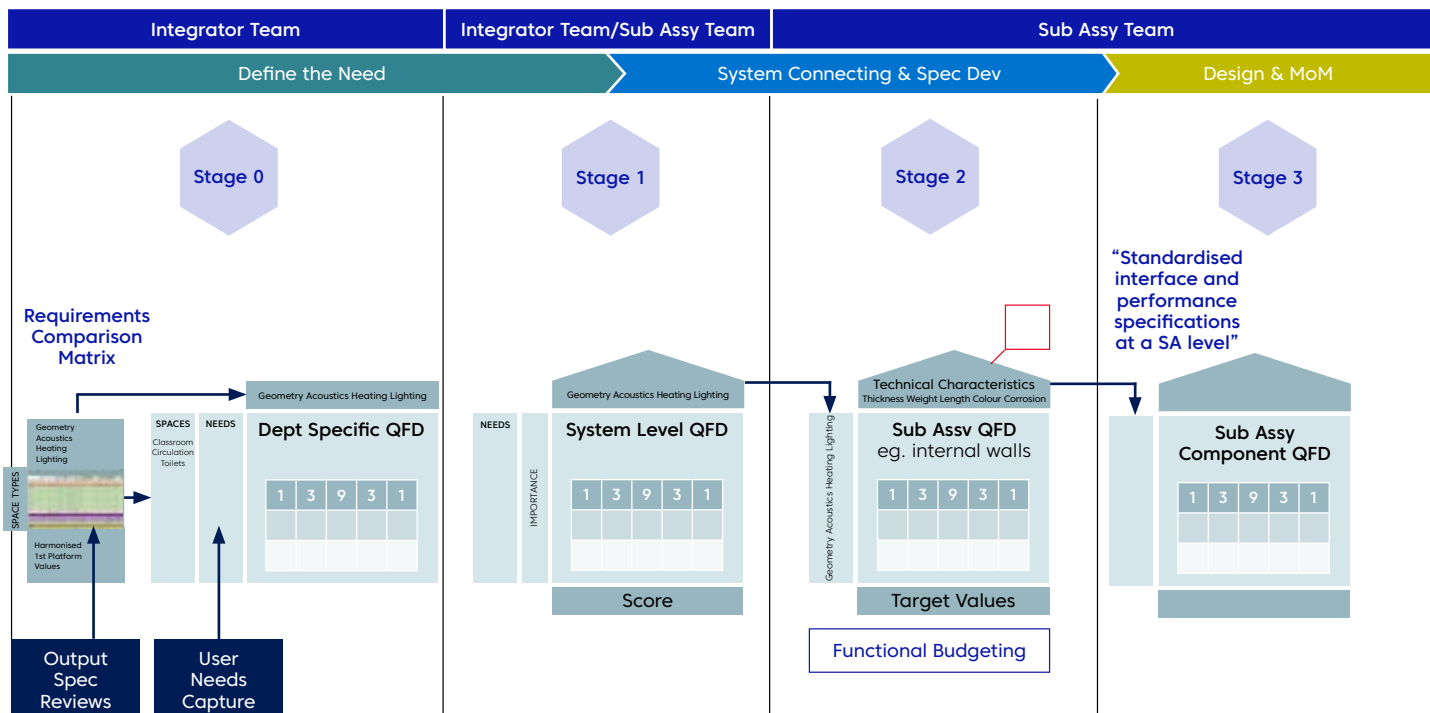


Figure 21: QFD analysis process flow

DfE end-user needs capture case study

QFD activity is commonplace in the manufacturing sector, however there are limited examples of its application in construction. The Define the Need activity allowed the Hub to understand how the QFD process can be applied to the construction sector. As QFD is a process that will support the design and manufacture of the Platform Design Programme and hence extend through the length of the programme, only insight and learning from the first HoQ are described in this section with a focus on the DfE.

