THE PRODUCT PLATFORM RULEBOOK

CONSTRUCTION INNOVATION HUB

UK Research and Innovation

DRAFT FOR CONSULTATION

MAY 2022

THE RULES

1. DEPLOYABLE

2. CONFIGURABLE

3. COMMON REPEATABLE ELEMENTS

4. INTERFACES

5. QUALITY

6. STRUCTURED INFORMATION

7. OPEN

FOREWORD

Infrastructure and Projects Authority

Government has made clear its intent to deliver better societal outcomes from the interventions that it makes in the built environment. Since 2018 the Construction Innovation Hub, funded from UK Research and Innovation's Industrial Strategy Challenge Fund, and with significant contributions from over 300 partners from industry and government, has focused on enabling this transformation.

In line with this aim, the Product Platform Rulebook has been developed to support the implementation of the policies described in the Construction Playbook and enable the accelerated adoption of platform approaches as described in Transforming Infrastructure Performance: Roadmap to 2030 (TIP).

The Platform programme has focused on adapting and developing manufacturing approaches that will improve productivity whilst shifting focus to quality, performance and the whole-life value of assets. Platform approaches represent a fundamental change, requiring different behaviours from both the client and the supply chain, and enabling outcomes not just at the level of individual projects or programmes, but at a societal level, for example by creating more inclusive employment.

The Hub weaves together the Platform programme with three other connected themes to create a suite of enabling mechanisms for change. The Value Toolkit is driving a permanent shift towards value-based decision-making; the Information Management projects have enabled organisations and governments to realise the benefit of digital transformation and the International programme established opportunities for an open and digitalised global construction market.

The Rulebook is an open-access guide to key processes giving industry the tools they need to invest in their capability to develop product platforms and build their capacity to respond to an aggregated pipeline. In turn, clients will be enabled to specify a platform approach with confidence – secure in the knowledge that it will enhance safety, performance and quality standards.

During the development journey, *Defining the Need*, published by the Hub in January 2021, identified the extensive market opportunity for platform construction systems across social infrastructure. This Rulebook takes accounts of those findings and following extensive industry consultation and engagement, offers not just 'The Rules' – a guiding set of principles that should be followed to develop a valid product platform – but also the Product Platform Development Framework – a common framework of approaches to guide anyone seeking to develop and deploy product platforms. This, along with detailed guidance, links to related research and supporting materials, is underpinned by tangible case studies, involving proof of concepts, flagship projects and solutions to demonstrate the applications in real world projects championed by leading industry players.

This Rulebook stands ready to be the blueprint for developing and implementing product platforms for current and future market players. Designed with built-in mechanisms for continuous improvement and future opportunities for harmonisation and rationalisation as capability and capacity grows. The work involved in getting to this point shows the power of effective collaboration and the commitment of the organisations involved to work together – tackling common industry challenges for the benefit of all.

Produced by industry, for industry and always in step with government policy.

However, input does not stop here. This beta publication marks the start of a final round of consultation to enable further refinement and alignment ahead of a first edition release in the summer.

I hope that the industry will seize the opportunity, continue to collaborate and use it as the basis for transforming construction for the future, creating sustainable, productive and profitable businesses, and successful projects that deliver real value.

Nick Smallwood, Chief Executive Officer of the Infrastructure and Projects Authority and Head of Government's Project Delivery Function

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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're a market enabler. Our main role is to enable transformation through collaboration. We are working with over 300 partners in government, industry and academia to develop outputs that are driving efficiency and quality in construction manufacturing and delivery so that our built environment is fit for the future. We share a vision for a built environment that deliver better outcomes for current and future generations. Businesses of all size stand ready to meet the UK's future construction and infrastructure needs and to achieve this vision we must continue to develop these solutions, to embed them at scale, and to build capability and capacity in both clients and industry.

Together, we're transforming construction.

For further details about the Construction Innovation Hub, please contact: info@constructioninnovationhub.org.uk
www.constructioninnovationhub.org.uk

1. FUNDAMENTALS

"Since most companies design new buildings one at a time, the focus on individual schemes results in a failure to embrace commonality, standardisation or compatibility across projects or programmes of work"

Adapted from Meyer & Lenherd (1997)

The Platform Programme and this Rulebook were first conceived as a response to the growing and well-documented recognition that platforms can help the construction sector realise opportunities and benefits, address common challenges and adopt ways of working that will make us more efficient, reduce our impact on the environment, and achieve better outcomes.

The challenges and obstacles faced by the industry have been thoroughly analysed over the years. The case for change is clear and established. Yet, where past initiatives in this field have not maintained momentum, what has become apparent this time is the recognition by the industry that collaboration truly does accelerate innovation. There is now an opportunity to collectively make step changes in process to compete more effectively on delivery, meaning a win for everyone.

There has never been such a level of support and commitment from the UK government to both Modern Methods of Construction (MMC) and a Platform approach to Design for Manufacture and Assembly (P-DfMA) to transform the sector's performance.

Platforms – standard, repeatable assets with interoperable components – are championed to reduce cost, waste and carbon but also generate improved societal outcomes by enabling a "*disaggregated manufacturing industry that creates stable and inclusive employment where jobs are most needed*", [*TIP Roadmap*] offering a mechanism to support the ambitions of the Levelling Up agenda. To achieve these objectives, however, will require ongoing transformational change, founded upon the development of new skills, new ways of working and collaboration spanning organisations.

This Rulebook is intended to support this change, by accelerating the awareness and understanding of product platforms, whilst facilitating a common process of development, that is consistent across industry.

1.1. Policy context

In 2017 the government committed to leveraging its buying power to support modernisation of the construction sector and create a stable cross-government pipeline of demand, announcing that five central departments would adopt a presumption in favour of offsite construction. Three years later, government expanded upon this, via *The Construction Playbook* and by setting out specific proposals relating to a 'Platform approach to Design for Manufacture and Assembly (P-DfMA)'.

"P-DfMA is an innovative approach to leveraging the government's collective buying power to aggregate demand for platforms made up of digitally designed components, that can be used across different built assets. This will deliver greater efficiency through economies of scale and add value by providing businesses and public services with infrastructure that performs better over its lifecycle."

IP Proposal for New Approach to Building - Summary of evidence (2020)

Fig. 1A: The Policy Landscape

Building upon progress made through collaboration with the Hub and industry and to support achievement of its strategic outcomes, the government has reaffirmed its commitment to enabling an increasing use of platform approaches in construction.

The *Transforming Infrastructure Performance – Roadmap to 2030,* published last year, details the planned steps behind this commitment, outlining how government will apply platform approaches to not only realise economic benefits, but "*to generate greater societal outcomes from its pipeline by enabling a disaggregated manufacturing industry that creates stable and inclusive employment where jobs are most needed*".

The TIP Roadmap acknowledges that to realise these ambitions will require transformation and adaption of culture, processes and skills, alongside development and management of core, technical elements. The development of this Rulebook is a key technical enabler to this roadmap, in setting a framework for the development of platforms that supports harmonisation and industry consensus of approach.

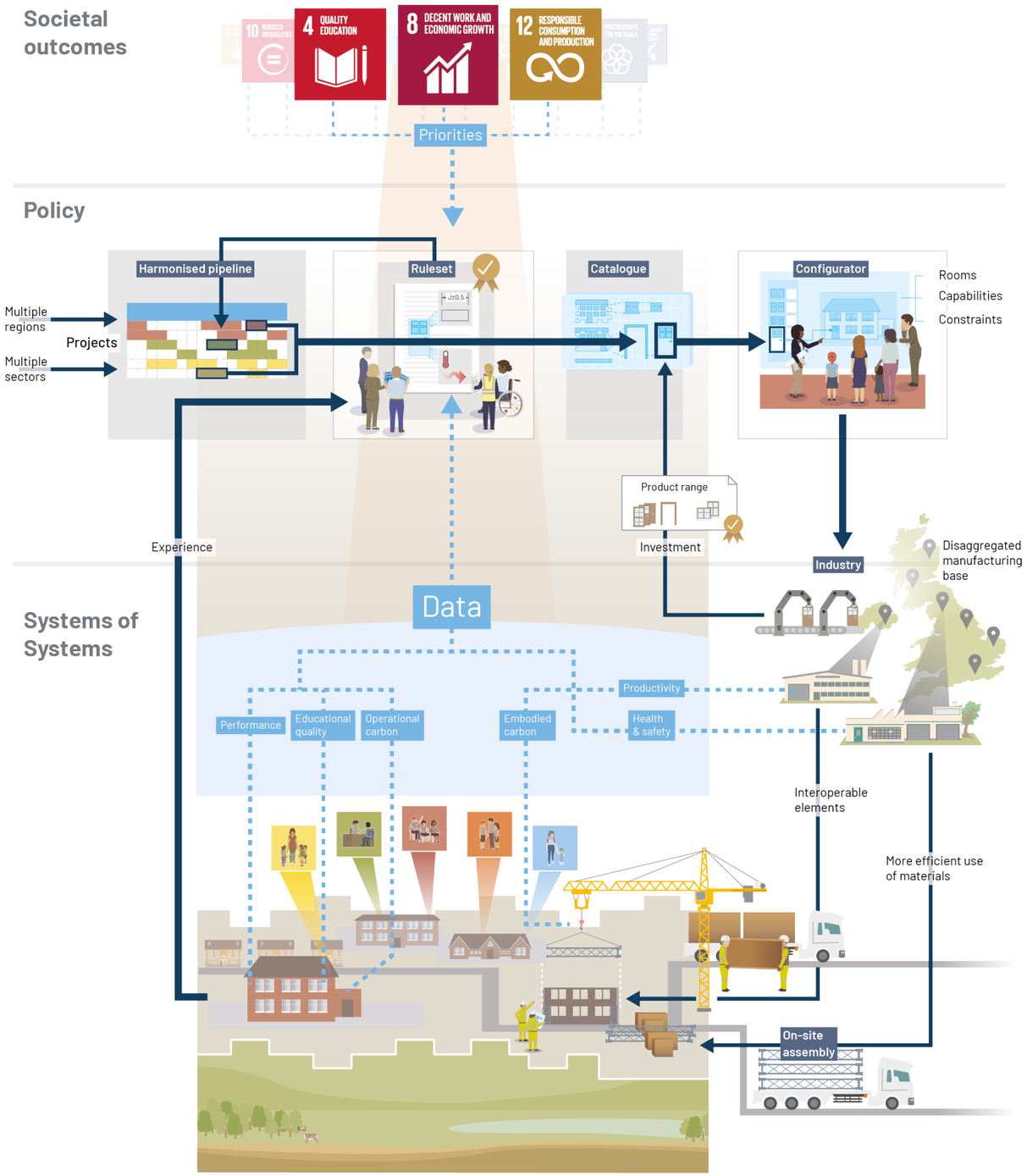


Fig. 1B: How the Rulebook fits within the Transforming Infrastructure Performance (TIP) Built Environment model

HARMONISE, DIGITISE, RATIONALISE

The Construction Playbook contained 14 'key policies' that should be considered throughout the project and programme lifecycle, mandated for central government departments and arms-length bodies on a 'comply or explain' basis. Product platforms can play a role in furthering many of these key policies. In particular, one of the policies is 'Harmonise, Digitise and Rationalise demand' and is described as follows:

"Demand across individual projects and programmes will be harmonised, digitised and rationalised by contracting authorities. This will accelerate the development and use of platform approaches, standard products and components. Combined with longer term contracts, this will transform the market's ability to plan, invest and deliver digital and offsite manufacturing technologies."

You will see frequent reference through this Rulebook to these terms and the mechanism through which this approach supports the departments in applying it. (See Future State Enablers, page 22).

1.2. Rulebook overview

WHAT IS THE PURPOSE OF THE RULEBOOK?

The Rulebook is a fundamental step forward towards creating a voluntary consensus standard that support the construction industry, as a whole system, to develop and deploy product platforms consistently in delivering better environmental and societal outcomes through the built environment.

Recognising the varying familiarity readers will have with the principles of platform-based approaches, the Rulebook is structured to:

- **Educate:** to provide an introduction to the principles of product platforms
- **Empower:** to provide a framework that guides, supports and empowers those seeking to develop and/or deploy product platforms
- **Enable:** to establish rules, principles and a framework that support consistent development and deployment of product platforms, stimulating the potential for cross-platform harmonisation and cultivating market capacity to respond to an aggregated pipeline.

With this ambition the Rulebook has been written to aid the full breadth of the construction value chain, in developing knowledge, understanding, application and analysis of product platforms.

It is underpinned by a philosophy of cooperative competition, enabling a marketplace that *"collaborates on standards and competes in delivery"*[1] to deliver better outcomes for society.

1 - Matthew Thomas Gough, 2021

RULEBOOK STRUCTURE

The Rulebook has been structured as follows:

1. Fundamentals: A outline of the principles of product platforms, what they are and the benefits that they can bring in the construction sector.

2. The Rules: A set of Rules which must be adhered to, and a set of Principles that should be followed, in order to develop a valid product platform.

3. Guidance: (including Platform Product Development Framework) Guidance for those wanting to develop a product platform, including how to create the conditions to enable their successful use.

4. Governance: An outline of how the Rulebook is expected to evolve and the roles involved in this.

5. Recommendations: Actions for government and industry to promote the use of product platforms and next steps.

6. Appendices: Case study examples of how product platforms have been applied in practice.

7. Definitions: Definitions of terms used, providing a common framework to support the development of product platforms.

You can navigate to each of these sections by using the contents tab at the foot of each page.

Recognising the diverse outputs and activities within the construction industry, there is significant challenge in trying to provide a rulebook that satisfies the needs of all.

This Rulebook does not detail an exhaustive set of considerations for product platforms, nor should be read as a comprehensive deployment manual for delivering them. It does however define rules, principles and a framework which, if applied with context, will support as intended by the Construction Playbook *"the development and use of consistent, structure, rules and language .... to facilitate a shared understanding"*.

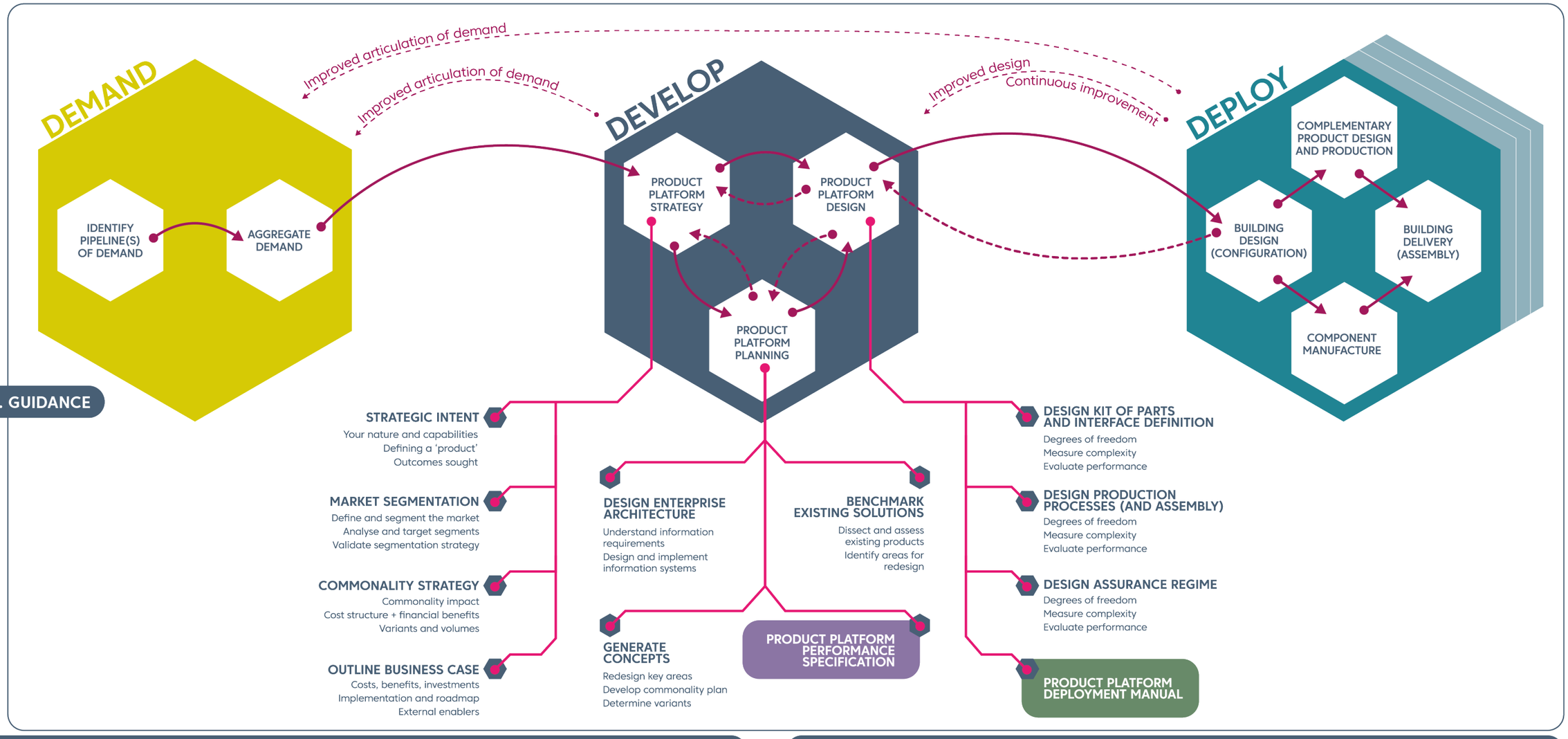
This is a navigation aid to the Product Platform Development Framework - click on the section you'd like to explore.

RULEBOOK

1. FUNDAMENTALS - CONCEPTS AND PRINCIPLES

2. THE RULES

1. DEPLOYABLE
2. CONFIGURABLE
3. COMMON, REPEATABLE ELEMENTS
4. INTERFACES
5. QUALITY
6. STRUCTURED INFORMATION
7. OPEN



3. GUIDANCE

4. GOVERNANCE

5. RECOMMENDATIONS AND NEXT STEPS

6. APPENDICES - CASE STUDIES

7. DEFINITIONS

Fig. 1C: Product Platform Development Framework Structure & Navigation Aid

1.3. Platform fundamentals

WHAT IS A PLATFORM?

The term 'platform' is used in both different contexts and at varying degrees of scale, ranging from specific products to solutions that span multiple industries. Irrespective of this diversity, platforms share several common features:

- A set of low variety common assets shared by a set of products.[2] These 'common assets' are typically physical components, but may also include repeated processes, knowledge and relationships. The common assets are replicated multiple times, enabling platform owners to gain competitive advantage by enhancing production or delivery efficiency.
- A complementary set of peripheral components that exhibit high variety. The use of interchangeable peripheral components results in a diversity that creates distinctive offerings to the market.
- A stable interface that acts as a bridge between the stable core and variable peripherals, permitting innovation in both core and peripherals.
- A set of rules/standards governing how components can be integrated.

Strategically leveraging the benefits of commonality, platforms have been successfully applied across a variety of industries to deliver mass customised products, affording customers with variety of choice whilst maintaining an efficient and effective method of production.

In assessing the opportunity for these principles to be applied by government, the Hub's *Defining the Need* report quantitatively assessed a £50bn five-year pipeline, highlighting that 70% of new build social infrastructure will commonality and consistency of geometrical characteristics, offering the potential for pan-government efficiencies.

Fig. 1D: This range of trainers is an example of a product platform from the manufacturing sector. Low-variety common assets, produced in the same way, make up the majority of each shoe. Stable interfaces and peripheral components allow the inclusion of different soles, laces and colour finishes for a high degree of customisation.

Fig. 1D: Platform shoes

2 - *Platform Thinking for Construction, Tranforming Construction Network Plus*

WHAT IS A PRODUCT PLATFORM?

This Rulebook has been written to focus upon on 'product platforms', defined as:

- The kit of parts, associated production processes, knowledge, people and relationships required to deliver all or part of construction projects using a platform approach:
- A product platform provides a stable core which is configured and combined with complementary components (via defined interfaces) to suit a particular project.
- A product platform also includes the processes, tools and equipment required for assembly.

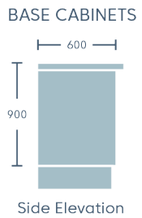
Rather than individual teams repetitiously working on singular products, platforms allow organisations to share common components, processes, and knowledge across a range of distinct solutions (a product family) efficiently, whilst maintaining economies of scale and scope.

The combination of common, repeatable assets with complementary elements, brought together with standard interfaces, enables a product platform to be extended to produce product families (a group of related products that share common features) that serve a variety of market segments.

THE PLATFORM

The platform is both the underlying elements that are common but also the rules and interfaces that govern how parts and elements can be integrated.

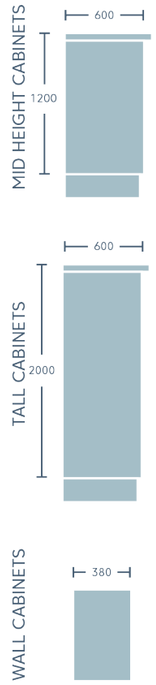
In this example, the platform is the standard dimensions of a kitchen cabinet - in defining a standard size it provides a common framework.