Approach and assumptions

What we did

- Using the network available to the team in the Hub, teachers and students i.e. the key end users of the DfE estate were engaged.
- Interviews were set up with a set of topics to talk through relating to key performance criteria of spaces. Conversations were semi-structured allowing the interviewee to highlight areas where they thought shortcomings existed and also share delighters.
- The collected data was qualitatively analysed and clustered by similarity of needs.
- Clustered needs were scored against the performance criteria of spaces using the HoQ tool.

Why we did it

- The activity aimed to compare the specifications against end user needs. This was with the intention of identifying gaps and therefore opportunities such that the Platform Design Programme was making due consideration for multiple perspectives in a traceable way.
- The specification analysis consisted of an exercise to infer needs. The interview process served as a means of validating those inferred needs as well as to give space for frustrations and delighters that can augment the needs analysis.

Limitations

Time and budget constraints did not allow the activity to extend the interviews across a comprehensive cross-section of the end-user group (e.g. demographics, geography), and the myriad of users (e.g. maintenance staff), that would have a view of the DfE estate. As such, this activity should not be considered fully scientific and there are shortcomings in the data collected as a result. This was a known deficiency as the exercise commenced, however, interviews were carried out regardless to ascertain whether any value could indeed be elicited through the approach. As such, the process and outputs should be considered as proof of process.

Results

An extract of some of the insights from the interview activity is presented in the table with considerations for how they could impact technical characteristics. In many respects, this provides insight that would otherwise not be immediately identifiable from specified requirements – many behavioural factors, in addressing how things ‘actually’ work rather than how they ‘should’. The HoQ scoring prioritised technical characteristics based on the needs that drove them, i.e. if a need was linked to more characteristics it had a high priority. Therefore, the design is likely to cater to that need as the QFD process cascades needs to requirements and then to specifications.

DfE user insight	Reflection	Impact on technical characteristics
Toilets are a problem area in secondary schools for bullying.	Bullying not described in the government specifications.	Further research would need to be carried out to understand what, if anything, could be detailed in the design of toilets to mitigate this issue. Design considerations are presented in a number of case studies and articles. ¹⁶ These should be reviewed and could form a part of the platform design for toilet spaces.
Being able to use the school space out of teaching hours serves as an essential revenue stream to sustain the school.	The core use case of a school estate is teaching children, however for many schools the estate serves as an asset for revenue generation through hiring halls for events, grounds for sports, and classrooms for tutoring. Design considerations around adjacency and security/ access of spaces could facilitate this.	Technical characteristics may need to consider multi-purpose use, to recognise the potential for alternative revenue streams both today and in the future. This may influence the operational and functional strategy (such as security) but also cost and value profile.
Teachers want to be able to control temperature in their own classroom.	Temperature was one of the key issues highlighted both by students and teachers.	Heating and cooling provision in spaces are a particular point of sensitivity to occupants, with design requirements needing to be intuitive and reflective of operational strategy. 'Energy efficient design in educational buildings guidance' over 20 years ago, pointed out that controls should be robust, easy to understand and operate – consistent themes resonating today with the increasing use of placebo buttons suggesting that maintenance teams prefer to maintain system control.

R

- Recommend extending this process across a broader cross-section of end users to continuously refine specification and verify that needs have been fully understood.
- Data from post occupancy evaluations should be fed into the requirements capture exercise.
- Recommend undertaking stakeholder mapping of the customers of government assets, and in turn the customers for the Platform Design Programme.
- Promote the customisable nature of the platform to address customers' needs, whilst maintaining standardised components.

Conclusions, next steps and recommendations

Conclusions

Each government department's new build pipeline over the next five years has been assessed and sub-divided by space type. Across the c.£50bn spend projection, the most common space type (by area) across DfE, MoJ, DfHSC, MHCLG & MoD is: circulation, followed by storage and bathrooms. This highlights the predominance of general non-departmental-specific spaces, providing significant opportunity to harmonise what constitutes c.30% of the government's estate.

The opportunity to develop a platform across social infrastructure is real.