THE PRODUCT FAMILY

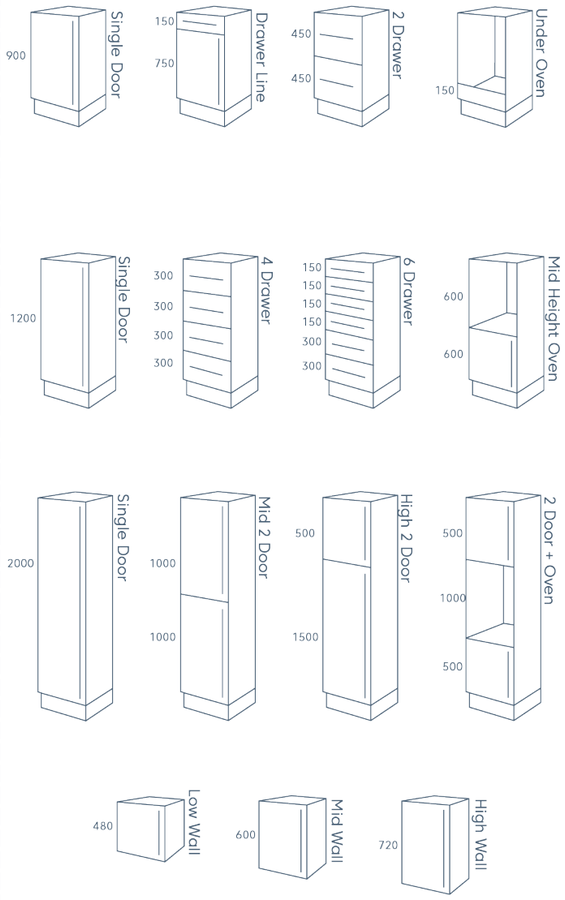
The product family is a group of related products that share common features, parts and systems, yet deliver variety.

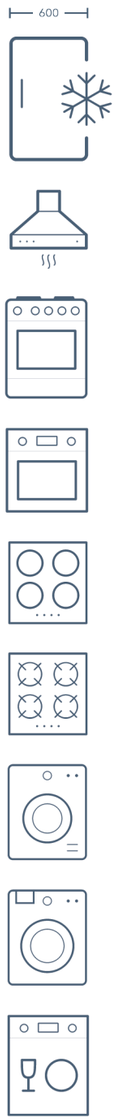
In the kitchen example, the carcase size is common (the platform) with variety of functionality or purpose (i.e. drawers).

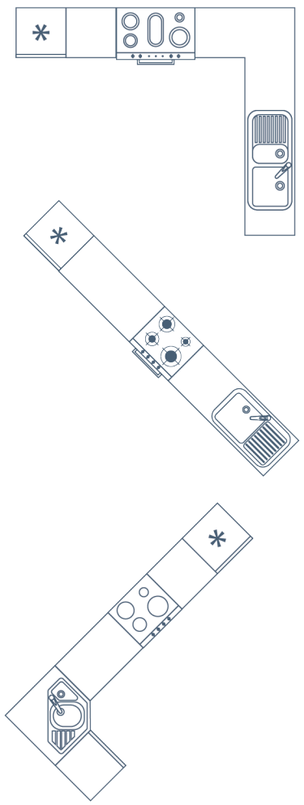


THE PRODUCT VARIANTS

Working within the framework of the platform, individual products can be variants or derivatives. For the kitchen unit example, this could include adding, removing, or substituting one or more elements - a change in door finish for example - or scaling or stretching the platform - standare base cabinets lead into mid-height or tall, wall cabinets, or double units, etc.







The variety of output can be applied within diverse markets across the globe, for example commercial/professional or domestic, and with a wide variety of styles - industrial, modern, farmhouse, rustic etc.

COMMON REPEATABLE ELEMENTS

COMPLEMENTARY ELEMENTS

DERIVATIVE PRODUCTS

Fig. 1E: This kitchen cabinet is an example of how a platform (a core base cabinet that has been designed and manufactured to have interfaces that fit with a kit of parts) can combine with complementary products to create a product family and product variants

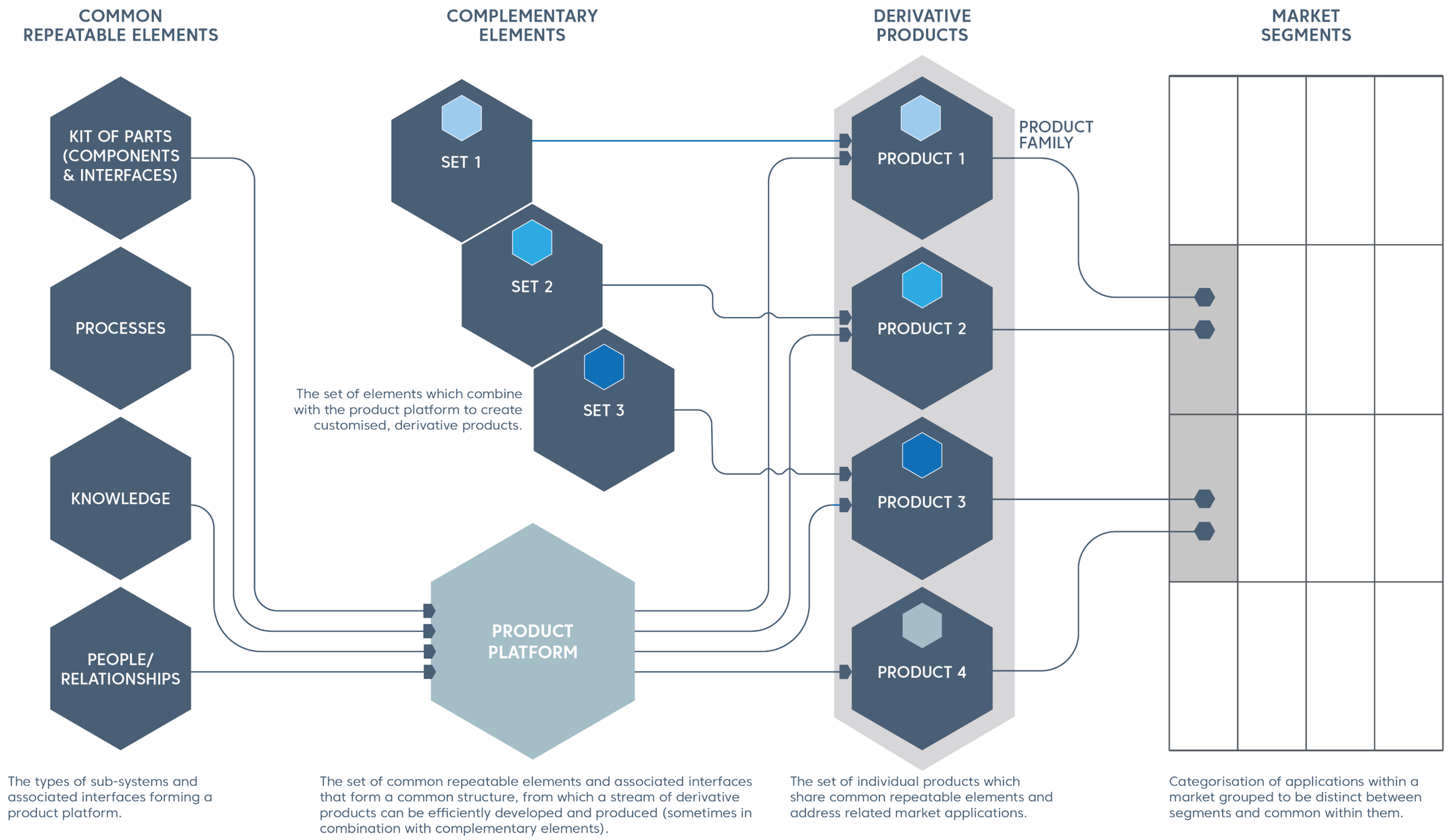


Fig. 1F: Platform Terminology

Source: Derived from Meyer and Lehnerd

PLATFORMS IN CONSTRUCTION

In 2017, Bryden Wood released a seminal book (*Delivery Platforms for Government Assets*) that brought into close focus the opportunity and benefits of applying a platform approach to the scale and scope of the UK Government construction portfolio. Pioneering in its vision, this text gave clear definition and assignment of title to a strategy which has, in instances, been successfully applied within the construction industry.

Open standards, developed by *ISO* and BSI for example, share many of the characteristics of platforms, providing a pivotal role that enables the industry to operate with degrees of commonality and standardisation, without inhibiting innovation and variety. Many clients, such as Government departments, also maintain common processes and elements across diverse delivery teams, whilst trade bodies, seek to leverage consensus and commonality for the benefit of their members.

At an organisational level, companies such as British Gypsum have developed product platforms, publishing and promoting their range in an open manner that encourages adoption and interoperability with other components. The *British Gypsum White Book* for example, provides information and guidance for specifying partitions, wall lining and ceiling systems, guiding external parties to embed and interface BG's products. By engaging prospective clients and other members of the supply chain, with select information these product platforms can be construed as semi-open; a tact growing in prominence and regularly, facilitated by the rapid evolution of digital tools such as BIM object libraries.

Albeit rarely labelled as such, many other industry players apply platform principles internally to deliver benefits to their organisations or customers. Developers within sectors such as residential, commercial, industrial and data-centres are honed towards developing buildings as products: offering customer choice within rationalised range that maintains commonality and standardisation. *Geraghty Taylor's LivinHOME* is an open example of this, whilst *Urban Splash Residential* is one of many examples applying a closed platform approach, to derive economies and efficiencies for their business.

As the breadth of product platforms within the construction industry is wide, so too is the strategy for their development and adoption. As outlined later within the Platform Product Development Framework, defining the rationale for adoption and desired outcomes is a critical consideration; the development of product platforms is a strategy for better outcomes, not an end in itself.

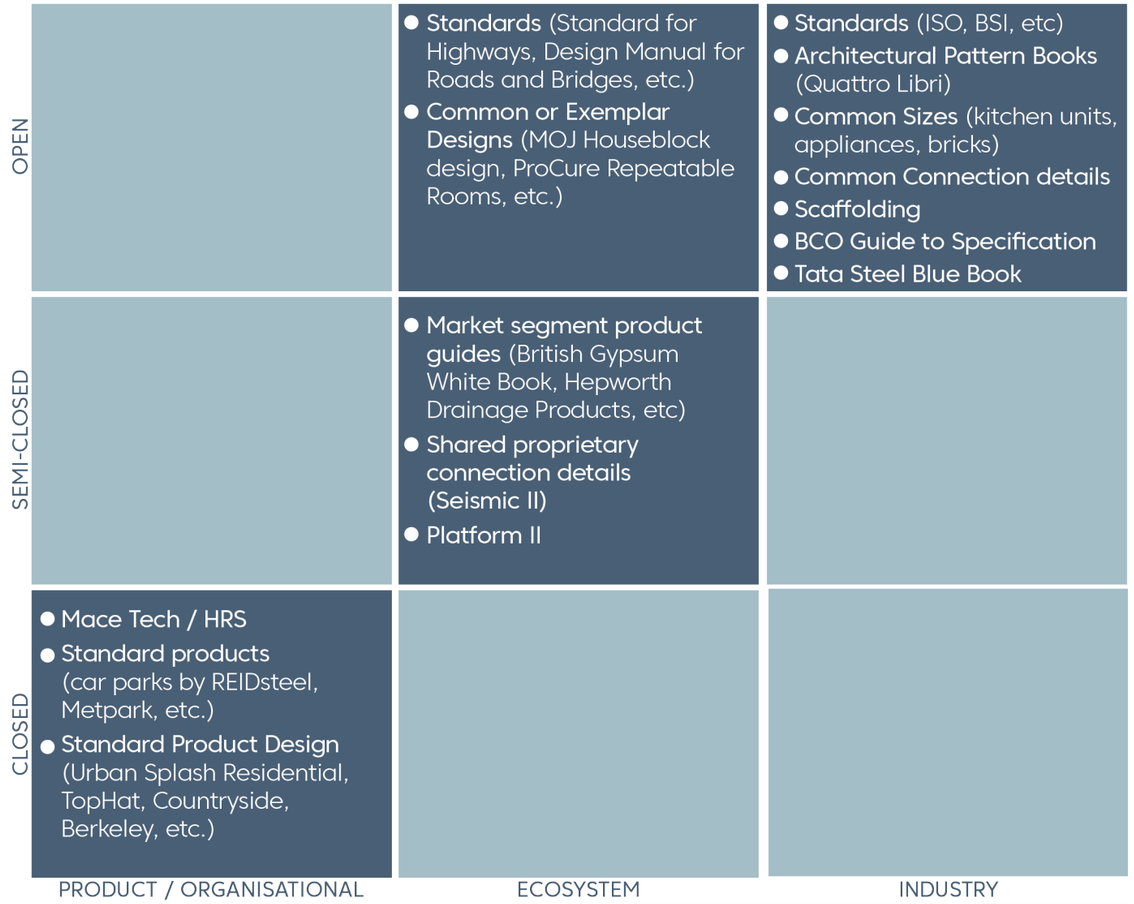
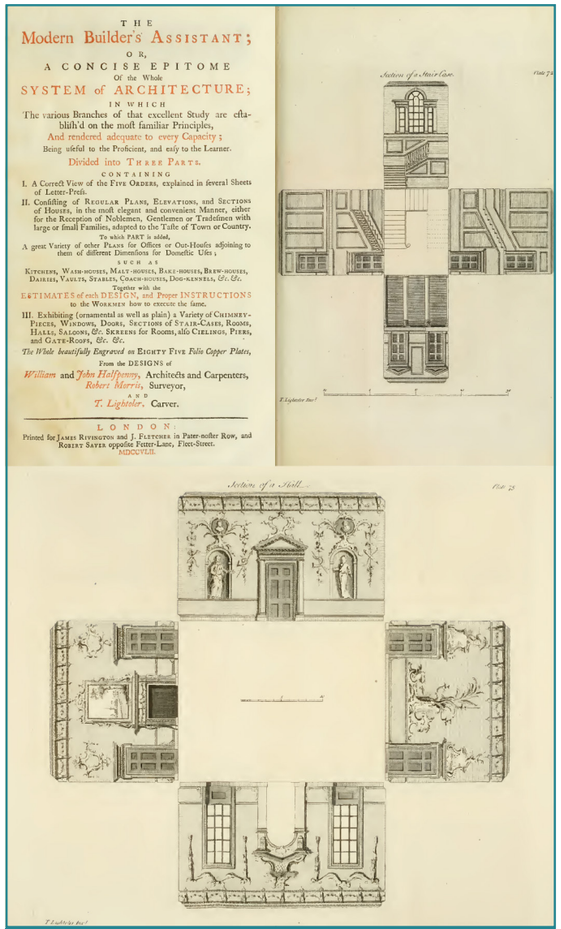


Fig. 1G: Examples of platforms within construction industry



PLATFORMS IN CONSTRUCTION

Dating back as early as the 16th Century, 'pattern books' are an example of where the construction industry has historically applied platform principles. Playing a vital role in the dissemination of design information between architect, master builder and client their use has shaped the planning, style and build of many historical towns and cities, not least Georgian London, Dublin and Bath.

BENEFITS OF PLATFORMS

The manufacturing sector has leveraged the re-use of common components, processes, knowledge and relationships for many years to deliver mass customised products at a reduced cost, faster and with lower risk. As outlined earlier, the construction industry is being encouraged to follow suit, as a way of addressing systemic issues such as low productivity, poor predictability and industry fragmentation.

By shifting the perspective from individual solutions or projects to a productised mindset, actors within the industry can begin to leverage the re-use of knowledge, designs and process to mitigate repeat work, unlock economies of scale and focus effort towards areas that add real value and continuous improvement. Furthermore, these same platform principles offer a new paradigm to the construction industry by opening the door to a manufacturing-led approach.

> *"By increasing scale, platforms can achieve the economies of scale and consistency of pipeline that unlocks the benefits of manufacturing."*
>
> *Bryden Wood*

At an organisational and project level this affords the potential for:

1. Improved productivity, efficiency and predictability
2. Reduced cost through standardisation, repeatable solutions that leverage economies of scale and scope
3. Enhanced quality control and minimised risk of rework
4. Reduction of on-site safety risk and labour
5. Reductions in waste, carbon footprint and impact upon local environment
6. Solution optimisation and continuous improvement

More broadly, government has begun to consider the wider benefits that may be realised at societal, economic and environmental level. The aggregation of demand and harmonisation of requirements for product platforms unlocks opportunities for a wider, more diverse supply base, cultivating conditions that support a transition to a lower carbon, manufacturing industry.

> *"... the government will generate greater societal outcomes from its pipeline, by enabling a disaggregated manufacturing industry that creates stable and inclusive employment where jobs are most needed."*
>
> *IPA's Transforming Infrastructure Performance Roadmap to 2030*

The growth of regional manufacturing hubs enables safer, stable and inclusive employment that can deliver enhanced social value relative to transient project working. Fixed production locations also unlock the opportunity to focus investment in areas of greatest need; catalysing cluster economies, that enable the growth of local labour pools, supply chain linkage and technological spill-over. With reduced waste, optimised processes and measurable outputs that can be refine, the potential to deliver a decarbonised routemap and thus the trinity of economic, social and environmental benefits is real.

Fig. 1H: Platforms and their outputs have benefits both in terms of the direct outcomes that result from them, and the wider outcomes that they promote in the industry and economy; many of these benefits can help improve the platform in future, leading to a continuous improvement loop.

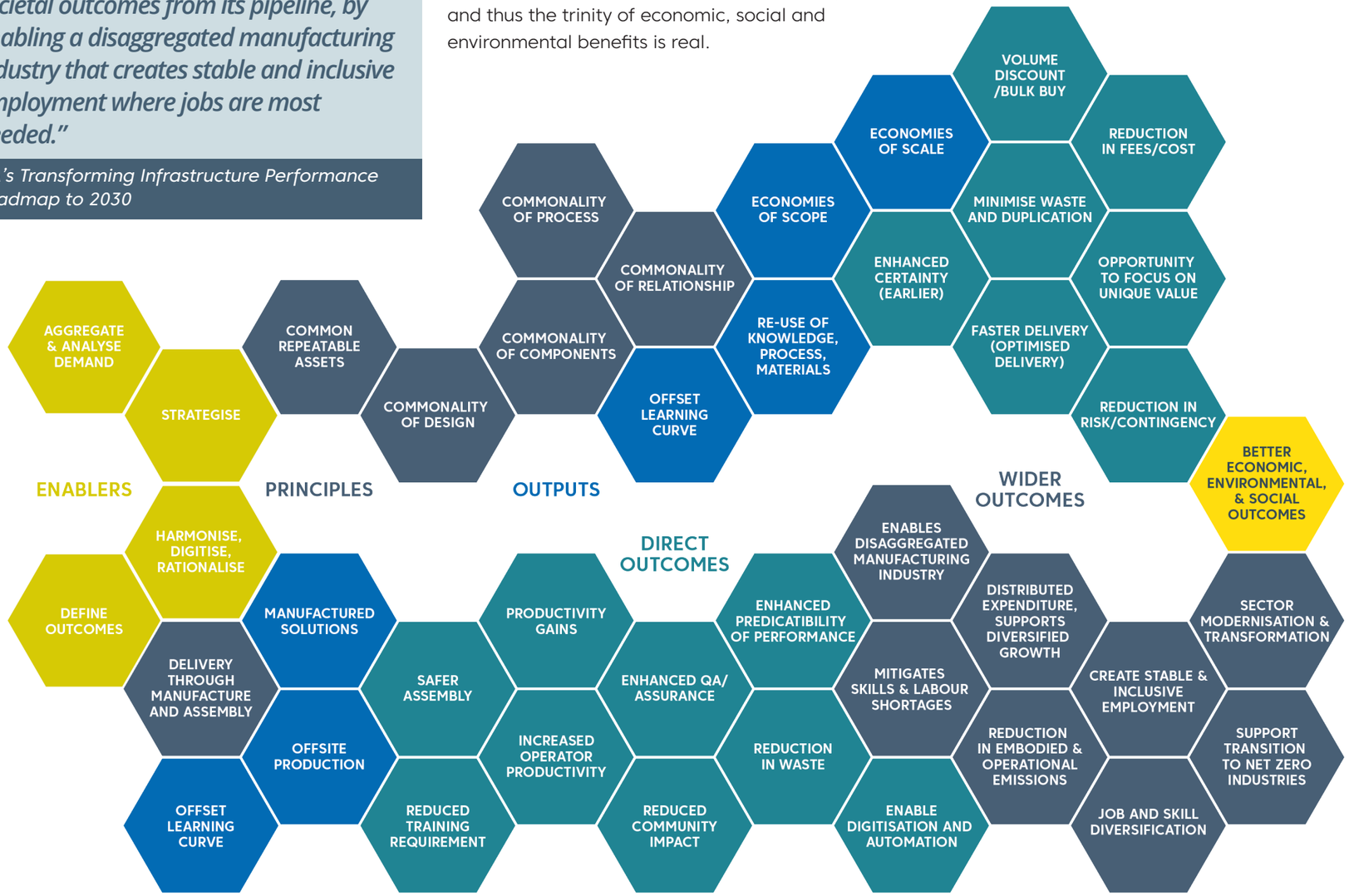


Fig. 1H: Benefits of platforms

CHALLENGES

> *"Commonality is a strategy for developing better products. Commonality is not an objective in itself..."*
>
> *NASA*

Whilst espousing the benefits of product platforms, they are like all best practices, only 'best' in certain contexts and to achieve certain objectives. The decision to develop a product platform is a strategic choice, requiring clarity of vision and recognition that not everything can or should be delivered through product platforms.

As outlined later within the Product Platform Development Framework, definition of the intended benefits mapped against the quantity, nature and variability of product demand, is critical to establishing a business case for investment, resource and co-ordination required.

The Hub's *Defining the Need* report demonstrated a methodology for aggregating and rationalising demand to inform the business case at a pan-government level; it also acknowledged the potential paradoxes of platforms, where the intended result can contradict the expectation.

The complexities and challenges associated with defining and implementing product platforms, particularly to the scale expressed by government, are not to be under-estimated. Construction's opportunity to draw advantage from the manufacturing industry includes benefiting from their learning curves; where possible such lessons learnt have been factored into the guidance included later within the Rulebook.