Notwithstanding the above, the overarching finding of the work undertaken to date is the degree of variance between departments: from the specifics of their technical requirements, to the metrics and phraseology used to define their performance attributes. This analysis supports the findings of academics who have previously concluded that public sector construction - be it schools, healthcare facilities or prisons - has a high degree of complexity and is governed by numerous regulations containing a wide range of requirements. Many of these requirements are not always explicit and properly understood, but open to interpretation, with this subjectivity requiring human problem-solving capacities to determine.¹⁷

This, therefore, highlights how the opportunities for platform-based design could be maximised through the alignment of pan-government design standards through digitisation, harmonisation and rationalisation. Utilisation of Uniclass as a common language in the articulation of requirements could be applied at a pipeline, entity and elemental level. This would make pan-government demand and requirements much easier to understand, thereby facilitating comparison across the government estate and act as an enabler to harmonisation. This would also enable automated rule-checking as a steppingstone to convert these requirements into computer-executable language and logic-based parametric design.

The key ingredients to enable development of a platform strategy exist, with definition around:

- Market segmentation.
- Benefits of commonality.
- Identified customisation and differentiation demanded by the Departments.
- Pipeline volumes and variation.

From these foundations, the Platform Design Programme will continue to develop, test and demonstrate a platform - whilst sharing learning, alongside recommendations, that will enable followers in our path to make these primary steps easier in the future.

Process improvement

In defining a model for future cross-departmental definition of needs, the following recommendations are made:



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- Allocate resources for the cross-departmental analysis of requirements. The focus to date has been on departmental working groups, however to identify alignment of requirements, particularly when conveyed in a multitude of specifications and open to interpretation, significant inter-departmental resources are required.
- Set standardised methodology from the outset. In recognising the role of the Hub Platform Design Programme as a trailblazer in this area, many methodologies have required refinement and iterative development. This exercise has demonstrated the need to create a common language between departments. This is essential to allow the harmonisation and aggregation of demand, and will underpin the longer strategy for cross-sector data interoperability in digital twins etc. It is recommended that Uniclass is further developed to provide a robust, common framework for this.
- Develop a tracker to capture interim findings and process adaptations. In line with robust project management mechanisms, the establishment of an agreed approach to capture the audit trail of findings, decisions and changes should be established and rolled out from the outset.
- Pre-commencement engagement and onboarding of client groups to confirm Terms of Reference, extent of scope, etc. This would facilitate common understanding of project requirements, and speed of transition from project establishment to Defining the Need activities.

Updates to the hypothesis specification

When departmental pipeline data is triangulated with spatial data, then 70% of the government's new build pipeline can be seen to utilise a mid-span frame. This aligns with the draft hypothesis specification. Whilst the hypothesis specification focused on a superstructure spanning up to 12m, the Defining the Need analysis would suggest this can be further refined to c.8m.

Adaptability needs to be considered with regards to developing a platform that can interface with new or old buildings, including whether sub-assemblies can meet the divergence requirements of each department, for example: security and robustness detailing for MoD and MoJ assets; anti-ligature requirements of DfHSC and MoJ. In debating the fine line between a platform that offers flexibility yet seeks to standardise, consideration should be given to the potential number of platforms that may be needed to meet the addressable market of the government estate. Proposing that the platform design focus on a mid-span solution, in turn reduces some of the departmental-specific security requirements associated with small-span residential facilities.¹⁸

Whilst each department may not yet have conveyed their sustainability policies into updated technical specifications, for the Hub Platform Design Programme to meet the future trajectory of clients' requirements, an holistic approach to achieving net zero in operation will be required, beyond the hypothesis specification's current inclusion for an active roof. A minimum service life of 60 years will also be required, but with opportunity for enhancement, where possible, by the platform design and/or consideration given to a components' deconstructability to inform the circular economy.

From a services perspective, departments require a grid supply with an option for local generation back-up, with distribution via circulation routes. Departments require circulation areas, namely staircases, to be a minimum of 1500mm wide. Building typologies are generally required to be between 2 and 5 storeys.