EXPECTATION	RISK	MITIGATION* (*Within Product Platform Development Framework)	
INCREASED COMMONALITY	LACK OF DISTINCTIVENESS	UNDERSTAND KEY DIFFERENTIATORS	PRODUCT PLATFORM STRATEGY
COMPONENT RE-USE	LACK OF INNOVATION	ESTABLISH DIVERGENCE PLAN	PRODUCT PLATFORM STRATEGY
CROSS-FUNCTIONAL WORKING	CULTURE CLASH	ESTABLISH A PLATFORM MINDSET	PRODUCT PLATFORM STRATEGY
STEAMLINED DEVELOPMENT	ADDED HIERARCHICAL BURDEN	DEFINE PROJECT TEAM ROLES & RESPONSIBILITIES	PRODUCT PLATFORM STRATEGY
PLATFORM LEVERAGING	OVER/UNDER-DESIGNED SOLUTIONS	CONSIDER PLATFORM ARCHITECTURE	PRODUCT PLATFORM PLANNING
REDUCED LEAD-TIMES	LONG LEAD-TIMES	AVOID PLATFORM CREEP	PRODUCT PLATFORM PLANNING
SOLUTION FLEXIBILITY	CANNIBALISATION OF DESIGN SOLUTION	UNDERSTAND KEY DIFFERENTIATORS	PRODUCT PLATFORM PLANNING
REDUCED FRONT-END COSTS	HIGHER FRONT-END COSTS	ESTABLISH REALISTIC EXPECTATIONS	PRODUCT PLATFORM PLANNING

Fig. 1I: Expectations of product platforms do not always align with reality and thus the Product Platform Development Framework has been established to mitigate this risk. Adapted from MIT - Designing Product Families: From Strategy to Innovation (2020)

THE TRANSFORMATION

Product platforms require a sensitive balance between commonality and the need for distinction and flexibility. Technically, a successful platform will have sufficient commonality across a range of product variants to create efficiencies, yet enough variants and unique parts to satisfy the varying needs of multiple customers.

Fig. 1J shows how common, variant and unique parts are defined and how they fit together.

- **UNIQUE PARTS** are, as the name implies, unique to only one variant. Unique parts are used to differentiate one variant from others.
- **VARIANT PARTS** are shared by two or more products that differ in one or more aspects, such as feature, size, or colour.
- **COMMON PARTS** are shared by all of the product variants and are identical. These are also known as the platform elements.

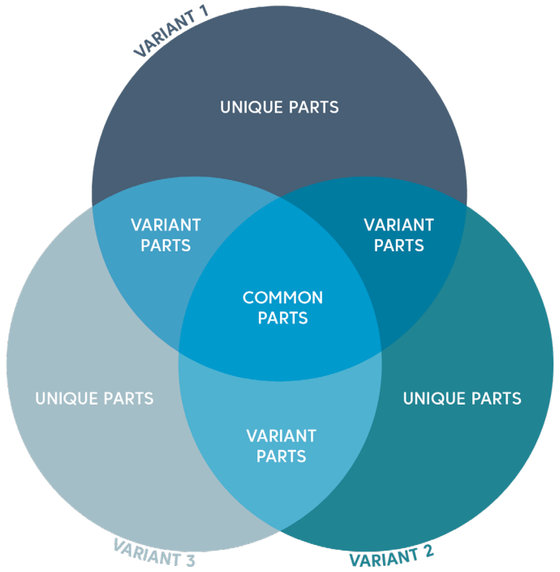


Fig. 1J: Common, variant and unique parts all play a role in a successful platform.

The ability to achieve this optimum state is often complicated by the reality of varying and competing demands and considerations, both internally and externally, leaving a state of design uncertainty.

The Product Platform Development Framework included within this Rulebook is intended to act as source of reference and guide in developing a strategy and plan that addresses this uncertainty.

Whilst this Rulebook predominantly focuses on providing technical details, readers should recognise that the transformation required to successfully embed product platforms will require adaptions in process, mindset and interactions both within and outside organisations.

The capacity to realise the potential of commonality, compatibility and standardisation will require for many a shift in organisation construct, necessitating multi-party co-ordination and greater collaboration (see Fig. 1L).

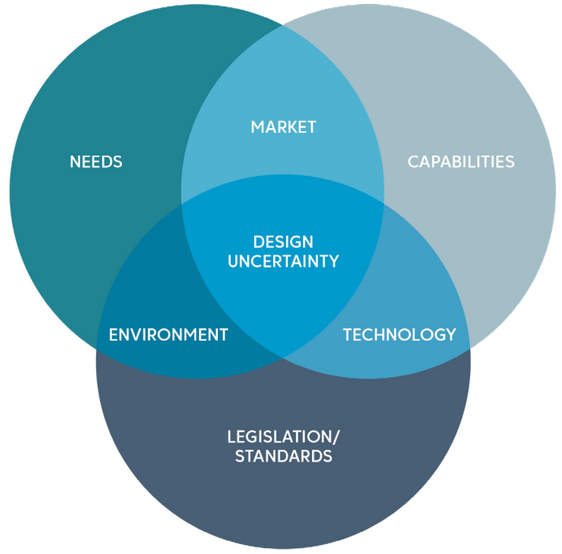


Fig. 1K: Adapted from Nadadur et al, 2012 'Strategic Product design for Multiple Global Markets'

	CONDITIONS FOR SUCCESS	CONDITIONS FOR CHALLENGE
Pipeline	Clear and measurable	Intermittent, varied and unpredictable
Requirements / Outcomes	Harmonised and rationalised	Diverse, variable and inconsistent
Design Focus	Product lifecycle	Singular project
Construction Focus	Manufactured & digitally enabled	Traditional

	CONDITIONS FOR SUCCESS	CONDITIONS FOR CHALLENGE
Value of Product Data	High	Low
Management approach	Holistic	Distinct / piecemeal
Supply Chain Management	Strategic	Transactional
Cultural	Bespoke by choice	Bespoke by default

Fig. 1L: Conditions for success and challenge

2. THE RULES

2.1. Scope

The Rulebook establishes the Rules and Principles for product platforms in construction and provides supporting explanations. The Rulebook only covers activities that are specific to the development of a product platform: activities that would take place irrespective of whether or not a product platform is being used, and are unchanged by its development, are outside of its scope.

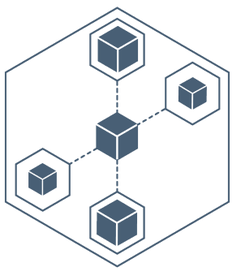
2.2. Distinction between Rules and Principles

Depending on the character of individual clauses, distinction is made in the Rulebook between Rules and Principles.

The Rules comprise general statements and definitions for which there is no alternative; as well as requirements for which no alternative is permitted unless specifically stated.

The Principles are requirements which should be applied in conjunction with the Rules.

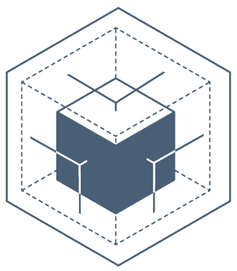
Compliance with the Rules determines whether something can be considered a product platform or not. Performance against the Principles determines how advanced a product platform is.



1. DEPLOYABLE

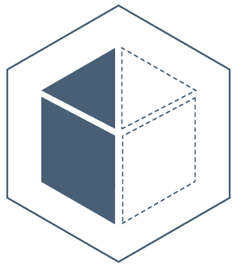
2. CONFIGURABLE

3. COMMON REPEATABLE ELEMENTS

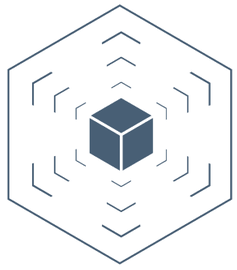


4. INTERFACES

5. QUALITY



6. STRUCTURED INFORMATION



7. OPEN

2.3. Rules and Principles

	RULE (IS IT A PLATFORM?)	RULE INTENT	PRINCIPLE (IS IT A GOOD PLATFORM?)
1 	**1. DEPLOYABLE** Product platforms shall be **deployable** across multiple, non-identical assets	that it is possible to physically deliver non-identical buildings or parts of buildings using the product platform - to distinguish from a one-off or a cookie cutter repetition.	Product platforms should be flexible without being inefficient. Buildings – and the industry which delivers them – are sufficiently diverse that one 'globally optimal' discoverable solution is doubtful. Product platform providers should work together to identify opportunities for standardisation and sharing across product platforms. Such collective convergence will drive even greater benefits for the built environment. Flexibility is essential to accommodate the need for good design, varying needs placed on individual buildings, and place-based context. But we still need to ensure efficiency (in material, labour and capital) in the solutions we create.
2 	**2. CONFIGURABLE** Product platforms shall be **configurable** to suit individual project requirements	that it is possible to comply with variations in requirements across different projects while still using the common repeatable elements of the platform.	
3 	**3. COMMON REPEATABLE ELEMENTS** Product platforms shall comprise **common repeatable elements** including: • *A kit-of-parts* [i.e. physical components] • production processes [i.e. the methods used to produce the kit-of-parts, and associated information systems] • *Knowledge* [i.e. the market insight, customer insight, operating procedures, intellectual property, methods and skills needed to develop, produce and enhance the kit-of-parts and production processes] • *People and relationships* [i.e. the individuals (and associated roles, authorities, responsibilities) needed – as well as the environment and incentives for those people, which may extend to contractual relationships between organisations]	that there is holistic consideration of improving productivity and risk across all aspects of the delivery process, whilst accepting that different product platforms will share elements to differing degrees.	Product platforms should facilitate a disaggregated supply chain, with common repeatable elements able to be supplied by multiple, independent manufacturers. Product platforms should ensure their use of common repeatable elements does not inhibit their ability to satisfy specific security considerations for their intended applications.
4 	**4. INTERFACES** Product platforms shall have **defined interfaces** which can be made available to the designers and suppliers of peripheral or complementary products.	to enable the product platform to be reliably integrated with other parts of a building without being wholly dependent on the platform provider.	Product platforms should work together to identify standard interfaces which can be used across the industry and promote interchangeability and fungibility of elements (products, processes, skills and capabilities, organisations).

	RULE (IS IT A PLATFORM?)	RULE INTENT	PRINCIPLE (IS IT A GOOD PLATFORM?)
5	**5. QUALITY** Product platforms shall have a defined **quality standard**	To define a minimum level of quality to be achieved, and have documents and procedures in place (requirements, specifications, guidelines, or characteristics) that can be used consistently to ensure that materials, products, processes, and services (as appropriate) are fit for their intended purpose	Product platforms should facilitate an improved quality standard – to develop and provide product platforms that will correspond to the requirements and to the assumptions made in project designs, appropriate quality management measures should be in place. These measures should include as a minimum: Definition of the reliability requirements Organisational measures Controls at the stages of design, execution, use, maintenance and, where appropriate, end of life. The design working life of a product platform should be specified, with time-dependent performance determined accordingly such that deterioration over the design working life does not impair the performance of the product below that intended, having due regard to its environment and anticipated level of maintenance.
6	**6. STRUCTURED INFORMATION** Product platforms shall have a **structured approach to information** for: • Product information; • Deployment information; • Organisational information; including capability and credibility.	To enable those in the client domain to make an informed choice about the use of the platform and how it will affect outcomes; and to enable those in the product domain to feed in their information seamlessly. To enable those in the project domain to correctly evaluate, configure and deploy platforms.	Product platforms should promote interoperability on a technical, legal, semantic and organisational level. Product platforms should facilitate convergence to a consistent approach to structured information, enabling interoperability across the supply chain. This includes (but is not limited to) the following aspects: • Product information: • Value • Interface and compatibility • Limits of applicability • Past performance and credibility (accreditation, compliance, quality assurance) • Deployment information: • Lead times and capacity • Offsite activities and requirements • Logistics requirements • Onsite activities and requirements • Compliance and quality assurance • Organisational information; including capability and credibility.
7	**7. OPEN** For a product platform to be deemed an **open** product platform, it shall enable any party to make, use and buy the common, repeatable elements, for legitimate purposes.	To enable a consistent understanding of what it means to be an open platform.	Open product platforms should provide an open foundation on which others can develop complementary products, services and technologies; they should have a stable architecture with open interfaces. Open product platforms should reduce the barriers to adoption through accessible information and tools, the use of commercially available products and open, performance-based production requirements, skills and know-how required to produce and assemble Open Product Platforms.

Fig. 2A: The rules and principles

3. GUIDANCE

With an understanding of what product platforms are in the construction context, we will now explore the conditions required to enable their use, provide guidance for those looking to develop them and discuss the maturity and step-changes required by industry to facilitate this.

It is important to note that standardisation, while valuable, is not in itself sufficient to develop a successful product platform. Standardisation of all components and processes yields a rigid and inflexible platform, making renewal and customisation difficult. One of the central challenges of platform development is determining which components and processes ought to be standardised, and where flexibility and customisation need to be retained.

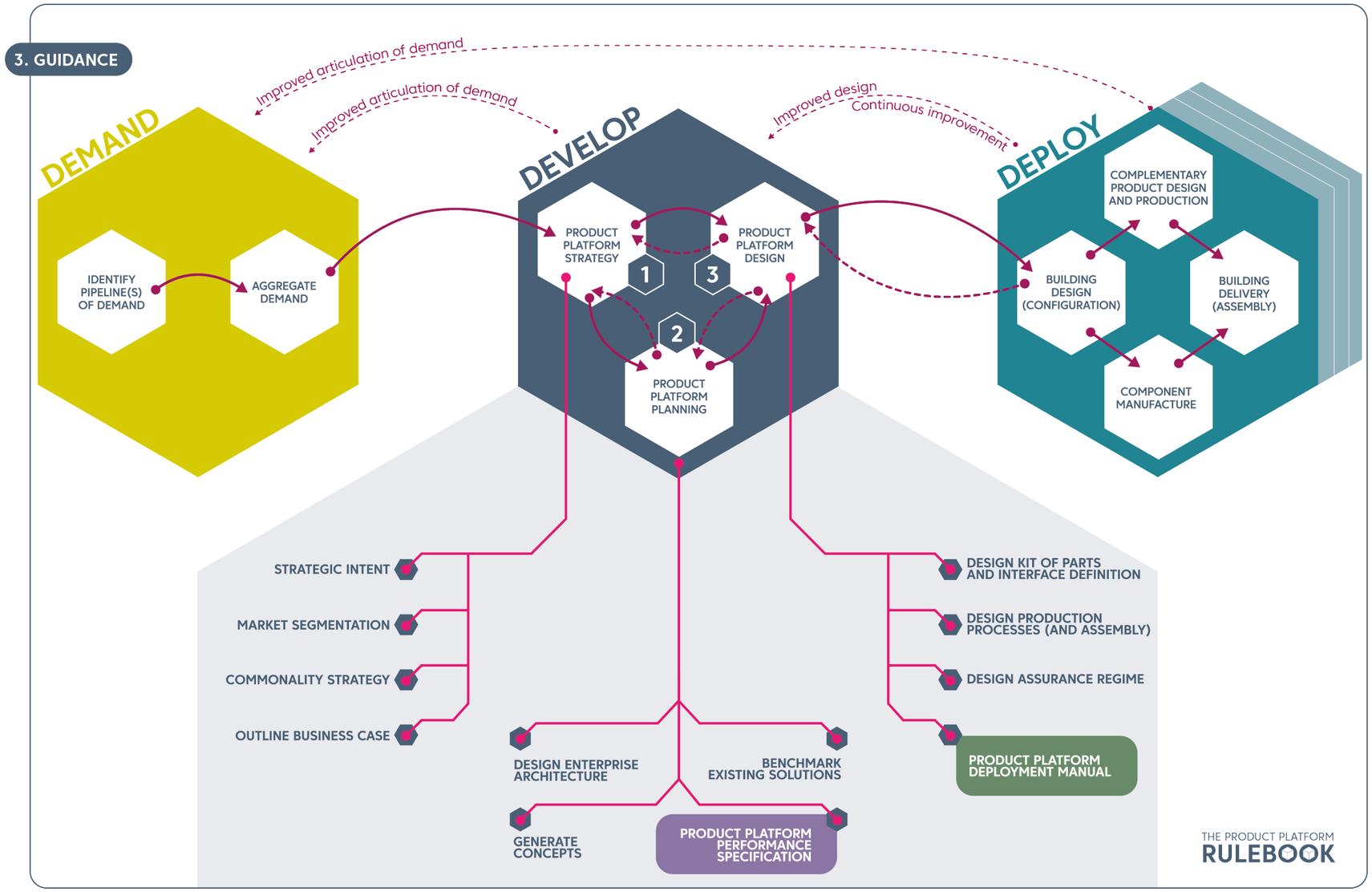


Fig. 3A: The three steps of the Develop stage of the Product Platform Development Framework
1. Product Platform Strategy 2. Product Platform Planning and 3. Product Platform Design

3.1. How the industry must change to enable product platforms

To identify the key enablers for the introduction of product platforms in construction, it is important that we understand the context in which they will be applied. Broadly speaking, the construction sector has three primary 'domains':

1. The client domain
2. The project domain
3. The product domain

Each domain plays a vital role in the construction of the built environment, but the way the domains interact often creates inefficiencies, which could in some cases be addressed by the emergence of product platforms.

PLEASE NOTE: The following sections are not intended to be an exhaustive account of the features of the industry, but an account of those features which impact upon its ability to accommodate product platforms.

CLIENT DOMAIN

The client domain represents those responsible for the delivery, operation and management of the built environment, ranging from large 'portfolio' clients such as government departments, down to those concerned with individual assets. Similarly, the role of client varies, from those simply delivering assets (e.g. developers) to those owning and operating long-term portfolios.

Demand for construction services (new construction, refurbishment, demolition etc.) originates in the client domain. Such demand is usually articulated through discrete projects or programmes, and clients interface with temporary groups of organisations in the project domain to deliver them. Accordingly, the requirements (technical, value etc.) associated with this demand, and the way services are procured, often vary from project to project.

In the client domain, 'construction works' are often considered in isolation from operational activities. This means the link between design and construction and operational performance and outcomes is often lacking and the opportunity for continuous improvement is limited.

PROJECT DOMAIN

The project domain represents those organisations involved in the design, delivery and management of construction works. As stated above, asset management services are generally not considered to be part of this domain, although there has been an increase in business models and contracts attempting to bridge this gap (e.g. 'design, build, operate' contracts). It contains thousands of organisations, from large multinational contractors and consultants through to small specialist subcontractors, and is dominated in volume by SMEs with high levels of self-employment and subcontracting.

The project domain is predicated on groups of these organisations coming together, temporarily, to deliver construction works against the clients' specific requirements and procurement approach. As such, organisations operating in the project domain often have poor sight of long-term demand pipelines, and their project-based business model and uncertainties over procurement means they often lack the confidence to invest in training and innovation outside of specific projects and programmes.

The temporary and variable nature of projects (in terms of size, time, site and client requirements) makes for a fragmented and specialised delivery process, which is challenging to make more efficient through continuous improvement. Similarly, a lack of long-term, structured feedback from operational activities also prevents continuous improvement in asset design.

Organisations in the project domain interface with the product domain to select products and services suitable for deployment on a given project and in response to the specific requirements associated with it.

PRODUCT DOMAIN

The product domain represents those responsible for the extraction, processing and manufacture of construction materials and products. Products range from commoditised materials supplied to a wide marketplace, to bespoke solutions with a single customer. The organisations in the product domain range from large multinational materials groups to specialist SME component manufacturers, who supply their products into projects and programmes within the project domain in line with specific requirements.

There is little direct dialogue between the client domain and the product domain, with the project domain acting as the gateway (and translator) between client requirements and technical solutions. As such, conversations relating to standardisation and rationalisation of client requirements are often restricted to those achievable within the realms of a project or programme – missing the opportunity to look for scale advantages across clients, projects and programmes.

Continuous improvement in the performance of construction products - and/or their contribution to the performance of the delivery process - is challenging, due to the bespoke way that products are brought together in the project environment, the level of customisation currently required and a lack of feedback from operational activities in the client domain (or subsequent construction works).

SUMMARY OF THE CURRENT STATE

In summary of the above, demand for construction works originates in the client domain as discrete projects or programmes delivered by temporary groups of organisations in the project domain. These projects and programmes interface with the manufacturers and suppliers in the product domain to source and bring together construction materials and products which meet the specific requirements of a project or programme.

The temporary nature of projects, and the separation between construction works and asset operations, prevents continuous improvement in either process or product and a lack of direct dialogue between the client and product domains prevents economies of scale being realised.

FUTURE STATE ENABLERS

The most fundamental collective enabler for change – in line with the ambitions of Government (TIP2030) – is for the construction sector (represented by the project domain) to be recognised as a component of the wider built environment. Construction projects should not be seen as discrete activities, but as repetitive interventions into an existing system. With this mindset, we can recognise the value of creating stronger links between assets, projects and products.

Secondly, we must recognise that although the demand for construction works across the built environment is vast and continuous, the way in which it is passed into the project domain does not take advantage of this scale. The way in which pipelines and associated requirements are articulated need to be harmonised. This will allow those in the project and product domains to more easily aggregate demand for products and services but will also provide the foundation for increased rationalisation of requirements.

Organisations across the client domain will need to work together to agree common standards against which pipeline data and client requirements are communicated.

With this in place, clients can then work closely with organisations in the project and product domains – outside of the project environment - to identify opportunities to rationalise their requirements. Such rationalisation exercises require a clear understanding of where differentiation is necessary and valuable (e.g. security requirements) and where it is adding unnecessary cost and complexity to product and process. Critically, this conversation should be solution agnostic, leaving the market to respond and driving continuous improvement through competition.

With the three domains operating in this manner, projects will no longer be seen as the starting point for design and construction activities but the final step in the configuration and deployment of pre-engineered solutions (including but not limited to product platforms). The focus of the project domain will therefore shift towards product customisation and process optimisation, including evaluation and configuration of existing solutions, management of interfaces and assembly processes, and execution of any complementary design and construction works*.

**It is unlikely that project requirements can be entirely satisfied through the deployment of pre-engineered solutions and product platforms – however, it is expected that their use will have knock-on benefits for bespoke design elements through the provision of clear system boundaries and interfaces.*

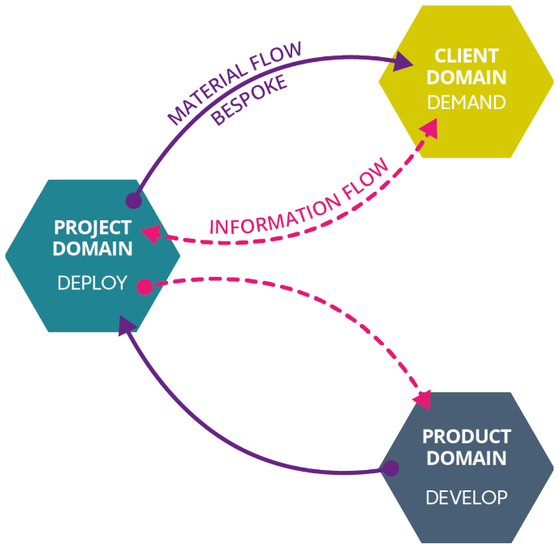


Fig. 3B: Current State Domain. The lack of connection between the Client and Product domains results in a bespoke material flow

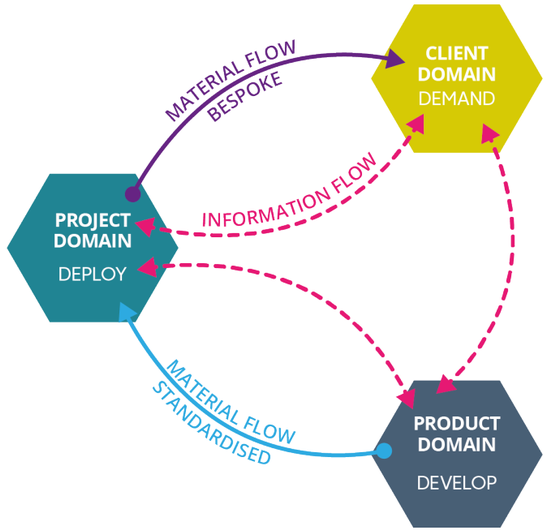


Fig. 3C: Future State Domain. Material and information flows within the desired future state, with platforms being widely utilised.

SUMMARY OF THE FUTURE STATE

In summary of the above, instead of information from the client domain flowing exclusively to the project domain, it now flows to both the project and product domains. The product domain uses this information to supply standardised, rather than bespoke, products and materials to the project domain. The project domain configures these standardised products and adds limited bespoke activity and material to complete the required projects.

STATUS QUO	NHP GOAL
VERTICAL SUPPLY CHAIN	HORIZONTAL SUPPLY CHAIN
BARRIERS TO ENTRY FOR SMEs	PROGRAMMATIC /MARKET-LED
RISK DUMPING	PRODUCTISATION
TRADITIONAL CONTRACTING	BROAD SUPPLIER RANGE
SILOED PROJECTS	INCUBATE IDEAS & NEW WAYS OF WORKING
COST ONLY SIGNAL TO MARKET	VALUES-BASED DECISIONS

Fig. 3D: Aspirations of the New Hospital Programme

3.2. Product Platform Development Framework

The previous chapter has outlined the three primary construction domains and the change in the relationship between them that is required to enable the introduction of product platforms.

Building on this, the Product Platform Development Framework (Fig. 3E) provides a summary of the core activities that need to be undertaken in each domain for the successful development and deployment of product platforms.

It should be noted that there is a multiplying effect through the framework. That is to say that the '**demand**' activities undertaken in the client domain should lead to the '**development**' of multiple product platforms in the product domain, each of which will be '**deployed**' many times in the project domain.

The following sections describe each of these core areas of activity and the objectives within them.

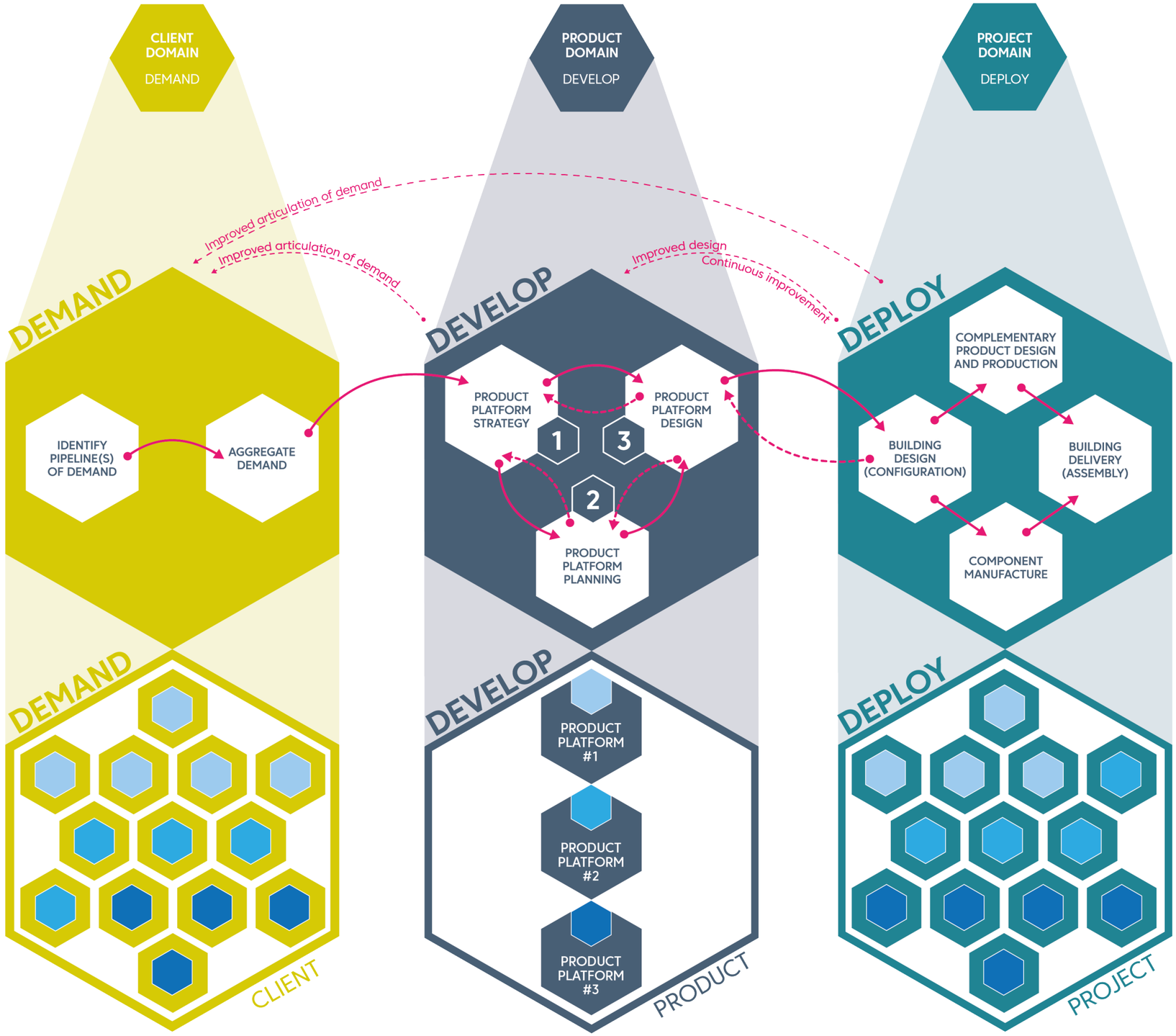


Fig. 3E: Product Platform Development Framework aligned to the three domains

AIM	OBJECTIVES	APPROACH
CLIENT DOMAIN DEMAND To provide confidence to the supply chain that the solutions they develop will have a market. The use of product platforms requires an aggregated demand, which is supported by harmonisation and rationalisation of design requirements across a range of asset types and client organisations.	To identify future planned procurements and forecast needs including financial value and characterisation of procurement/ need. To bring together the demand pipeline from multiple clients with associated technical requirements and value drivers so details can be segmented and analysed. To provide long term performance feedback from operational assets to aid continuous product improvement. To gather feedback from project and product domains on the suitability of pipeline data and requirements.	This is done collaboratively across the client base, away from the project environment. Clients will need to agree on suitable time frames for the publication of pipeline and requirements data, balancing the need for continuous improvement with the need for stable demand (i.e. where requirements or pipelines are updated too regularly, PPPs could quickly find their products out of date.)

AIM	OBJECTIVES	APPROACH
PRODUCT DOMAIN DEVELOP To respond to aggregated market demand through the development of a particular product platform that can be deployed across multiple projects and programmes.	To set the strategic intent for a product platform. To clearly understand the problem a product platform is aiming to solve. To design a product platform, the supporting production environment, and how it will be deployed across multiple projects. To provide adequate information to project and programme teams to support evaluation, selection, and deployment of the product platform including mechanisms for performance feedback.	It is expected that there will be multiple product platforms in the market serving different segments of the market. The 'Rules' set out in chapter 2 provide a voluntary consensus framework that supports development of product platforms in a consistent manner, allowing clients to demonstrate compliance with any future government mandate for their use. The next section (3.3) sets out detailed guidance for the development of a product platform which, where followed, demonstrate compliance with the rules.

AIM	OBJECTIVES	APPROACH
PROJECT DOMAIN DEPLOY To deploy one or more product platforms in a specific project or programme. To shift, where possible, from design and construction to configuration and assembly whilst managing interfaces with bespoke elements of design and on-site fabrication/ construction.	To evaluate the suitability of available product platforms to project- or programme-specific requirements. To configure selected product platform(s) by project or programme requirements. To identify the extent and nature of bespoke design elements and manage interfaces with the selected product platform(s). To manage manufacturing and assembly processes and their interfaces with any traditional construction operations. To provide feedback to PPPs regarding the configuration, assembly (including interfaces) and, where possible, operational performance of deployed product platforms.	Project domain organisations will need to work closely with product platform providers from the very early stages of a project or programme to ensure effective incorporation of product platforms. The exact role of project teams, the supply chain and the delivery model more generally may vary depending on the specific product platform – for example, for 'open' product platforms, the need to identify and manage suitable manufacturing capability may be increased when compared with a more vertically integrated solution. Design and construction teams working in the project domain will need to consider the impact of increasing levels of pre-design and pre-fabrication on their current business models. *Note: organisations operating in the project domain may also be product platform providers.*

3.3. Product Platform Development

The use of platforms is a strategic choice to design once and use that design across multiple products. It is predominantly a financial strategy and is only one way to offer variety to customers and projects while reducing the cost-base; it is not universally applicable. Given the level of effort needed, the development of platforms should not be undertaken lightly or without understanding the financial case for doing so.

This section provides guidance, supported by current examples from industry, for those considering whether investing in the development of a product platform is the right approach for them. It focuses on the 'develop' section of the Product Platform Development Framework described in section 3.2 and does not cover activities undertaken in the 'demand' and 'deploy' sections (in terms of rationalising requirements, or the project delivery process). It does, however, set out the inputs required from, and outputs to be provided to, these activities.

Throughout, we refer to the "product platform provider" (PPP) as the firm or consortium engaged in the development of the product platform under consideration.

The development process is split into three stages:

1. **PRODUCT PLATFORM STRATEGY:** setting the strategic intent for the platform and determining whether a platform is the right approach. If it is, identifying where to play and how to win by maximising market leverage from a common technology.

2. **PRODUCT PLATFORM PLANNING:** clearly defining the problem to be addressed by, and approach to, the proposed product platform before commencing design.

3. **PRODUCT PLATFORM DESIGN:** designing the product platform itself and production and assurance processes (both on- and off-site) needed to deliver in line with the plan and strategy. Establishing ongoing management of the product platform and the method of deployment in projects.

The following sections take each of these critical stages in turn, describing the questions to be addressed, and the key outputs. It should be noted that these stages are linked, and PPPs will need to iterate between them during development.

INPUTS FROM THE CLIENT DOMAIN

As stated in the section 'Future State Enablers', "*organisations across the client domain will need to work together to agree on common standards against which pipeline data and client requirements are communicated*". A topic of current debate across the emerging product platform space is the extent to which rationalisation and standardisation should be undertaken within the client domain. The following sections are written in response to the following assumptions:

- That clients will work together to harmonise their requirements. This is, to articulate requirements in a consistent, standard format;
- That clients will work together to digitise their requirements. That is, to structure and publish requirements data against agreed data template(s);
- That clients will work together to rationalise, where appropriate, these requirements within and across sub-sectors or asset types, and;
- That clients will not specify (implicitly or explicitly) the products and processes required to address these requirements.
- That it will be the job of the market to determine how best to meet these requirements, whether through PPs or otherwise.

In accordance with the above, the PPP's key inputs from the client domain are a clear and stable articulation of client demand (pipeline) and a set of harmonised – and increasingly rationalised – requirements associated with that demand. It is now the job of the PPP to determine whether the development of a product platform will allow them to meet this demand more effectively and/or efficiently.

PRODUCT PLATFORM STRATEGY

A product platform strategy comprises the answers to two fundamental questions:

1. where to play, and
2. how to win in the pursuit of delivering more variety at a lower cost.

Establishing the intent of the platform must come first, with the technical characteristics of any platform being amongst the last decisions to be made. Despite this, there may be a temptation for PPPs entering the world of product platforms to jump straight into the technical design – reflecting the current project-based mindset.

The platform strategy helps serve as a deliberate approach to maximising market leverage from common repeatable elements and processes, and minimising unplanned new product introduction. Undertaking new product introduction cycles instead of refining a product platform leads to increasing complexity in the product line. In a product platform, this effort can instead be utilised in continuous improvement exercises, increasing productivity.

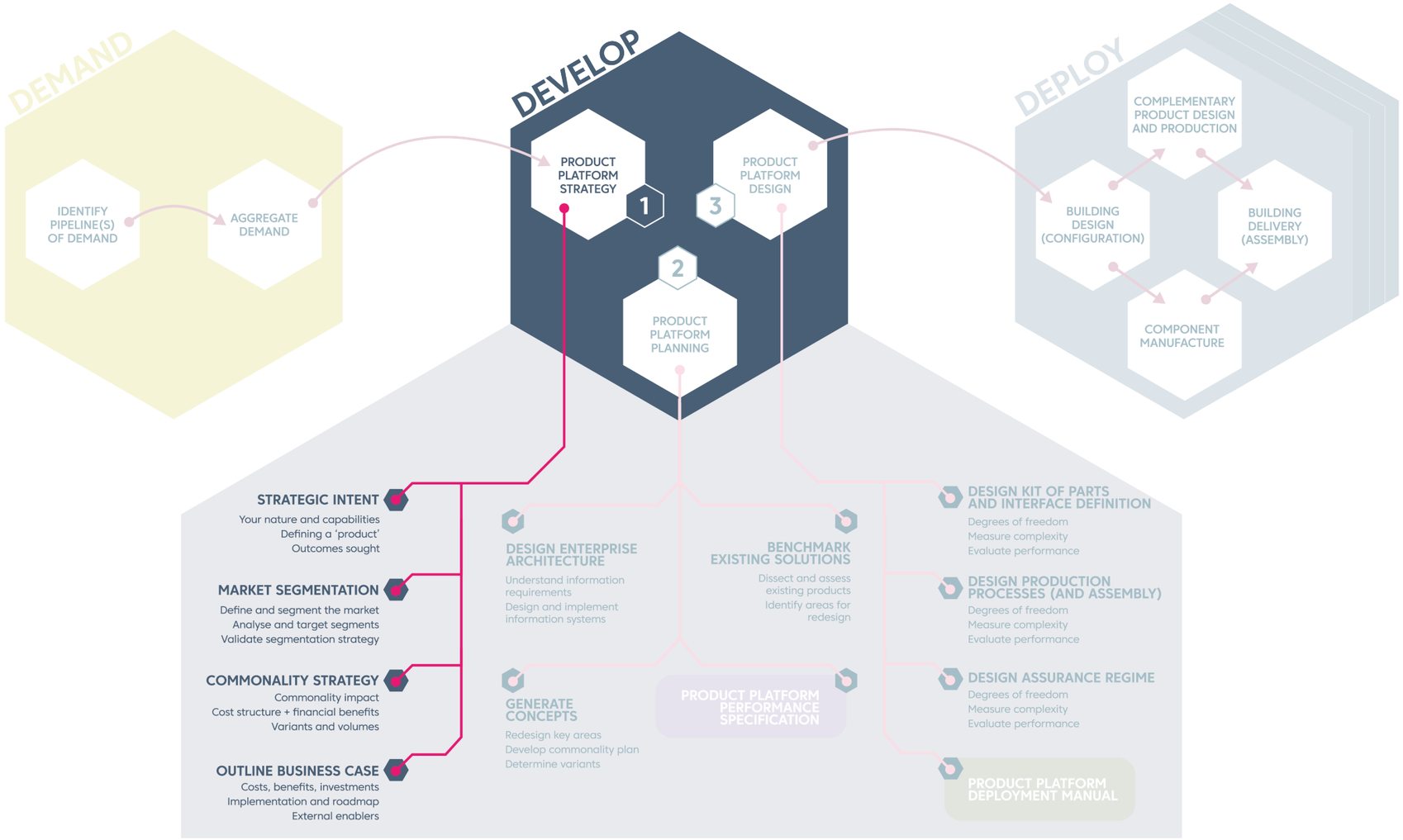


Fig. 3F: Outlines the core steps and activities underpinning the development of a product platform strategy

STRATEGIC INTENT

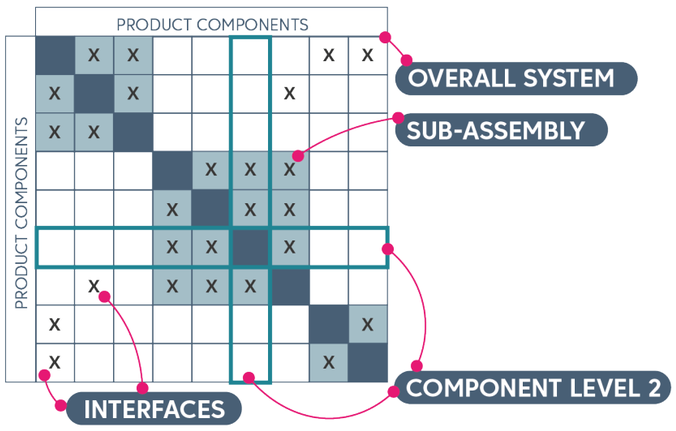
The first step of the product platform strategy is to define the overall strategic intent of the product platform. This is predicated on three main factors:

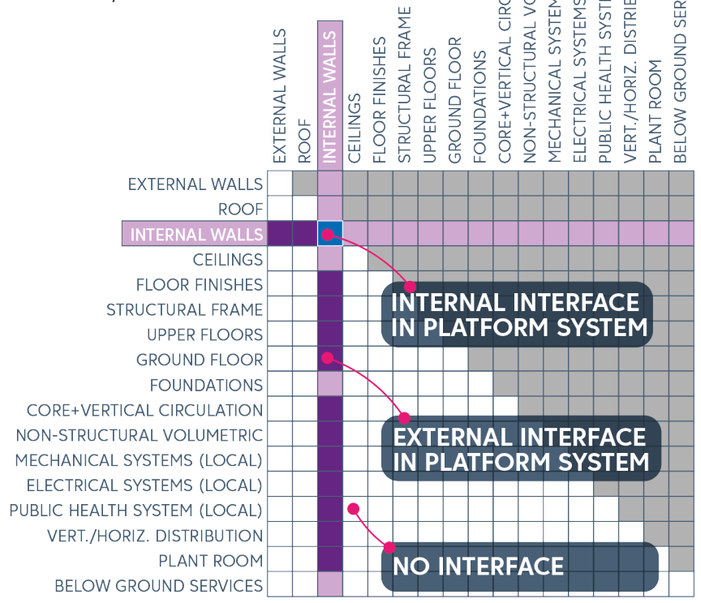
YOUR NATURE AND CAPABILITIES: The nature and capabilities of the organisation(s) developing the product platform - the PPP. Including what the PPP sells, to whom, with what cost structures, and aspirations for the future.

DEFINING A PRODUCT: The definition of 'product' as it relates to the output of the proposed product platform and resulting interfaces - both technical and non-technical - with other products, systems, people, and services.

OUTCOMES SOUGHT: The outcomes the PPP seeks to gain from developing a product platform - whether economic, such as enhanced revenue through an increase ability to deploy new products) or cost saving (through efficiencies, economies of scale), environmental or social benefits need to be clear defined as a fundamental to the Product Platform Strategy.

A clear vision of the intended outcome is critical to to establishing a business case for investment, resource and co-ordination required. This strategic direction will equally aid and inform decisions regarding commonality, sharing and distinctiveness during the development of the product platform and thus needs to be clearly defined.





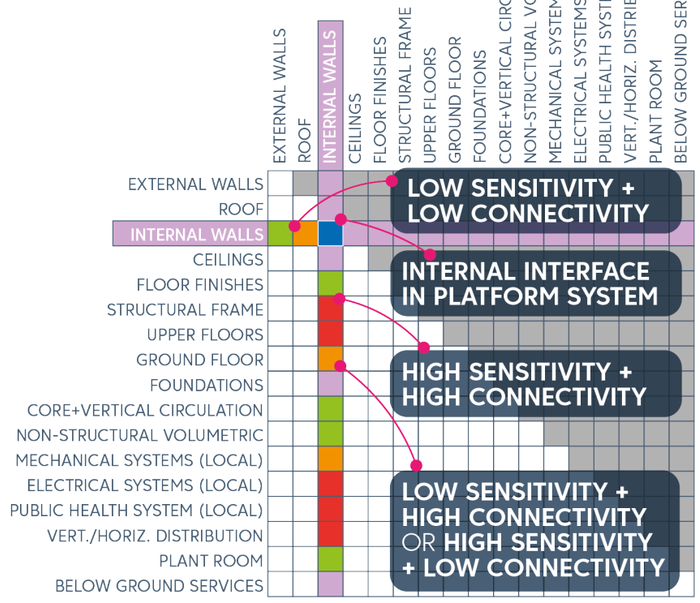


Fig. 3G: Interfaces with other systems - using a design structure matrix (DSM) can be valuable in defining product (purple) and high-level interfaces (other shading) for a product. With all the component types of a building listed along each axis, you can concentrate on one component at a time and consider its interfaces with all other components. Components that are part of the product will need to be linked by an internal interface, while other interfaces will be external. Having identified which components should form part of the product (left, with the chosen product in purple) you can then rate the importance of each other interface (right) according to sensitivity and connectivity

DEFINING A 'PRODUCT'

Defining a 'product' in the context of construction is inherently more difficult than for other sectors but is critical to successful execution of the PP development process.