Next steps

Harmonising requirements

The next exercise is to identify the synergies across the entire government portfolio to determine the potential for standardisation. To achieve this, the Quality Function Deployment (QFD) needs assessment will be extended to test the functional weighting of the relative attributes of each department's defined requirements, and consolidated analysis by system and sub-assembly.

In addition, an iterative process will be developed with the Hub's Lead Designers to assess sub-assembly specification development and deployment in line with entity-level requirements, including regulatory requirements.

Future improvements to specifications

The Defining the Need exercise has highlighted areas of ambiguity and variability in how government departments specify their capital programmes and projects' requirements. Building on the data captured thus far, the Hub intends to create a set of guidelines and improvement areas to improve the future process, which should lead to improved outcomes in procurement and delivery.

These activities align with broader government initiatives seeking to encourage the Harmonisation, Digitisation and Rationalisation of client specifications to:

- Standardise requirements across government
- Simplify clients' standards to remove potential conflicts and duplication
- Codify requirements to mitigate the potential for subjective interpretation of needs

The Hub will also work with the Value Toolkit working group to ensure alignment and support the refinement of government output specifications to hardwire outcome-based performance attributes

Future use cases

This exercise has created some unique insight into the combined buying power of Whitehall. Using the data collected to date, the Hub will run an exercise with industry partners to assess future value and efficiency opportunities. For example, departments' collective buying power in areas of high commonality, such as lifts, or bathrooms.

Future use cases will be further extended over the duration of the Platform Design Programme to test the recommendations in this report, for example:

- Cross-departmental working group to standardise performance metrics
- Develop a 'future state' working group to translate QFD analysis findings into outcome-based specifications.

Appendices

Paradox of platforms

In promoting the adoption of platforms, we recognise that there are certain paradoxes, whereby the result contradicts the expectation.

Part of our experience in learning from the manufacturing industry is to recognise and draw from their learning curve to our advantage. The following key principles have been identified, with a plan developed to ensure the project delivers to expectation.

Expectation	Risk	Project Team Plan
Increased commonality	Lack of distinctiveness	Understand key differentiators
Platform leveraging	Over/under-designed solutions	Considered platform architecture
Reduced lead-times	Long lead-times	Avoid platform 'creep' and adhere to a development timeline
Component Re-Use	Lack of innovation	Establish divergence plan
Solution flexibility	Cannibalisation	Understand key differentiators
Reduced front-end costs	Higher front-end costs	Establish realistic expectations
Cross-functional working	Culture clash	Establish a platform mindset
Streamlined development	Added hierarchical burden	Defined project team roles and responsibilities

Adapted from MIT - Designing Product Families: from Strategy to Innovation (2020)

Schedule of assessed standards and specifications

DfHSC No.	DfHSC	DfE No.	DfE	MoJ No.	MoJ	MoD No.	MoD
	HBN 10-02 p. 47	ER: Part B - BB103	Occupancy	1	Cellular Accommodation - Design Guide'	1,2	CIBSE recommendation and BS 5489, refer to relevant guidance on discomfort glare
	HBN 11-01: pp. 56-60	GEN5 Design Guide	Grid Type	2	HMPPS Fire Safety Design Guide	3,4,5	Internal Lighting - Emergency lighting shall be provided in accordance with BS5266 and Crown Fire Standards, and in accordance with the Building Regulations.
	HBN 10-02 from example 1.0	ER: Part B - Annex 1A	Min Usable height	3,4	STD/E/SPEC/014 and STD/E/SPEC/038		For spaces that are specified as requiring natural ventilation, but which have no windows or form of ventilation, Env Code (V5) is to be used.
	HBN 12 - 4.8	ER: Part B - BB103	Min Area	5	STD/A/SPEC/047 p8 3.1.06:	6	Kitchen ventilation to HVAC specification DW171.
	HBN 00-04: pp. 5-15	ER: Part B - GDB	Min Depth		Physical and Special Security Guide	7	HTM 08-01, pp. 16-17. advises consulting a structural engineer.
1.2	Require access to CIBSE docs (LG2 and SLL code), referenced on p. 17 of HTM 00	GEN5 Design Guide	Max Depth			8	HTM 07-04.
	There are many references to 'ventilation' in HBN 11-01, p. 141. However, the main point to note is that HTM 03-01 (specialised ventilation) is referenced a number of times as the detailed guide	ER: Part B - GDB	Corridor width			9	Socket outlets in office/training spaces that feed quantities of information technology equipment (PCs, etc) and earthing requirements shall be as set out in the appropriate extant guidance, such as IEE Wiring Regulations, regarding the installation of equipment having high leakage currents.
	HTM 08-01 - Acoustics	ER: Part B - Annex 2E	Spatial Daylight Autonomy (sDA)			10,11	Specific and detailed lighting requirements to be found in CIBSE guide LG2. Also in BREEAM guide.
	Further guidance on acoustics and vibration can be found in Health Technical Memorandum 08-01 – 'Acoustics'	ER: Part B - Annex 2E	Useful Daylight Illuminance (UDI)				