For the purpose of this guidance, 'the product' is defined from the PPP's perspective; being the final configuration of core repeatable and complementary components which are deployed into a project. The collection of product variants is the product family.

Depending on the type of product platform being developed, 'the product' may manifest as anything from complete buildings to the constituent parts of an MEP system. Each deployment of the product platform into a project represents a product variant and together these variants make up a product family.

When defining and determining a product, it is important to understand the nature and source of any waste associated with the product, so that this can be minimised during the rest of the development process.

In determining the above, the PPP can now determine the role, or roles, it wishes to play – and by extension, the role of other parties - in the development and deployment of the product platform.

We have identified several different models to illustrate the role of a given product platform in the market. While these models do not describe all possible scenarios, they do clearly articulate how strategic intent influences a PPP's approach to the rest of the development process.

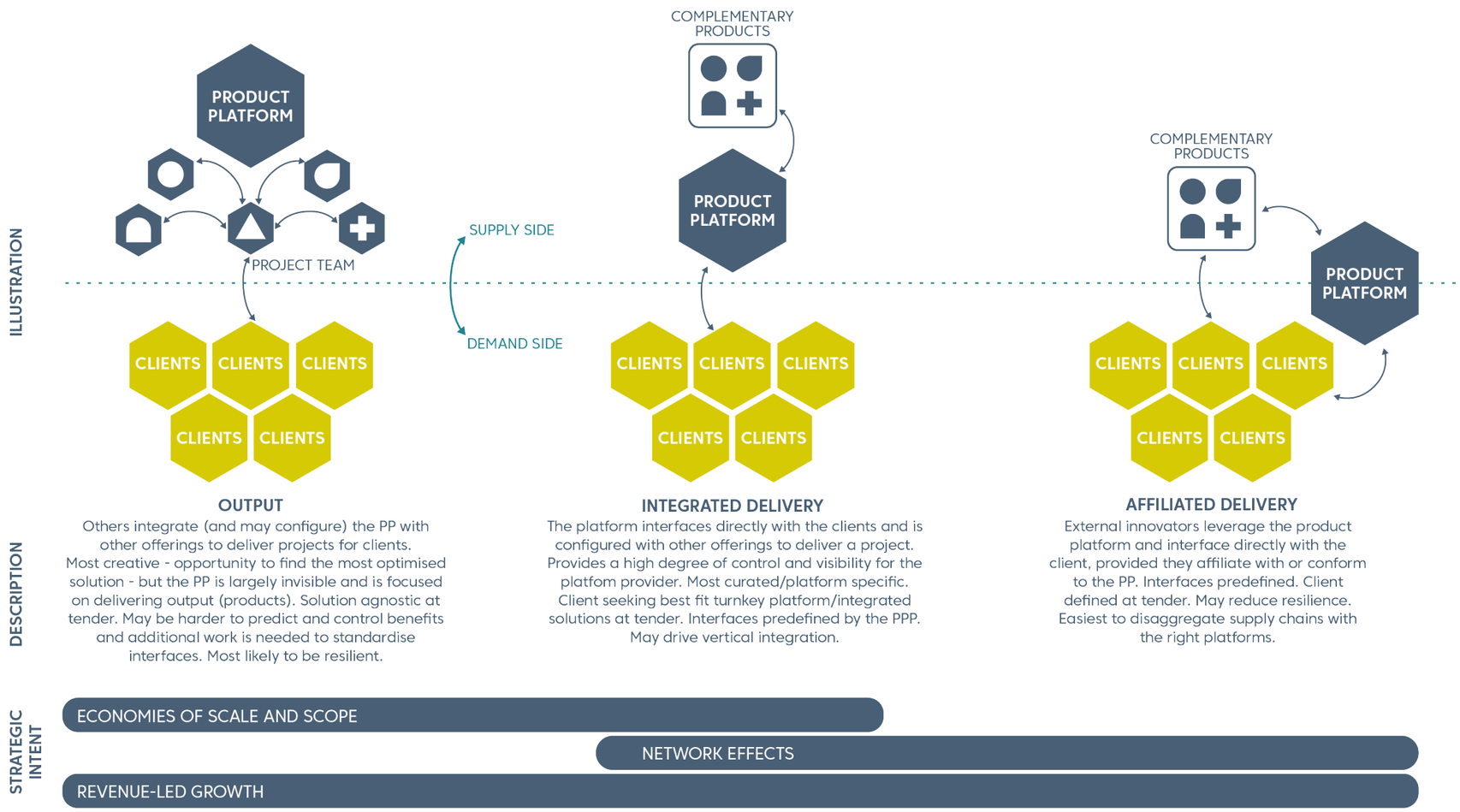


Fig. 3H: Three possible models for a product platform in construction. In the output model, the platform is invisible to the client. In the integrated delivery model, the client interfaces with the platform but not its complementary products, receiving a turnkey solution. In the affiliated delivery model, the client is committed to the platform and its complementary products and engages partners who can work with it.

MARKET SEGMENTATION

Market segmentation is used to group market opportunities (construction projects) according to common requirements or attributes, with the aim of identifying the right segment(s) to focus on. How a PPP defines the market will be directly influenced by the strategic intent. Where the PPP includes a client, the total addressable market may be restricted to their own pipeline.

The market segmentation exercise can take many forms, with different industries taking different approaches according to the nature of the product and the structure of the market(s) they serve.
The following approach is suggested as a robust starting point for the construction industry but it is recognised that the PPP is likely to have an existing understanding of the most effective way to look at the market.

DEFINE AND SEGMENT THE MARKET

First, the PPP must establish who wants what, how much of it, and when and how they intend to buy it. The total addressable market represents all those projects that will be delivered within a given time frame, likely covering different clients, procurement routes and asset types, likely categorised by construction sub-sector (healthcare, education, commercial etc.). The PPP may wish to rank or rationalise these sub-sectors based on their current market presence or access. As described above, where the PPP is or includes the client, the scope of this exercise is likely to be significantly reduced.

With the total addressable market identified, the PPP must now look to group – or segment - project opportunities in a manner relevant to the nature of the PP. Typically, this is done by identifying technical factors which drive cost, and these will vary depending on the type of product platform being developed. For example, the cost of a building structure is typically driven by the volume of the internal spaces. However, the cost of MEP systems is more likely to be driven by the conditioning needs of those spaces. It is also likely that the same grouping exercise will be undertaken from other perspectives, such as procurement route or production approach (e.g. offsite construction maturity). As such, PPPs will need to consider multiple driving factors before reaching an appropriate grouping.

ANALYSE AND TARGET SEGMENTS

Before deciding which groups or segments to target, the PPP should determine the role the proposed PP is likely to play in driving total project cost in each segment within the visible timeframe. This can be done by considering the percentage of total project cost represented by the PP and the extent to which it may influence the remaining cost. This exercise identifies where the PP is likely to be most effective and highlights the different approaches that may need to be taken in different parts of the market. For example, market segments where the PP is a dominant element of total cost and has a significant impact on the cost of other elements are likely to be more attractive than those where it represents a small proportion of total project cost and is highly affected by other elements. For clients looking to develop PPs without an initial technical position/ bias, this exercise can be undertaken in a solution agnostic manner to inform their approach.

With any 'unattractive' market segments removed from the analysis, the remaining segments should now be analysed with regard to aspects such as market size, growth and stability, performance trends, competition and market share.

Drawing on the completed analysis, the PPP can now select its target market segments. Depending on the PPP's strategic intent, they may approach this in one of two ways: a top-down approach will drive them to consider the type of projects, assets, or procurements they wish to target, leading to consideration of what needs to be done to address them. Alternatively, a bottom-up approach will drive them to consider the segments they already serve, with consideration for additional segments with similar characteristics or requirements.

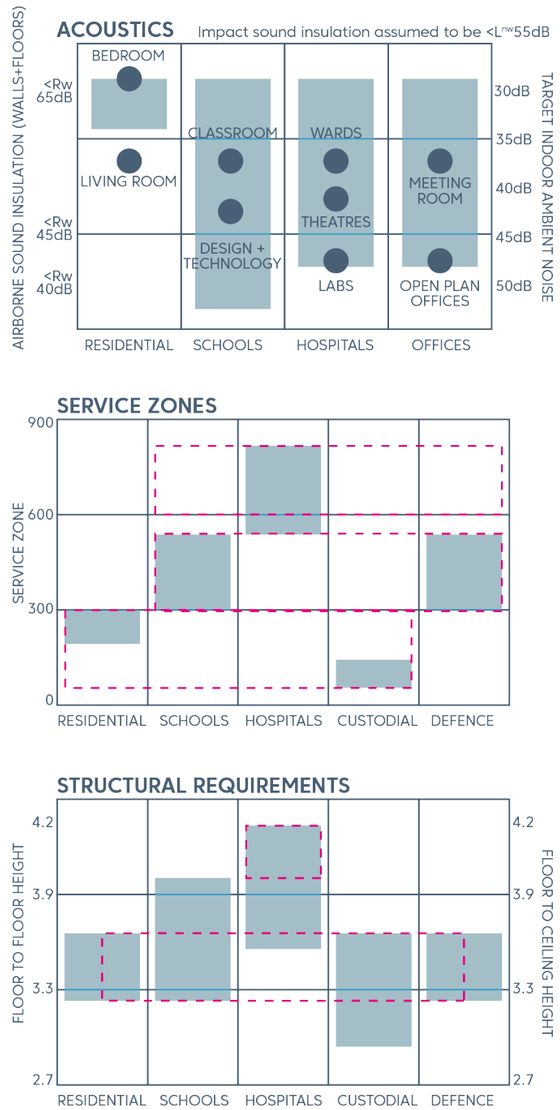


Fig. 31: A selection of segmentation grids, covering different lenses for different PP types

VALIDATE SEGMENTATION STRATEGY

If required, further detailed analysis of each target segment may now be undertaken – likely through more direct engagement with the market - to understand the financial opportunity associated, current market players and typical technical solutions. This exercise should also provide an initial understanding of the value drivers, pain points, regulations and standards etc. for each target segment which will provide a starting point for later planning activities.

With detailed analysis complete, the market segmentation strategy should be reviewed and refined, checking for alignment with the strategic intent. This may take multiple iterations, but time spent here is likely to be critical to the development of a successful and sustainable product platform.

Here are some considerations to guide and supplement this process:

1. Consider how many segments can realistically be served in terms of the capability and capacity of the PPP – noting the role(s) it intends to play (according to strategic intent)

2. Take early note of the trade-off between commonality and variability. Tackling too many segments may result in unacceptable levels of commonality for clients or, conversely, insufficient commonality to make a product platform viable.

3. Consider the stability of market segments. PPs are long-term investments and the dominant drivers for a given segment may change over the lifetime of the product platform (e.g. how affected might a segment be by the drive to net zero?). Where identified, such changes are likely to affect a PPP's investment profile and associated technology roadmap. Where not accounted for, product platforms could become obsolete earlier than intended.

4. Consider any strategic relationships that may need to be formed in order to execute the segmentation strategy.

5. While this section describes the process of selecting multiple market segments, it is entirely possible that a given segment presents a sufficiently large and stable opportunity to warrant it being the sole focus of a PP. Similarly, the segment or segments targeted may reflect the capabilities or capacity of the PPP.

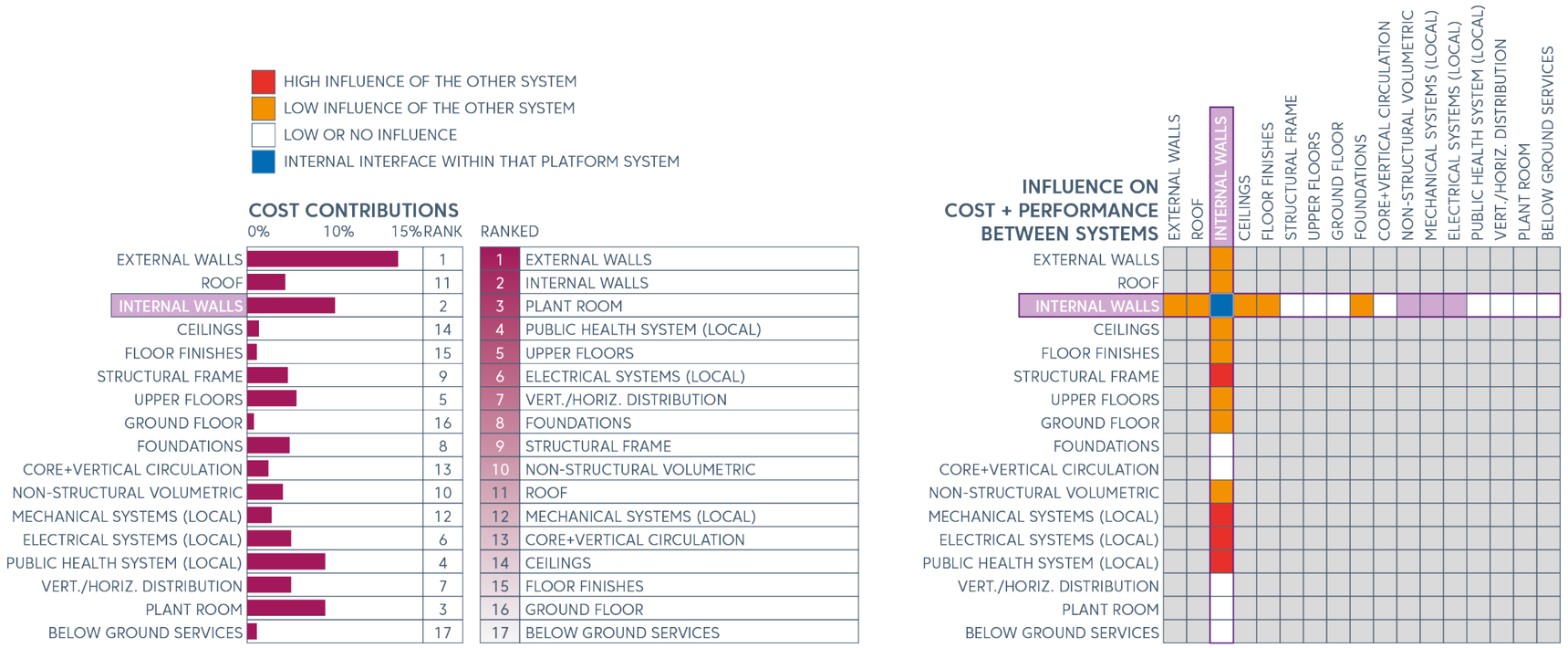


Fig. 3J: The different segments are ranked by their contribution to project cost (left) and the influence that they can have on other elements and systems (right).

COMMONALITY STRATEGY

With target market segments selected, and with an understanding of the timeframes associated with the projects within these segments, the PPP must now develop an outline commonality strategy (what to make common and why). This exercise provides an initial view of the extent to which components, processes and relationships can be common – or shared – across target segments and where variants may need to be developed. Doing so also provides an early indication of the level of investment (capital, time, effort, capability) required by the PPP which may lead to a revision of the target segments.

The commonality strategy seeks to establish how commonality helps the PPP to realise its strategic intent through the correct blend of:

- **revenue benefits,** such as the ability to deploy new technologies, find and serve niche requirements, and reducing the time to market;
- **cost reduction,** such as sharing development and testing costs, economies of scale, amortising fixed costs and reducing inventory;
- **risk reduction,** such as increasing quality, reduced susceptibility to changing requirements, and improved management of spare parts for production.

Blind attempts to share as much as possible without regard for expected benefits and costs are likely to incur costs which far outweigh the benefits.

Fig. 3K: The aims, benefits and risks from commonality[1]

1 Cameron, B.G., Crawley, E.F. (2014). Crafting Platform Strategy Based on Anticipated Benefits and Costs. In: Simpson, T., Jiao, J., Siddique, Z., Hölttä-Otto, K. (eds) Advances in Product Family and Product Platform Design. Springer, New York, NY. https://doi.org/10.1007/978-1-4614-7937-6_2

A key distinction between a platform approach and a traditional approach is the ability to mass customise products. This means leveraging higher volume manufacturing methods to create products which are tailored to meet the needs of individual projects.

In doing so, a platform can develop different products more effectively, growing market share and increasing the flexibility and responsiveness of offerings. The key is to balance commonality with variability in a way which outwardly creates differentiation, but inwardly enables economies of scale. We therefore need to understand what needs to vary (or be distinctive), and what can be common.

Variable attributes are those which customers deem to be important in distinguishing between products and projects. Customers expect differences between these attributes in different spaces and different buildings. An example might be the layout of a building, the dimensions of a space, or the fixtures and finishes for different walls in a classroom.

Common attributes are those which customers do not necessarily interact with or notice. An example might be the form of construction of a floor or the make-up of a façade.

Variable and common attributes are related – for example the dimensions of a space are related to the form of construction to some degree – but they are fundamentally different ways of describing aspects of a building.

The relationship inevitably involves a trade-off. Variability increases appeal to customers, but may also increase cost. The commonality strategy is central to successfully achieving this trade-off. A strong commonality strategy needs to address four key areas:

- **Technically feasible** – it must be technically possible to deliver variable attributes within and across target segments with common repeatable elements;
- **Financially beneficial** – there must be a financial benefit, consistent with the strategic intent, to developing and deploying these common repeatable elements within and across the target segments;
- **Acceptable to the market** – that the common repeatable elements offer a benefit to the target segments, that any trade-offs needed (for example through more constrained solutions) are acceptable, and that variability is realised where required; and
- **Organisationally possible** – the PPP must be able to deliver the PP, including having the right capability (skills, know-how), capacity, culture and governance (for example establishing clear decision rights, co-investment and deployment across projects or profit and loss groups) since platforms require multiple functions to work together.

The following process is recommended for developing the commonality strategy.

TEST THE MARKET

Building on the high-level exercise completed as part of strategic intent, the PPP should now develop a more detailed understanding of their product's 'touchpoints'. Exploration of these touchpoints will be used to understand the extent to which commonality is desirable and achievable within and across their target market segments. Typical touchpoints may include:

- **Touchpoints with other products:** which other building products and systems might the PP interact with and how? *Note: This activity builds on the high-level view of interfaces defined as part of strategic intent and helps understand technical feasibility.*
- **Touchpoints with other delivery processes:** which construction, procurement, assembly or disassembly processes might the PP interact with? Where might there be opportunities for continuous improvement or better use of supply chain capacity? Which skillsets are needed in delivery? With whom does the PPP exchange information during delivery, in what way and for what purposes? *Note: this activity helps understand technical feasibility and financial benefit.*
- **Touchpoints with asset users:** who will be interacting with the PP through all lifecycle phases, from the capital delivery phase through to operations, maintenance and eventual decommissioning? What are the information requirements from the 'product'? *Note: this activity helps understand acceptability in the market.*

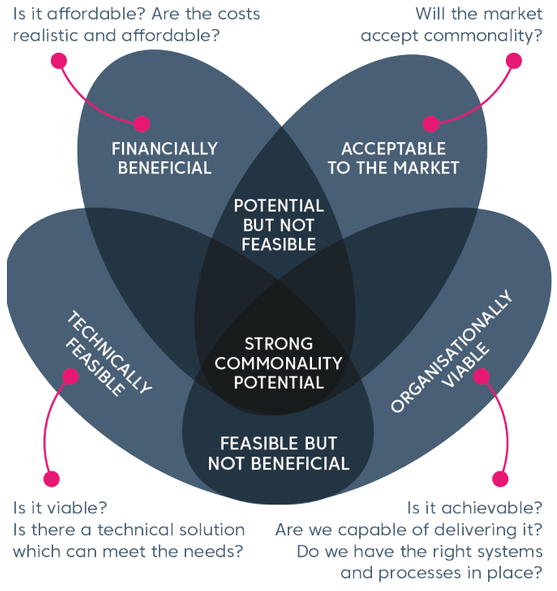


Fig. 3L: Key factors to a successful commonality strategy

Within each target segment, the PP should consult relevant stakeholders (i.e. representing the identified touchpoints) to understand where there is a perceived benefit to commonality and where there is a perceived need for customisation in the context of project opportunities within that segment. In some cases, it may be necessary to consider the benefits or barriers to commonality across segments (for example where clients operate in multiple segments) though this is likely to be less common in a construction context. PPPs should elicit as detailed a response as possible, potentially employing techniques such as the '5 whys' to help distinguish between actual and perceived needs or barriers.

Barriers and benefits may be assessed within a project (for example across a range of buildings on one site), across projects (for example across different buildings in the same estate) and across segments (for example across different estates).

QUANTIFY CAUSE-EFFECT RELATIONSHIPS

With an understanding of touchpoints, the PPP can use tools such as cause-effect (or fishbone) diagrams to establish possible effects of variability in products (i.e. a lack of commonality) on increased levels of activities and use of different resources in development and production (both on and off site).

An example of this can be found in Fig. 3M which shows a cause-effect diagram for delivering three unique frame systems across three projects, showing elements in the product and process that can be assessed for cost of variety.

This helps to identify key areas of focus for commonality to help realise targeted benefits. It is an iterative exercise, and you may need to return to test the market repeatedly each time changes are made.

By tracking the effects of variability along activities and resources, we can identify a possible commonality strategy to address each cause. The cost structures identified at the outset may be useful here in breaking down and assigning costs for each cause. This provides the PPP with relevant cost information as to which part of the product might yield the greatest financial benefits through having a PP.

The focus of this activity may be on the PP itself and/or on other systems downstream – for example: a product of high value but low influence on other systems should focus on the PP, whereas a less valuable but more influential product should focus on other systems.