DfHSC No.	DfHSC	DfE No.	DfE	MoJ No.	MoJ	MoD No.	MoD
	Piped medical gases should be designed in accordance with Health Technical Memorandum 02-01 – ‘Medical gas pipeline systems’	ER: Part B - Annex 2E	Light colour type				
3	Electrical installations should comply with the current edition of BS 7671 IEE Wiring Regulations together with Guidance Note 7 – Special Locations (Institute of Engineering and Technology (IET)) and Health Technical Memorandum 06-01 – ‘Electrical services supply and distribution’	ER: Part B - Annex 2E	Colour rendering index				
4	Where applicable, electrical installations should also comply with ‘Medical Electrical Installation Guidance Notes’ (MEIGaN; Medicines and Healthcare products Regulatory Agency (MHRA))	ER: Part B - Annex 2E	Min Horizontal Task Illuminance (HTI)				
5	Audio induction loop systems should be provided in main receptions, seminar rooms and waiting areas in accordance with the Equality Act 2010	ER: Part B - Annex 2F	Normal Operating temperature (NOT)				
	HTM 05-02, pp. 39-40	ER: Part B - Annex 2F	Maximum Operating temperature				
	HBN 11-01, p. 49, 10.61 to 10.66	ER: Part B - Annex 2H	Thermal conductivity				
	Must ensure compliance to HTMemorandum 05-03 Part B – ‘Fire detection and alarm systems’	ER: Part B - Annex 2H	Actual air change				

DfHSC No.	DfHSC	DfE No.	DfE	MoJ No.	MoJ	MoD No.	MoD
6,7,8,9	Lighting of lift cars, landing, machine and pulley rooms should be in accordance with BS 5655-1 and BS 5655-2 together with the requirements of BS EN 81-1 and BS EN 81-2	ER: Part B - Annex 2F	Max Co2				
	Ventilation to the lift car, lift well, and machine room should be in accordance with BS 5655-1 and BS 5655-2 together with the requirements of BS EN 81-1 and BS EN 81-2	ER: Part B - Annex 2H	Permeability				
14	Smoke ventilation of, or pressurisation to, the lift landings should be provided in accordance with BS 5588-5	ER: Part B - BB93	Acoustic				
15	Where the premises will be used solely as office accommodation or contain no patient access (including as part of the means of escape), the fire detection and alarm systems should follow the recommendations of the relevant part of BS 5839	ER: Part B - BB93	UNL (Upper ambient noise level)				
		ER: Part B - BB93	Reverberation time				
		ER: Part B - Annex 2D	Floor natural frequency				
		ER: Part B - Annex 2D	Response factor				
		ER: Part B - Annex 1A	Gas supply				
		ER: Part B - Annex 1A	Water supply				
		ER: Part B - Annex 1A	Power supply				
		ER: Part B - GDB	Internet connection (Wireless/Wired)				