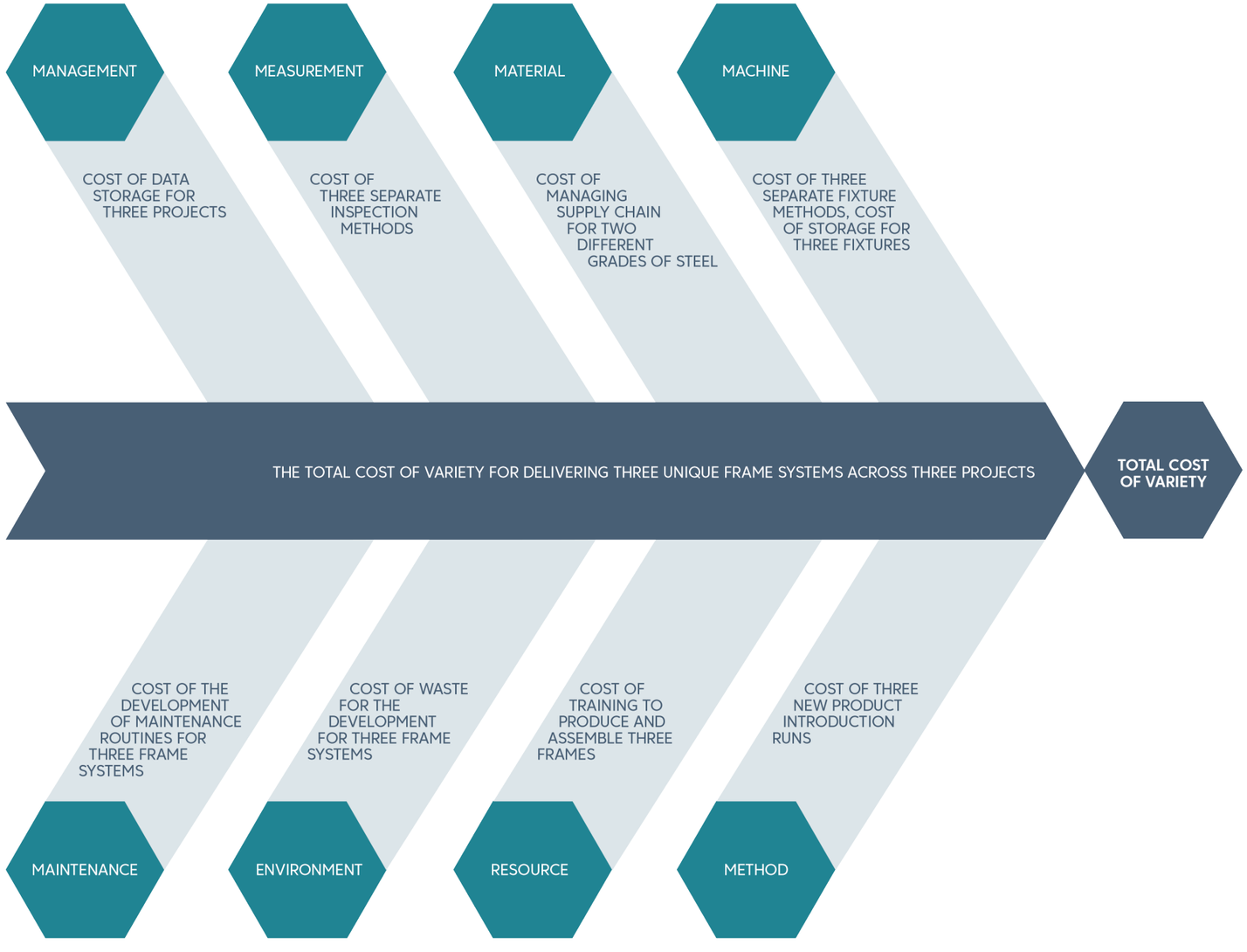


Fig. 3M: Cause-effect relationships for a PPP delivering three unique frame systems across three projects

ASSESS TECHNICAL FEASIBILITY AND PLATFORM EXTENT

Having understood the variability desired by the market, and the relevant cost data, the PPP can perform a high-level assessment of the technical feasibility of developing common elements (components, production processes, operating procedures) to support the realisation of financial benefits. This can make use of the activity-based costing performed above.

The following approaches may be useful in addressing cause-effect relationships:

- **Modularity** – focusing on the functionality which is assigned to sub-assemblies (collections of components) with variety achieved by combining different sub-assemblies and variants of sub-assemblies. This allows variety to be isolated and multiple functions can be assigned to one sub-assembly. Interface design therefore becomes critical.
- **Commonality** – focusing on reducing the number of unique elements without sacrificing variety. This can enable the same production processes to be used to make different products.
- **Standardisation** – focusing on commercially available, off the shelf components (in most cases cheaper than custom components).
- **Consolidation** – focusing on integrating several parts or materials into one that requires fewer distinct activities or less equipment to process.
- **Delayed differentiation** – focusing on maintaining commonality of components processes for as long as possible, with variability introduced as late as possible.
- **Reusability** – focusing on deliberately reusing existing elements (components, processes and so on) for new products.

This technical assessment can be used to define the intended 'reach' of a given PP or to inform the need for multiple platforms to be developed. Where requirements across target segments differ too much, it may not be practicable to develop a single product family which meets the requirements whilst being financially beneficial. In this case the PPP may need to create multiple product families (and hence multiple PPs). Conversely, it may prove possible to target further segments with one family.

DEVELOP OUTLINE COMMONALITY STRATEGY

Reviewing progress to date, the PPP:

- **has grouped 'attractive' and accessible project opportunities** according to common requirements;
- **understands the acceptable level of commonality** and expected level of customisation within those groups;
- **has identified key opportunities** for financial benefits;
- **has assessed the technical feasibility** of these opportunities;
- **has identified any refinements** required to the segmentation strategy.

By reviewing this information, the PPP can develop an outline commonality strategy. This will need to cover technical, organisational, market and financial aspects, as summarised below.

COMMONALITY STRATEGY

Technical: the common components and production processes that will make up the PP and the range of performance and requirements which will be met for target segments. Note that while increased commonality makes production processes more efficient, pushing commonality too far may lead to inefficiencies in deployment.

Organisational: the capabilities, resources and relationships that need to be secured by the PPP if they choose to proceed with PP development and inform the outline business case.

Market: the target segments and extent to which the common elements can be shared across them. This will be picked up in more detail during the development of the Product Platform Roadmap. Take note of areas where commonality of elements may unacceptably limit customer choice or performance of the asset in use.

Financial: The targeted financial benefits and how commonality will deliver these. The PPP should be checking the financial benefits against the most dominant areas of their current cost structure (as identified as part of the strategic intent).

DEVELOP OUTLINE BUSINESS CASE

Based on the outline commonality strategy, the PPP can now generate a preliminary business case for the proposed PP. This may serve as the basis for a formal stage gate review for the development project, determining whether there is a sufficiently strong case for continued investment. The PPP should now have gathered sufficient intelligence to set out:

- **The revenues expected from the selected target segments** – representing the likely share of project opportunities across the target segment that are expected to be served by the PP and the timeframes for these opportunities.
- **The costs and benefits (financial and non-financial)** associated with sharing components, processes and relationships together with an understanding of alternatives (not involving a platform), and the associated financial targets for the PP.

How the approach delivers on the strategic intent.

- **The level and type of investment required** to develop the PP(s) and supporting capabilities needed to serve those segments, and the approximate timeframe over which that investment will be needed.
- **Key metrics and measures of success**, including compliance with Rules and adherence to Principles.

The business case should also set out how the PPP will go about implementing the strategy, including key milestones and accountability, key risks (including dependencies) and appropriate mitigation, and key success criteria.

PRODUCT PLATFORM ROADMAP

The PPP now needs to define its planning horizon: how far into the future is it planning for (relative to the longevity of the repeatable elements) and which opportunities fall into this horizon? This enables it to focus on part of the pipeline of demand and account for known changes in regulation or requirements (such as targets progressively driving towards net zero) and to identify the order in which different product families will be developed.

The output of this activity is a Product Platform Roadmap. This is a detailed breakdown of activities to inform planning and investment decisions, that sets out the order in which the PPP needs to develop product families and constituent parts.

EXTERNAL ENABLERS

The business case needs to clearly identify any key conditions or enablers which need to be in place for the PP as planned to be viable, with the roadmap highlighting any phasing and dependencies. Key considerations for this are shown below.

KEY CONSIDERATIONS

Technical: key dependencies and requirements for other key systems, particularly those which dictate requirements for the PP.

Financial: procurement conditions; warranties and liabilities and insurances; tolerable ranges in material, labour and capital prices as applicable.

Market: predictability of demand (in both volume and nature)

Organisational: capability and capacity of the PPP's supply chain, which may be affected by the PPP's position in the supply chain and the role which the PP is intended to play (output, integrated or affiliated). Cooperation needed with other PPs during development and/or deployment, including where working with other systems is needed to function as a whole building.

PRODUCT PLATFORM PLANNING

PREREQUISITES

Before proceeding to product platform planning, PPPs should first reflect on the completed product platform strategy; ensuring they have a clear and collective understanding of the following:

- The target market segments the PP will address.
- How and when those target segments will be addressed.
- A bounded definition of 'product' in the context of the PP.
- How the 'product' will need to change to meet requirements across target segments* (product 'variants').
- The external interfaces and dependencies that need to be managed to allow successful deployment of the PP into projects.
- The need to develop additional platforms to serve all the product variants within and across targets market segments.
- A clear understanding of where commonality in the product is beneficial and where variability is required or expected.
- Financial targets for the platform and an outline strategy for how commonality will enable realisation of these.
- A defined lifetime for the product platform and ordered priorities for any key developments required over this period.

If any of the above is unsatisfactory or unclear, the proposed platform may need to be rethought or an alternative strategy pursued.

**Accepting that specific project requirements may not be available at this point*

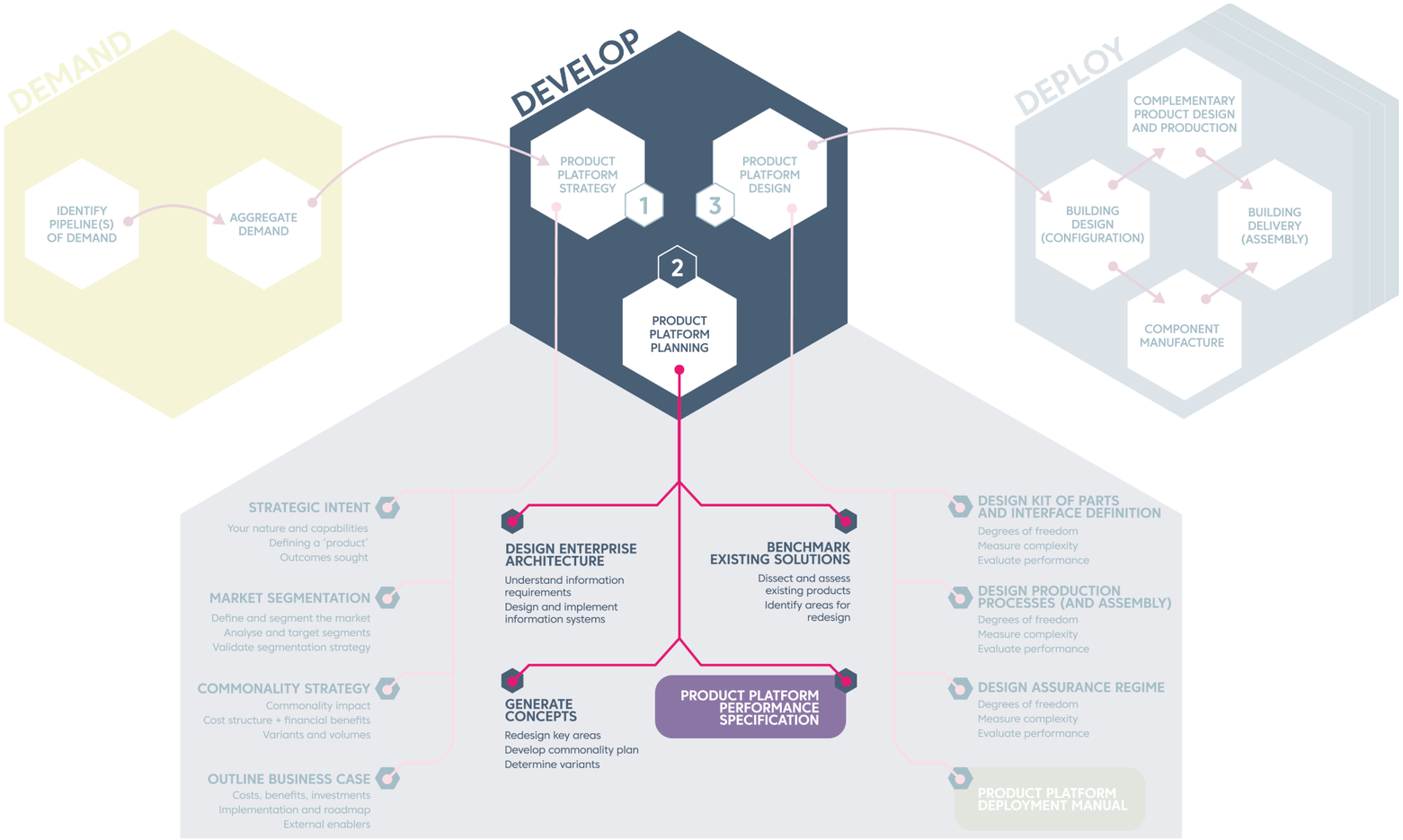


Fig. 3N: Product Platform Planning

Having determined that a platform is the right approach and established its strategic place in the market, the planning stage consists of clearly defining the problem to be addressed by the platform, and drawing up a plan for how it will operate.

The steps involved in this process include setting the information requirements and information management systems that the platform will need (enterprise architecture); benchmarking existing products to assess where the designed platform could improve performance; and generating concepts for design in these areas.

The output of this planning activity is the product platform performance specification, which will inform the next stage, product platform design.

DESIGN ENTERPRISE ARCHITECTURE

Successful implementation of the product platform strategy will be dependent on having the correct information management processes and systems in place, and on keeping these up to date during development and deployment.

Enterprise architecture represents the hardware and software systems needed to collect, process, store and distribute information needed over the life of the product platform. This may include (but is not limited to) the following:

- Business Intelligence
- Customer Relationship Management (CRM)
- Enterprise Resource Management (ERP)
- Product Data Management (PDM)
- Requirements Management
- Supply Chain Management (SCM)
- Manufacturing Execution Systems (MES)
- Specific or specialist software

The specific nature and arrangement of these systems will be dependent on the needs and nature of the PPP (e.g. single organisation or consortium) and needs to be periodically reviewed to ensure continued relevance.

The following steps are suggested as a good starting point for those new to defining and developing enterprise architectures:

1. Understand your organisational, operational information requirements.
2. Understand your existing systems, workflows, and integrations.
3. Understand information requirements of typical projects and associated clients.
4. Set product and production information requirements:
   - External (what clients, projects and others in the supply chain need from me and what feedback I want to gather);
   - Internal (what I need to organise myself and undertake my activities);
   - Different systems from different vendors, and which integrations are needed to fulfil which workflows across enterprise, management, supervisory, control and field/machine levels as appropriate.
5. Design information systems to suit.
6. Implement according to roadmap.

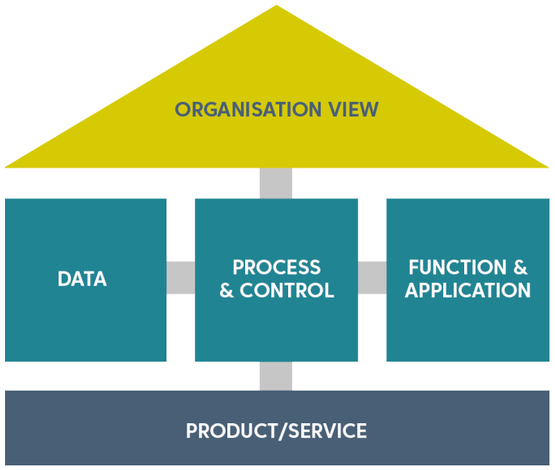


Fig. 30: Information systems

From: https://www.ariscommunity.com/university/tutorial

> *'The purpose of Enterprise Architecture is to optimise across the enterprise the often fragmented legacy to processes, into an integrated environment, that is responsive to change and supportive of the delivery of the business strategy*
>
> *The Open Group Architecture Framework - TOGAF*

BENCHMARK EXISTING SOLUTIONS

The focus of benchmarking is to inform where the PPP's efforts are best focused to realise benefits through the PP. The exercise requires PPPs to identify, assess and compare 'representative solutions' - concentrating on the initial product family(ies) identified in the Product Platform Roadmap (developed as part of the product platform strategy process).

Representative solutions should ideally be those the PPP already supplies into these segments along with those of competitors. However, the PPP may choose to use hypothetical or 'typical' solutions where such reference data is not available.

Fig. 3P outlines a suggested workflow for the benchmarking exercise with reference to existing tools and methods used in other sectors where appropriate. While not exhaustive, this should provide an understanding of the key steps and questions to be addressed.

	WHAT	WHY	REFERENCE POINT	HOW (SUPPORTING TOOLS)
1	**Dissect existing solutions**	To understand the system architectures of current solutions - that is, how their sub-assemblies and components are arranged and interact. Note: consider undertaking this exercise for processes and relationships as well as products.	With reference to past project deployments, what is the underlying system architecture for each reference solution?	Design Structure Matrices (DSM) can help to visualise system architecture (Fig.3Q) including sub-assemblies and constituent components, and how they relate to each other.
2	**Measure complexity**	To assess the inherent complexity of each of the reference solutions. Complexity fuels direct and indirect costs and complexity in architecture is likely to be mirrored in the organisational and project complexity associated with implementation. This will provide an initial indication of the most suitable system architectures to consider or work from for the PP.	How complex is the system architecture for each reference solution in terms of number and type of, and interfaces between, components?	Complexity can be measured using a complexity factor (CF) developed by Boothroyd and Dewhurst (*Source*) (Np x Nt x Ni)1/3 Where Np = number of parts; Nt = number of types of parts; Ni = the sum of the number of interfaces for each part.
3	**Understand needs and requirements**	To understand, for each identified system architecture, the functions the components perform and how these relate to customer requirements. To develop a normalised (relative) measure of performance and cost for the components of each reference solution.	With reference to past project deployments, how does the system architecture of each reference solution address functions and requirements (and how well)?	Quality Function Deployment (QFD) can be used to understand how components are linked to functions and how these functions are linked to customer attributes (Fig.3Q).
4	**Assess commonality**	To understand the level of commonality in the sub-assemblies and components of each reference solution across its family of products. Note: consider commonality in processes and relationships if possible.	Which components of the system architecture were common across project specific deployments of each reference solution?	Total Constant Commonality Index (TCCI) or Commonality Index allows comparison of commonality between different product families, allowing comparison between different solutions - both existing and proposed. Degree of Commonality Index (DCI) may also be used, but is less useful than comparisons between product families.
5	**Identify external drivers for variety**	To help understand what is likely to drive variation in each of the reference solutions over time and the associated cost implications for redesign and assurance associated with changing requirements. This will identify the level of flexibility that would need to be built into the components of each reference solution.	How might future changes in requirements impact upon the design of components of each reference solution?	Generational Variety Index (GVI), in conjunction with QFD, can be used to identify those components most likely to require redesign in the future (Fig.3R).
6	**Assess internal drivers for variety**	To assess, for each reference solution, how coupled its constituent components are with respect to changes in specification. This will help to highlight those components which can most appropriately be combined into subassemblies.	With reference to past project deployments for each reference solution, how connected are components in terms of specification changes?	The Coupling Index (CI) can help to quantify connectivity and help understand the level of coupling within a design – helping identify internal drivers for change. The use of matrices to visualise CI is recommended (Fig.3S).
7	**Identify elements for redesign**	To identify, for the system architecture of each reference solution, where component redesign offers most benefit. This will support the development of candidate system architectures for the PP and areas of focus for ongoing development.	With reference to past project deployments for each reference solution, which aspects of the system architecture could be improved.	Generate a graph for each reference solution plotting each component according to the cost of providing variety. Divide the chart into quadrants as per (Fig.3T)to determine areas of focus for each system architecture. The use of commonality indices, variety indices (including GVI), and coupling indices provides a basis for challenging and improving system architectures (and potential PP architectures). Plotting components onto a graph (Fig.3U) of normalised commonality vs variety illustrates those candidates most suitable to be redesigned. Coupling Index (CI) helps to identify where this redesign is likely to necessitate the redesign of other, coupled components and hence inform the focus of any redesign of the architecture of the system.