DfHSC No.	DfHSC	DfE No.	DfE	MoJ No.	MoJ	MoD No.	MoD
		ER: Part B - GDB	Comms				
		ER: Part B - BB 100	Min Fire Resistance				
		ER: Part B - BB 100	Max Fire Resistance				
		ER: Part B - BB 100	Fire detection				
		ER: Part B - Annex	Robustness				
		ER: Part B - Annex 1A	Access				
		ER: Part B - Annex 2D	Access control				
		ER: Part B - Annex 2D	Security				
		ER: Part B - Annex 2H	Annual Design Energy Targets				
		Primary SoA v7.4	Schedule of accommodation tool, version 7.4 (primary)				
			Schedule of accommodation tool, version 7.4 (secondary)				

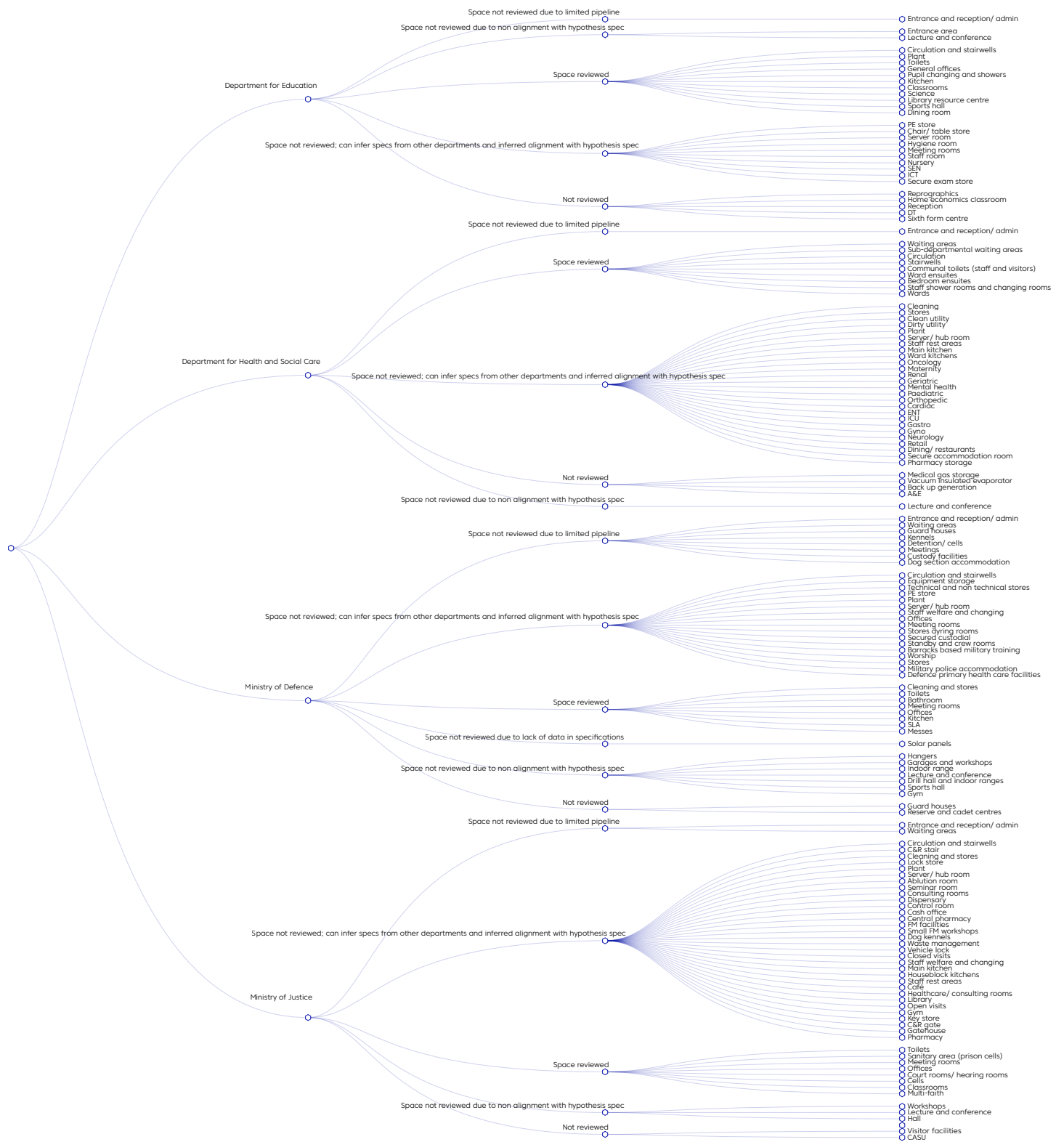


Key assumptions

General

Specification analysis

- Specification reviews have focused on departmental requirements, rather than on pan-industry and government requirements such as Building Regulations, BREEAM/DREAM. Compliance with these is deemed to be a requirement of the platform specification.
- All analysis is based on current technical standards at the time of review; no allowance has been made for potential changes to regulatory or departmental updates to these standards within the platform specification.
- To meet the programme's schedule, prioritisation of the specification review was required. Specifications were assessed at a space-level based on their alignment with the common space types. A synopsis of space types and status of specification review is outlined in the diagram opposite.



Department for Education

Pipeline analysis

- Based on the following DfE frameworks' spend projections: MMC1 and Framework 21.
- It is assumed that whole of MMC1 is “addressable” by platform.
- It is assumed that some of Framework 21 is addressable by platform – suggested only the Secondary contingent, which relates to the higher value tranches and includes less refurbishment.
- A space type analysis assessed against applicable pipeline has been undertaken using Schedules of Accommodation for 2 Form Entry (2FE) and 3 Form Entry (3FE) primary school designs and 6 Form Entry with sixth form (6FE) and 8 Form Entry without sixth form (8FE) secondary schools. The pipeline has been divided by an indicative 90/10 split for primary schools (2FE/3FE) and a 50/50 split by form entry for secondary schools to determine the volume of common space types across the portfolio.