Fig. 3P: Suggested benchmarking workflow

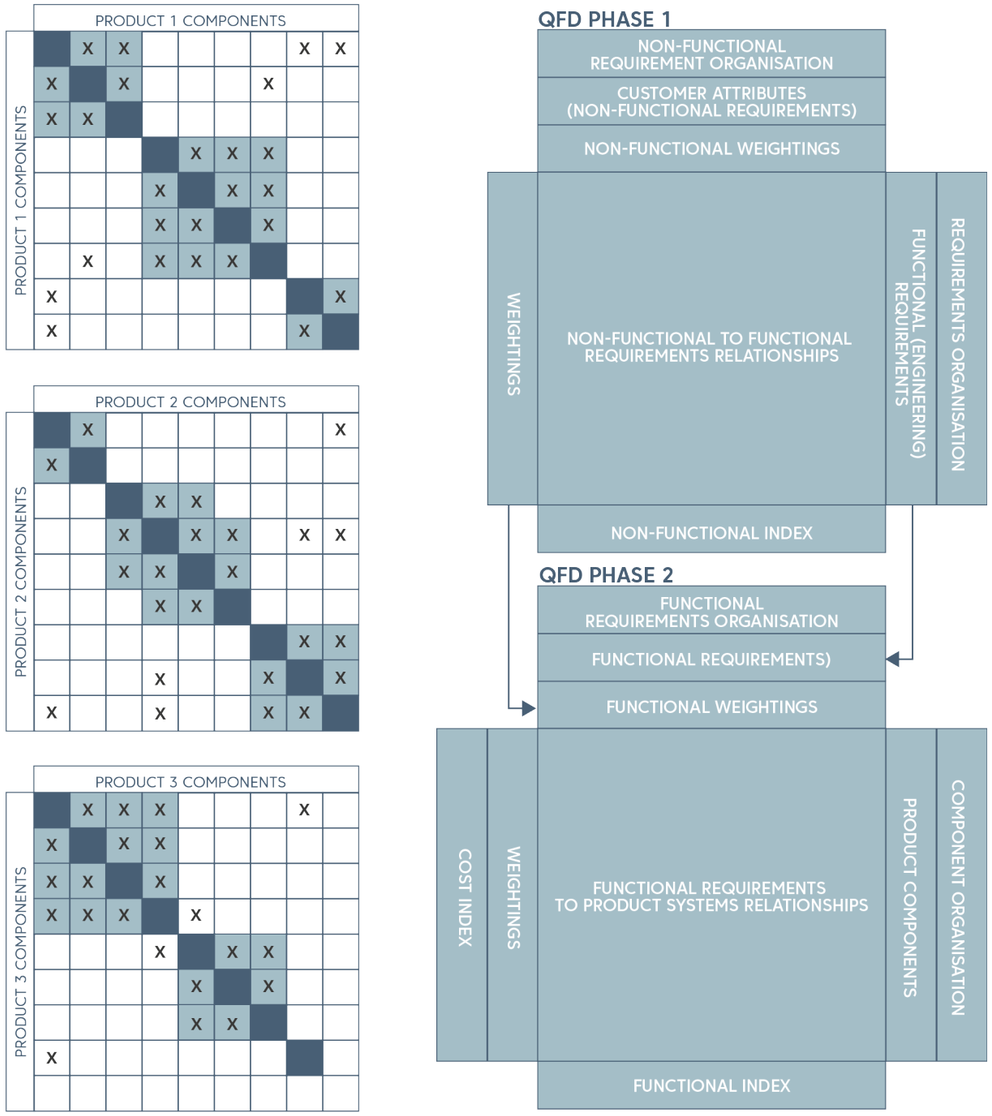


Fig. 3Q: Design Structure Matrices and QFD for Mapping of components to functions and non-functional requirements (Customer Attributes)

GVI: WHAT SHOULD BE COMMON OR NOT?

ENGINEERING REQUIREMENTS	COMPONENT							CHANGE LIKELIHOOD
	A	B	C	D	E	F	G	
REQUIREMENT 1	9			3		1		
REQUIREMENT 2		6	1		1		1	
REQUIREMENT 3	1							
REQUIREMENT 4		3					1	
REQUIREMENT 5	6	1	1		3	1		
REQUIREMENT 6			6			6		
REQUIREMENT 7	9		3				1	
GVI	25	10	11	3	4	8	3	

COMMONALITY: WHAT IS COMMON (OR NOT)?

COMPONENT	ACROSS PROJECTS/APPLICATIONS				COMMONALITY SCORE	DSM: HOW COMPONENTS ARE CONNECTED (OR NOT)						
	# IN FAMILY	SAME DESIGN	SAME MATERIAL	SAME ASSEMBLY								
A	10	2	4	3	0.02		X	X				
B	8	4	4	2	0.06	X		X				X
C	4	4	4	2	0.49	X	X					
D	5	1	5	1	0.03					X	X	X
E	2	2	2	2	1.00				X		X	X
F	8	2	8	8	0.25				X	X		X
G	3	3	3	3	1.00		X		X	X	X	
TOTAL # COMPONENTS	40			PCI	24%	CI: QUANTIFIES CONNECTIONS AND MAPS DEPENDENCIES						

Fig. 3R: How commonality, variety and interfaces can be visualised

COMPONENTS RECEIVING INFORMATION	COMPONENTS SUPPLYING INFORMATION: COMPONENT 1		COMPONENT 2		COMPONENT 3		COMPONENT 4		COMPONENT 5		COUPLING INDEX RECEIVING (CI-R)
COMPONENT 1			DIMENSIONS	1		3		1		1	6
COMPONENT 2	OPENING LOCATIONS, PIPE POSITION, WIRING POSITION	15				3		3		5	26
COMPONENT 3		1		3				3		1	8
COMPONENT 4		9		3		1				3	16
COMPONENT 5		9		5		1		6			21
COUPLING INDEX SUPPLYING (CI-S)		34		12		8		13		10	

INFORMATION SUPPLIED BY COMPONENT 1 AND RECEIVED BY COMPONENT 2

RATING SENSITIVITY OF RECEIVING COMPONENT TO SMALL CHANGES IN SUPPLIED INFORMATION

OVERALL SCORE FOR EACH COMPONENT

HIGHER CI-S: CONSIDERED TO BE HARDER TO ISOLATE (CHANGES HERE WILL DRIVE CHANGE ELSEWHERE)

HIGHER CI-R: HIGH INTERNAL DRIVERS FOR CHANGE (CHANGE IN OTHER COMPONENTS WILL DRIVE SIGNIFICANT CHANGE HERE). LOW GVI AND LOW CI-R COMPONENTS SHOULD BE FULLY STANDARDISED

Fig. 3S: Hypothetical Coupling Index Matrix

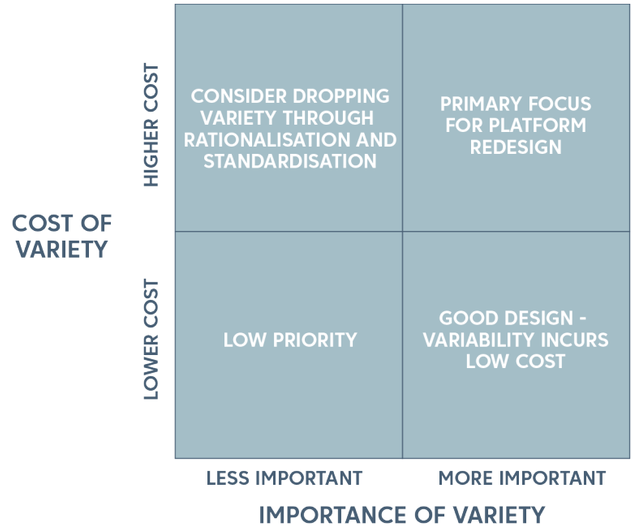


Fig. 3T: Identifying areas of focus using cost and importance of variety

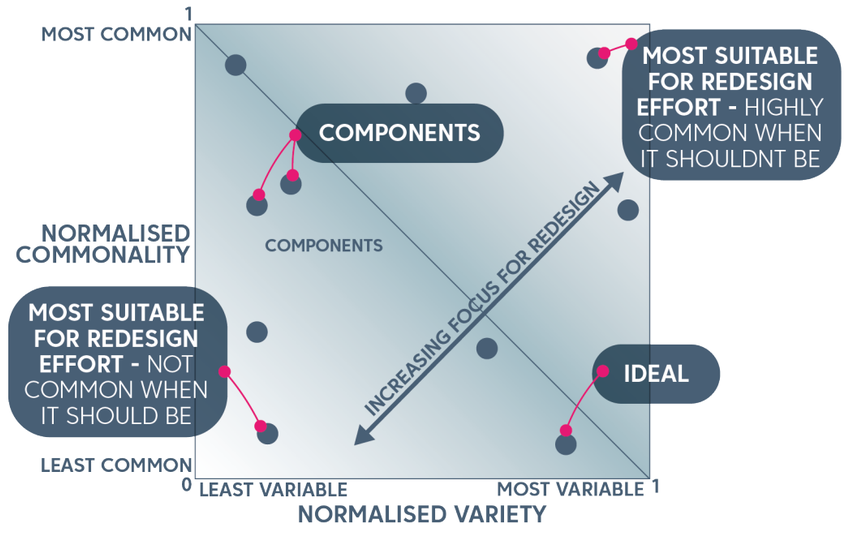


Fig. 3U: Identifying areas of focus using commonality and variety

GENERATE CONCEPT(S)

Based on benchmarking and areas needing redesign (or design), generate 'candidate' architectures as alternatives to existing architectures, which can be assessed using the same tools and processes set out in 'benchmarking' above to ensure against the same metrics for improvement. The benchmarking process highlights the areas where changes are likely to be most beneficial – for example by changing the functions which elements perform or the way they interface.

A useful place to start with this is reviewing the Design Structure Matrix to explore how to isolate key components which are likely to change frequently in the target segments by reducing interfaces and combining components into sub-assemblies. With new architectures, the benchmarking process can be repeated to identify whether performance has been improved or whether there are new areas requiring redesign.

To avoid getting stuck in too much detail at this stage, it can be beneficial to test changes to see if they are an architectural decision (and hence a focus at this stage) and deprioritise decisions which are not. Architectural decisions are those which have a significant impact on performance, trade-offs and ultimately cost, as well as affecting the ability to customise the design. Examples might include whether internal walls are load-bearing and contribute to stability of a volumetric frame, or whether services within a panelised wall system are integrated or not.

This can be done by asking two questions:

1. **Sensitivity:** does this decision strongly influence key metrics (such as performance, cost and risk)? GVI helps here.
2. **Connectivity:** would substantial rework be required to change this decision? Could we make this decision downstream without regards for other decisions? DSM and CI helps here.

Using the answers to these two questions, we can consider a 2x2 matrix (Fig. 3V), which allows us to prioritise. Sensitive and highly connected decisions are architectural decisions and should be prioritised. Those which are neither sensitive nor connected can be given the lowest priority at this stage.

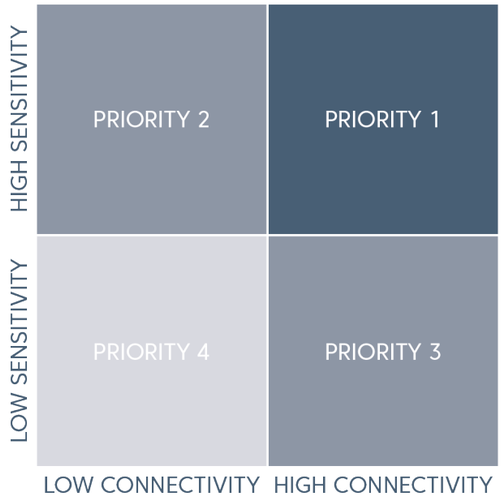


Fig. 3V: Mapping sensitivity and connectivity

DEVELOP COMMONALITY PLAN

Building on the outline commonality strategy developed as part of the PP strategy, the PPP can now develop a detailed commonality plan for the preferred concept(s). This plan sets out in more detail how the commonality strategy will be achieved and explicitly accounts for the approximate costs associated with development and production of each product. As with the strategy, this needs to consider four dimensions of technical, organisational, financial, and market acceptability.

Technical: Which elements are common, at which hierarchy levels and how many variants of those components will be needed to deliver the necessary variety? How many production steps can be common and how might they vary?

Hierarchy levels: features → components→ sub-assemblies→product

Organisational: Which elements are 'softer' and rely on the skills, knowledge and experience contained within the organisation? Determine where and how this may present additional costs or barriers to commonality.

Financial: Determine the investment needed to develop commonality and assess the financial benefit in greater detail (noting the emerging tension between DfA (designing for assembly: focusing on reducing part count and ease of assembly) and DfM (designing for manufacture: focusing on simplifying components and ease of production)) and the potential downstream costs and benefits of commonality, based on the interfaces with other systems and touchpoints identified above.

Market: Identify and map common elements and variants to product variants corresponding with particular segments (or projects where known). Determine acceptability to the market in terms of achieving necessary variety. Review and update roadmap and planning horizon as appropriate.

DETERMINE VARIANTS

Based on the commonality plan and the preferred architecture, update the mapping of requirements to the components. Identify variability in requirements (as per GVI assessments).

This represents the extent to which variations are meaningful to customers, and should include target values. This is driven primarily by what customers in the market value.

For repeatable elements to meet a range of performance targets, a range of those elements will be over-performing (i.e. will be exceeding performance targets). This is acceptable if the over-performance is more than compensated by consolidating the number of elements.

You will need to:

- **Define over-performance (physical, process, etc.) for sub-assemblies and associated processes, knowledge and people** – including considering the implications/burden of over-performance in these areas. Using the insight from the cause-effect relationships analysed as part of the commonality strategy may help here.
- **Estimate the costs and benefits of rationalising the number of component variants** (benefits = simplification and repetition; costs = over-performance and reduced choice). Consider how assurance regimes affect costs across a product family and the implications for the current approach – compare the cost of over-performance (e.g. cost difference between different assurance regimes) and the benefits (e.g. single approval across multiple segments).
- **Determine optimal number of variants, identifying where degrees of freedom can be given 'room to grow'** (i.e. by adding capacity, space or redundancy), enabling easier changes and enhancements in the future. In particular, consider where flexibility in the development and selection of interfaces between modules can be included, since it will likely add significant value and robustness to the platform. However, this is a balance as excessive flexibility will increase engineering and manufacturing costs.

DEVELOP PLATFORM PERFORMANCE SPECIFICATION

PRODUCT PLATFORM PERFORMANCE SPECIFICATION

Having defined the number of variants and their performance, this should be clearly documented in a platform performance specification.

Critical forms, functions and features become will become design drivers that will be utilised in the design section. Other factors are subordinated to these in a series of trade-offs.

Cost and performance targets for modules of the chosen product family architecture should also be clearly documented.

Roles, responsibilities and authorities should be set out, particularly relating to changing targets.

PRODUCT PLATFORM DESIGN

PREREQUISITES

Before proceeding to product platform design, PPPs should first reflect on the completed product platform plan, ensuring they have a clear and collective understanding of the following:

- The information management systems that will be required for the platform
- Performance benchmarks for previous and/or competitors' products
- Key areas of commonality and difference required to deliver the strategy
- The brief for design and production, including target performance levels and requirements

With strategy and planning completed, you can now proceed to the design stage. This consists not only of designing the product platform itself (including the kit of parts and interfaces) but also designing the production and assembly processes and the assurance regime required to deliver effectively. The main output from this stage will be a deployment manual for those using the platform in project delivery.

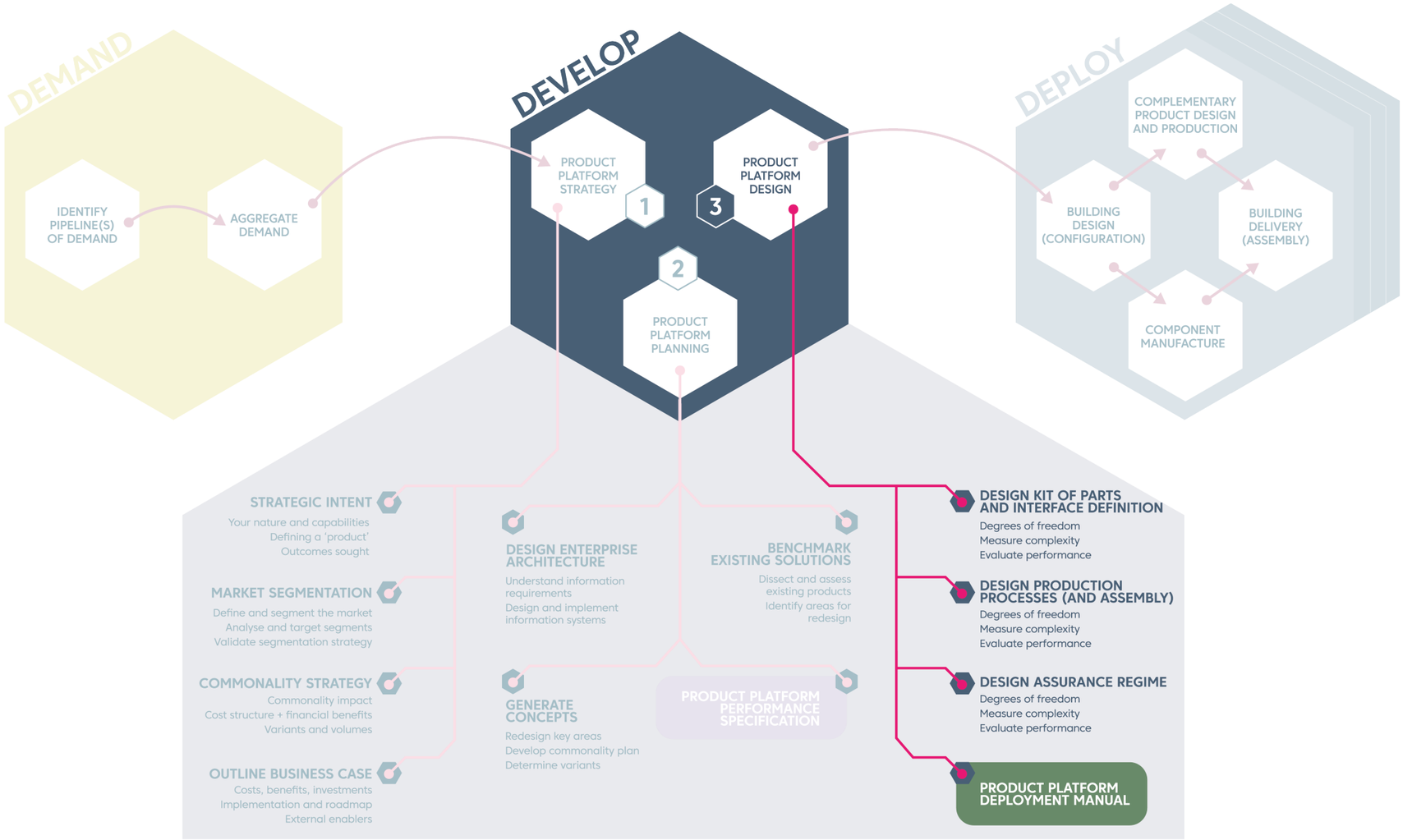


Fig. 3W: Product Platform Design

DESIGN KIT OF PARTS AND INTERFACE DEFINITION

In order to set interface definitions, the creation of initial assembly flow charts for offsite and onsite processes can be utilised to map the interfaces that need to be defined. Interfaces can then be defined functionally and physically for further development in the design process. Initial drawings/schematics can then be created to describe the product and its interfaces, complemented with a bill of materials (a list of items that create the product).

DEGREES OF FREEDOM

Degrees of freedom in this context describe modifications in the design that allow the possibility of upgrades or changes in the future, without a complete redesign.

In order to understand what degrees of freedom to build in, the Product Platform Roadmap should be studied to determine how the product should be changed over time to suit the market needs. Any potential degrees of freedom should be identified and assessed for design trade-offs using the product team's knowledge to compare short term gains vs long term gains. Degrees of freedom should then be incorporated into the design if benefits are verified.

MEASURE COMPLEXITY (ASSEMBLY)

The creation of assembly flow charts for offsite and onsite processes are required to assess the complexity of an assembly. Once this has been undertaken, measurement of the complexity can be undertaken using a method such as the Lucas method. Fig. 3X is an example of measuring the part count efficiency of an assembly.

EVALUATE PERFORMANCE AND COST

The evaluation of the performance and cost can be set up at this point for reviews throughout this process to understand the benefits of the improvements made. An evaluation could be undertaken using a verification model such as a cost modelling or computer aided design modelling with finite element analysis.

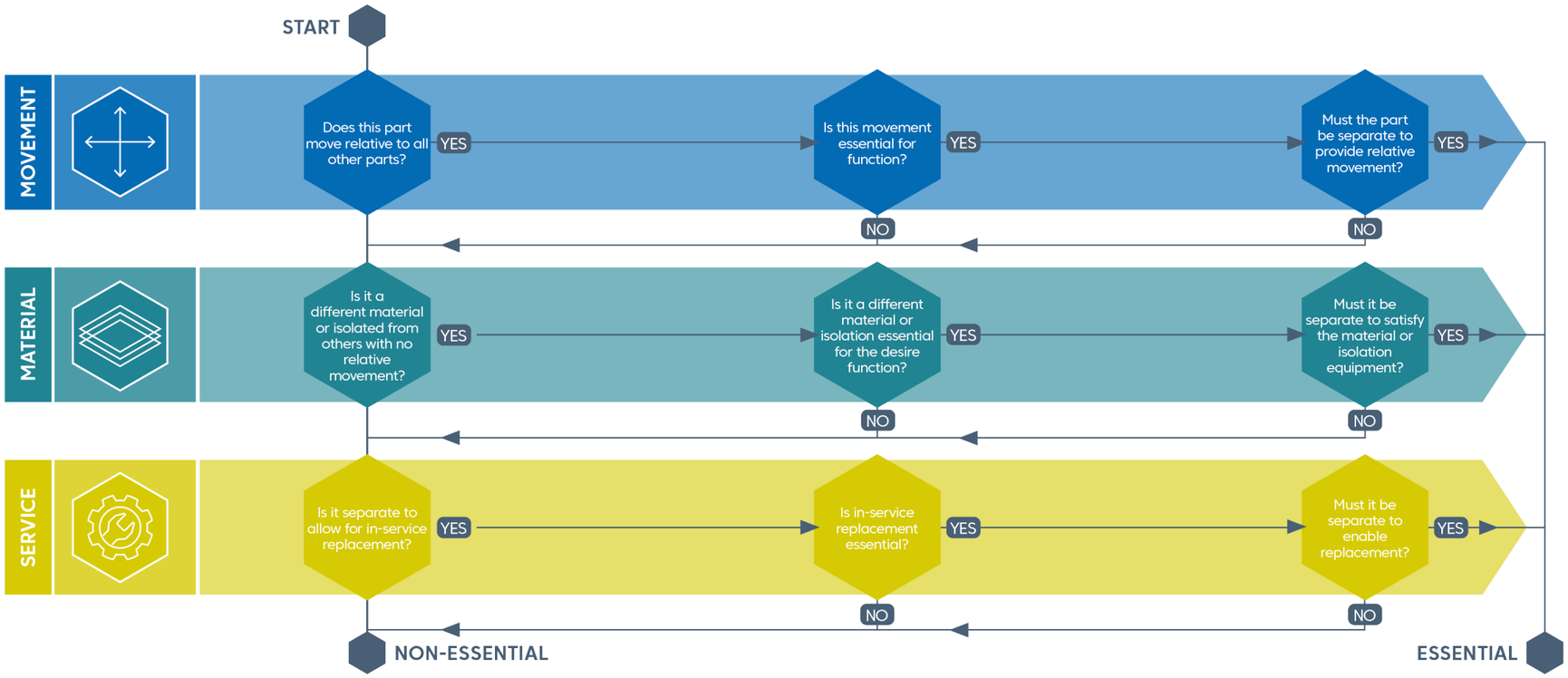


Fig. 3X: Example of measuring the part count efficiency of an assembly

Source: Swift, K. G. & Booker, J. D. (2003). Process selection: From design to manufacture (2nd ed.). Oxford, UK: Butterworth-Heinemann. From <https://www.odwebp.svc.ms/embed>

DESIGN PRODUCTION PROCESS (AND ASSEMBLY)

In order to design the production process, the bill of materials should be used to identify the products that will be made in-house and not outsourced. If products are being made in-house, the process flow chart, process instructions and other documentation should be completed to design the process.