Specification analysis

- Analysis does not account for DfE's current exercise to improve their output specification ('Spec21') or ongoing development of design guides for secondary schools ('Gen Zero').
- Specifications reviewed are those that are publicly available on the DfE website coupled with expert knowledge.

Ministry of Justice

Pipeline analysis

- The pipeline is based on the new prisons' (Four New Prisons) alliance programme, plus assessment of likely capacity and scope of the Category D expansion programme and houseblock expansion programme.

- No inclusion has been made for new build courts and tribunal services based on feedback from HMCTS that capital spend is focused on refurbishment and remodelling works.

Specification analysis

- Analysis does not account for MoJ's current review of their Technical Standards.
- Entity-level analysis and key spaces in the MoJ estate reviewed and discussed with government department representatives.
- Entity analysis predominantly based on Physical and Special Security Guide

Department for Health and Social Care

Pipeline analysis

- The pipeline is predicated on likely scope of New for Old Programme and Health Infrastructure Plan. Assumptions are still to be ratified by the DfHSC and recognise that the profile will in certain instances vary between modelled and actual.

Specification analysis

- Specification analysis based on Health Building Notes (HBNs) and Health Technical Memoranda (HTMs) to extract baseline requirements.
- Specifications reviewed for priority areas, representing repeated core provision and alignment to hypothesis specification.
- Engagement has taken place with the DHSC in relation to their ongoing redrafting exercise of HBNs.
- Where areas were not presented for spaces in HBNs, an indicative Schedule of Area was produced from a recent medium sized hospital to complete this information. The SOA was also used to ensure all spaces had been captured.

- Entity requirements predominantly based on 'Standardised Designs and the Intelligent Hospital', HBN & HTMs and industry partner experience from previous schemes.

Ministry of Defence

Pipeline analysis

- In the absence of available information, high-level pipeline data has been assessed by an Integrator partner based on their perception and review of historical trends.
- The defence pipeline has been sub-divided by space type based on the Baseline Performance Standards (BPS) for each building typology.
- Pipeline data has only been applied to those space types where technical information is available in the public domain, namely in JSP 315.

Specification analysis

- The specification analysis focused on information available in the public domain. Therefore limitations exist, particularly in relation to security requirements.
- JSP315 was used as the basis for this analysis

Ministry of Housing, Communities and Local Government

Pipeline analysis

- To estimate the pipeline data for MHCLG, the number of dwellings completed in 2018/19 (c.169,000) was used as the baseline data.
- Due to the autonomous procurement routes for housing construction, only those dwellings delivered by Housing Associations or Local Authorities would be taken forward (c.30,450)

- Of those, only apartments would be assessed (not houses), based on alignment to the hypothesis specification (36%, c.11,000 dwellings).
- 11,000 dwellings constitutes c.6.5% of total number of dwellings per annum.
- It has been assumed that this level continues to provide a 5-year pipeline.

Space type analysis

- From the above, a data set was established across the various apartment types in line with the splits between 1 bed/2 bed/3 bed.

Specification analysis

- Technical performance was based on: Home Quality Mark, Building Regulations, Building Standards, Net Zero Carbon Buildings: A Framework Definition, Secure by Design.
- Space standards as specified in Nationally Described Space Standards and Building Regulations.

References and Notes

¹ Digital Built Britain, 2017, Delivery Platforms for Government Assets – Creating a Marketplace for Manufactured Spaces

² Infrastructure Projects Authority, 2019, P-DfMA: Proposal for a New Approach to Building

³ Whilst the original intention had been to undertake this assessment across the Department for Transport's building estate, their focus is, understandably, on their infrastructure portfolio. As such, the remainder of the Defining the Need analysis excludes data pertaining to the Department for Transport.

⁴ Space types as defined in the Common Spaces and Pipeline spreadsheet, Hub's Platform Design Programme, 2020

⁵ Specifications were not assessed in this initial exercise for MHCLG based on the variety of commissioning bodies and differing requirements of each.

⁶ 144 of 300 available departmental specifications. Annex 1 outlines the full list of specifications reviewed.

⁷ NB. This relates to MoJ, MoD, DfE and DfHSC requirements per specification analysis

⁸ BREEAM is not applicable to the DfE; for MoD this relates to a DREAM Excellent requirement.

⁹ Zoia, D. E., 2013, Big Rewards, Hurdles Seen With Next-Gen Flexible Vehicle Architectures, <https://wardsintelligence.informa.com/WI019529/Big-Rewards-Hurdles-Seen-With-NextGen-Flexible-Vehicle-Architectures>

¹⁰ Relevant to DfE, MoD, MoJ and DfHSC technical specifications

¹¹ Notwithstanding opportunity for the Hub's platform to exceed service design lives

¹² To be read in conjunction with departments' sustainability initiatives

¹³ Akerlof, 2020, Designing to the edges, not averages

¹⁴ Data sources included: Stakeholder engagement log for P22 repeatable rooms (DfHSC), Prison Estate Transformation Programme stakeholder engagement log (MoJ) and utilisation of MTC's network of staff and service users.

¹⁵ Delgado-Hernandez, D., 2007, Quality function deployment in construction, https://www.researchgate.net/publication/24078041_Quality_function_deployment_in_construction

¹⁶ <https://www.commercialwashroomsLtd.co.uk/blog/reducing-bullying-with-school-washroom-design.html>; <https://www.focuswashrooms.com/prevent-bullying-schools/>; <https://www.dunhamswashrooms.com/anti-bullying-school-toilet/>

¹⁷ Tzortzopoulos et al, 2019, The Role of Building Information Modelling on Assessing Healthcare Design, International Council for Research and Innovation in Building and Construction

¹⁸ Although it should be noted that it does not remove the requirement for security