BUILD IN DEGREES OF FREEDOM (PRODUCTION)

In order to understand what degrees of freedom to build in, the Product Platform Roadmap should be studied to determine how the product will change over time to suit the market needs. Any potential degrees of freedom should be identified and assessed for production cost using the production team's knowledge to compare short term gains vs long term gains. Degrees of freedom should then be incorporated into the design if benefits are verified.

MEASURE COMPLEXITY (PRODUCTION)

The creation of production flow charts for offsite and onsite processes are required to assess the complexity of the production processes. Once this has been undertaken, measurement of the complexity can be undertaken using a method such as the Lucas method. Fig. 3Y is an example of classifying the complexity of a product to determine the complexity of its process.

Further guidance on DfMA will soon be available from the Hub and this section will be updated accordingly. Once complete any modifications to simplify the production complexity can be captured and discussed with the relevant stakeholders.

EVALUATE PERFORMANCE AND COST

The evaluation process has been included on page 45, 'Evaluate Performance and Cost. This can be revisited to ensure performance and cost are on plan.

SHAPE		COMPLEXITY		DETAILS
CYLINDRICAL PART ENVELOPE (SOLID OF REVOLUTION)	SINGLE AXIS	A1	Basic rotational features only	Rotational symmetry, grooves, undercuts, steps, chamfers, tapers and holes along the primary axis or centre lines.
		A2	Regular/secondary repetitive features	Internal/external threads, knurling and simple contours through flats, splines, keyways on or around the primary axis or centre lines.
	SECONDARY AXIS	A3	Internal	Holes, threads, counter-bores and other internal features not on the primary axis.
		A4	Internal or external features	Projections, complex features, blind flats, splines, keyways on secondary axis.
	COMPLEX	A5	Irregular or complex forms	Complex contoured surfaces and/or series of features that are not represented in previous categories.
RECTANGULAR/ CUBIC PRISM PART ENVELOPE	SINGLE AXIS OR PLANE	B1	Basic Features Only	Through steps, chamfers and grooves, channels, slots and holes, threads on a single axis.
		B2	Regular/secondary repetitive features	Regular through features, T-slots and racks, plain gear sections etc. repetitive holes, threads, counter-bores on a single plane.
	MULTIPLE AXIS	B3	Orthogonal/straight line based features	Regular orthogonal or straight line based pockets, projections on one or more axis, angled holes, threads and counter-bores.
		B4	Simple curved features on a single plane	Curves in internal or external surfaces.
	COMPLEX	B5	Irregular and/or contoured forms	Complex 3D contoured surfaces, geometries that cannot be assigned to previous categories.
FLAT OR THIN-WALLED SECTION COMPONENTS	SINGLE AXIS	C1	Basic Features Only	Blanks, washers, simple bends, forms and through features on or parallel to primary axis.
	SECONDARY OR REPETITIVE FEATURES	C2	Uniform section or wall thickness	Plain cogs and gears, multiple or continuous bends and forms.
		C3	Non-Uniform section or wall thickness	Section changes not made up of multiple bends or forms, steps, tapers and blind features.
	REGULAR FORMS	C4	Cup, Cone and box type parts	Components may involve changes in section thickness.
	COMPLEX	C5	Non-Uniform and/or contoured parts	Complex or irregular features or series of features which are not represented in previous categories.

Fig. 3Y: Example of classifying the complexity of a product to determine the complexity of its process

DESIGN ASSURANCE REGIME

In order to assure the product conforms to the design specification, an assurance regime should be set up to check the product. Using the process flow chart from Fig. 3X, an output from each step should be determined and a verification method should be selected. This could be a measurement check or a visual inspection and should be recorded using formal documentation.

BUILD IN DEGREES OF FREEDOM (ASSURANCE)

In order to understand what degrees of freedom to build in, the Product Platform Roadmap should be studied to determine whether assurance testing should verify at a performance standard that ensures the product can be used on future projects with increased performance requirements. The long-term gains of this should be assessed from a cost perspective against the short-term gains.

DEVELOP PRODUCT PLATFORM SPECIFICATION

The information that has been generated in the design of the product should be captured in a specification document, this will include:

- Assembly flow charts
- Production flow charts and instructions
- Interface specification
- Drawings/schematics
- Bill of materials
- Efficiency of assembly measurement
- Efficiency of production measurement
- Assurance regime for production

DEVELOP DEPLOYMENT MANUAL

The Deployment Manual sets out the information that PPPs need to provide to the project design teams to enable PP deployment.

A directory of information will be created for PPPs to create a Deployment Manual. This will be used by project teams, so PPs can be used on their projects. The steps shown in Fig. 3Z have been mapped to the RIBA DfMA workstages.

OUTPUTS TO PROJECT DOMAIN ('DEPLOY')

Having completed the steps above, the product platform provider is now able to provide the following to those operating in the project domain:

- core repeatable elements that have been designed to meet the majority of client requirements in one or more defined market segments;
- a variety of peripheral components that are available to be configured for different applications, that interact with the core assets via stable defined interfaces;
- specification information for the products above, showing that they meet defined quality standards;
- a deployment manual for assembling, using and configuring all components of the platform;
- assurance that the products on the platform will be able to be adapted to meet evolving needs in future (as evidenced by the Product Platform Roadmap).

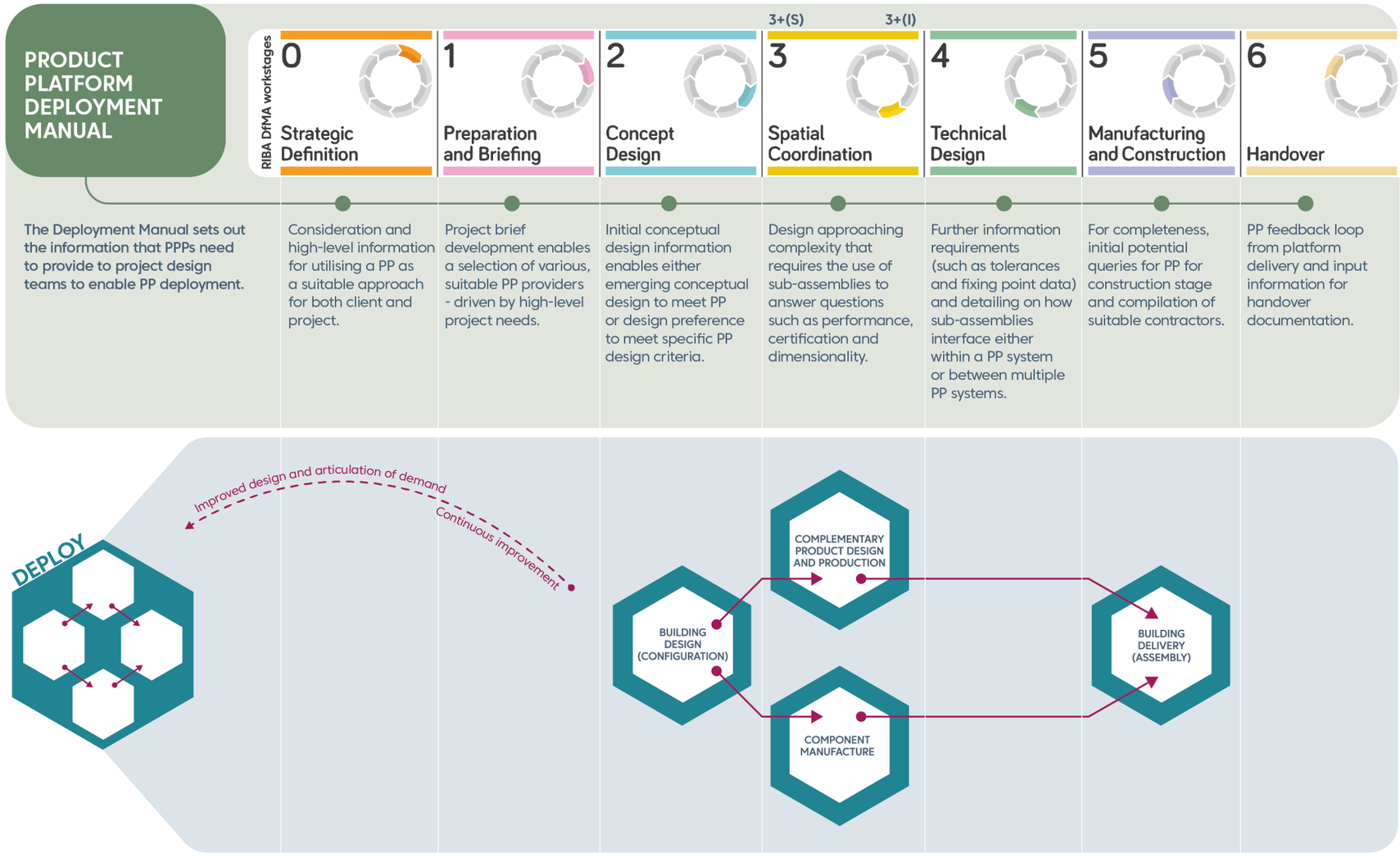


Fig. 3Z: Deployment manual development aligned to RIBA DfMA workstages

4. GOVERNANCE

4.1. Governance principles

INTRODUCTION TO RULEBOOK GOVERNANCE

The Construction Innovation Hub programme will be concluding in September 2022; however, it is critical that measures are put in place to ensure the Rulebook remains a live asset. Governance arrangements will be put in place to establish a framework for accountability. This Beta edition of the Rulebook provides a baseline and guidance on direction, but it must continue to evolve based on objective feedback and learning from application to remain relevant and viable, and to support accelerated adoption of product platforms in construction.

KEY PRINCIPLES AND EXPECTATIONS

It is expected that key principles of **Open**, **Collaborative** and **Continuously Improving** will be upheld.

The interaction between these principles points to the need for mechanisms and forums for sharing of ideas, information and learning to accelerate learning and evolution.

OPEN

The Rulebook is intended to provide a common and open basis for the exploration and development of product platforms, lowering barriers to entry and improving accessibility.

COLLABORATIVE

For product platforms to succeed, all parties involved in research, supply and demand will need to continue to collaborate on standards whilst maintaining competition on delivery.

CONTINUOUSLY IMPROVING

The Rulebook in this Beta format is not a finished, static artifact. It must continue to evolve through feedback and learning from practical applications, requiring a managed mechanism for a continuing cycle of learning, development and improvement that also supports progressive data-driven harmonisation.

DEFINING KEY ROLES

We anticipate that three key roles will be required for the governance of the Rulebook. These will be tested during the consultation that we will be holding on this Beta version.

1. OWNERS: setting the direction, strategy and rules of engagement. This is expected to be a dual responsibility between government and industry, with government acting in the capacity of policy driver and providing the aggregated pipeline, whilst industry ensures compliant implementation and continuous improvement.

2. CUSTODIANS: impartial and independent, the custodians ensure that response mechanisms are established, feedback is gathered, analysed and implementation is mapped into future Rulebook versions. This may be a body acting as interim owners whilst the Rulebook is being developed and established.

3. USERS: to test application and feedback. These will include:

- **Clients:** verify their ability to comply with a potential platform mandate and to develop aggregated demand
- **Product platform providers (PPPs):** develop product platforms in accordance with the Rules.
- **Design teams:** understand how deployment ability of PPs affects the utilisation of them into projects and programmes.
- **Manufacturers/suppliers:** recognise and facilitate their interfacing with PPs.

It would be valuable to identify '**champions**' who could represent each of these user groups and advocate for and embed the application and development of the Rulebook.

Fig. 4A: Venn diagram demonstrating key principles and their interaction

5. RECOMMENDATIONS

5.1. Recommendations and next steps

The purpose of this Rulebook is to **educate**, **enable** and **empower** by establishing rules and parameters that, through voluntary consensus, support consistent development and deployment of product platforms that deliver better economic, social and environmental outcomes.

Our recommendations and next steps are intended to reinforce this ambition, encouraging industry to develop platforms that make use of the Rules, Principles and guidance that we have set out in the Rulebook; enabling government, client organisations, and standards bodies to play a positive role in this transition; and supplying further information and detail which will empower all parties to move forward with confidence.

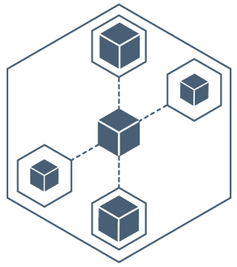
We include both recommendations for others to take forward, and next steps that the Hub intends to take.

The Hub welcomes feedback on the Rulebook. If you have any feedback please *click here to contact us.*

	WHAT	HOW	WHO
EDUCATE	**Continued development of the Rulebook**	Stakeholder consultation on the content of this Rulebook, to aid and accelerate the development and release of a completed version.	The Hub & Industry Partners
		Provide feedback on the Rulebook.	Industry, inc. Representative Bodies (e.g CLC, RIBA, ICE, CIOB, etc.)
		To expand the Rulebook to be explicit in the methodology for aggregating demand (over and above 'Defining the Need report').	The Hub & Industry Partners
		To develop the Product Platform Deployment Manual.	The Hub & Industry Partners
	Case Studies	Expansion of industry case studies that demonstrate the benefit of platforms.	The Hub & Industry Partners
	Training	Develop training materials that communicate the key principles of the Rulebook and its real-world application.	TBC
ENABLE	**Embed Rules and Principles**	Cabinet Office and Infrastructure Projects Authority to reference the Rulebook in working groups, supporting documentation and guidance published in response to the Construction Playbook and TIP Roadmap.	Government
	Establish structured information for products, production and organisations	Align and link the Rulebook and the Code for Construction Product Information (to drive higher standards in the presentation of construction product information and assurance).	Hub/CCPI
		To develop recommendations for industry, including indicators (leading and lagging), that support and enable the adoption of product platforms.	The Hub
		Work with NRM, Uniclass et al to develop a system hierarchy to inform a universal classification of building elements.	PPPs, manufacturers
		Develop a classification system for interfaces.	PPPs, manufacturers
	Common Standards	Review the extent of 'common specifications and standards' across government departments and the potential for alignment and harmonisation, publishing guidance (Specification Maturity Roadmap) and resources in support.	The Hub / Government
	Develop Product Platform Maturity Assessment	Create a Product Platform Maturity Assessment, aligned to the Rulebook, aiding the measurment of product platform maturity and informing forward steps in regards to: 1. Demand: Clients and PPP's ability to assess demand 2. Develop: The development of product platforms, by PPPs 3. Deploy: The application of PP's at a project or programmatic level	The Hub
EMPOWER	**Harmonisation of Demand and Requirements**	Client organisations to apply principles of demand aggregation and 'Specification Maturity Roadmap' to deliver against Construction Playbook.	Client organisations (inc. government departments)
	PP Maturity Assessment	Identification of leading product platform expertise, within industry, competent to apply Product Platform Maturity Assessment	The Hub
		Application of the Product Platform Maturity Assessment to assess the maturity of existing or developing product platforms.	PPPs
	Rulebook Governance	Define future governance model of the Rulebook (including feedback mechanisms for continuous improvement and development)	The Hub

6. APPENDICES

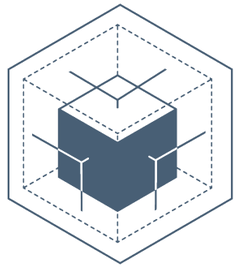
This section contains a selection of leading organisations that are developing Product Platforms that have exemplar characteristics which link to the documentation in the Rulebook. The characteristics described here have a page number reference to guidance information within the Rulebook. The Products also demonstrate 'what good looks like' for adherence to selected Rules. These are shown as icons on each individual case study.



1. DEPLOYABLE

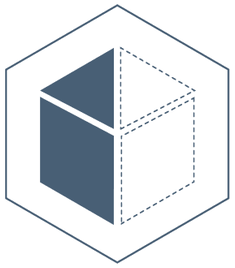
2. CONFIGURABLE

3. COMMON REPEATABLE ELEMENTS

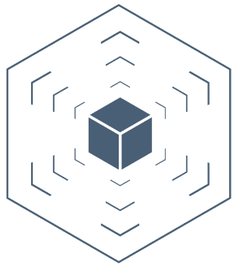


4. INTERFACES

5. QUALITY



6. STRUCTURED INFORMATION



7. OPEN

CASE STUDY: SEISMIC II

The Seismic II consortium comprises of Industry partners Blacc Ltd, Algeco (formerly Elliott UK), McAvoy Group, Tata Steel UK and academic partners Manufacturing Technology Centre, National Composite Centre and SPECIFIC Swansea University. In 2017, Seismic I developed a revolutionary universal corner connector, which enhanced horizontal and vertical interconnectivity of structural modular systems.

Seismic II builds upon this work and componentises and standardises the floor, ceiling, roof, internal wall and building envelope systems that integrate simply with the Seismic frame. The frame is scalable according to requirements using module spans of 8m and 10m and currently has two fully tested component specifications: Option 1 and Option 2. Both options can be configurable for MMC Category 1 - Pre-manufactured 3D primary structural systems or MMC Category 2 - Pre-manufactured 2D primary structural systems, depending on client requirements. The universal corner connector means that these modular buildings can be reconfigured and relocated depending on the changing need for flexibility, and it is even possible to restructure a building. By having this incorporated into the design, it enhances the scope of sustainability and extension of service life for these modules.

Seismic Option 1 and Option 2 Sub-Assembly configurations have been tested extensively for structural, fire, vibration and acoustic performance and both configurations are fully pre-assured and independently verified.

The Seismic II Product Platform Construction System was launched in March 2022 and is suitable for a range of different sectors, including schools, hospitals, offices and apartments, subject to sector specific component specifications. Clients or suppliers can develop and add their own specification of components beyond Option 1 and 2 to suit their requirements and meet with changing regulations. The platform is market ready and currently accessible to anyone via Blacc, McAvoy or Algeco with the intention that it will be freely marketed subject to volume demand. The platform has been independently assessed by the academic partners to achieve 70% less carbon, 70% faster and 47% better value than traditional construction.

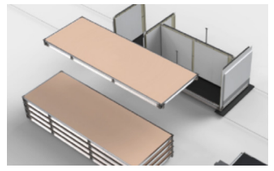
EXEMPLAR CHARACTERISTICS:

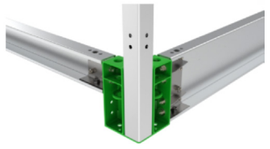
Reconfigurability: modules have a long service life as they can be reconfigured using the universal connector

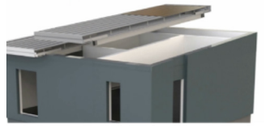
Modularity: Can be deployed as 2D or 3D Pre-manufactured primary structural systems

Offsite manufacture: High % Pre-manufactured Value (PMV). Delivery and assembly of the configurable components is predictable and reliable, and minimal construction processes are required on site

Defined interface.







6.2 CASE STUDY | Platform II

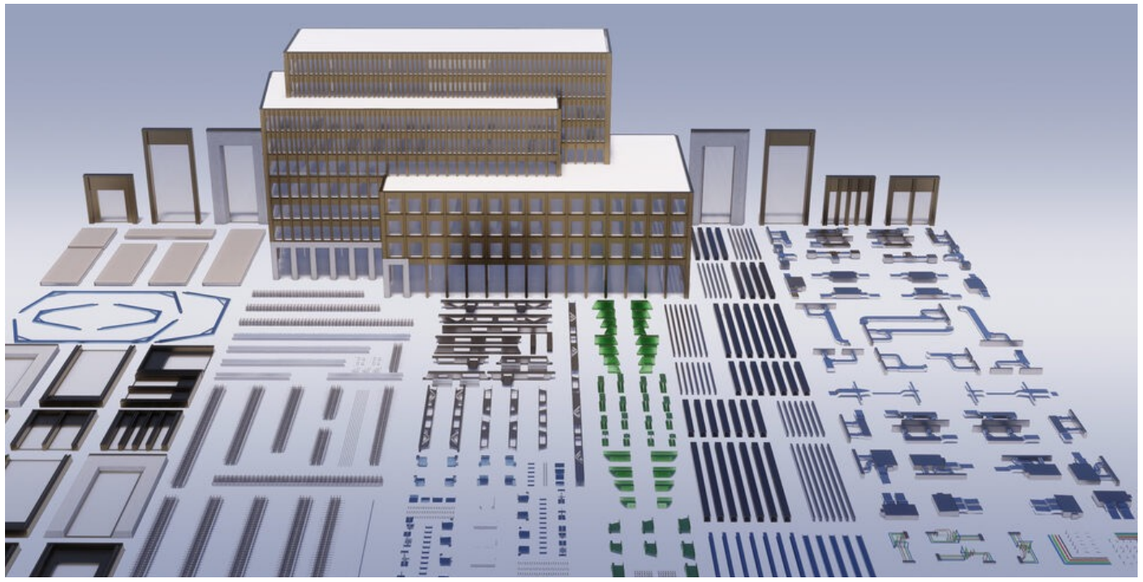
CASE STUDY: PLATFORM II

Platform II is a versatile midspan (~8m), low carbon structural system, developed by Bryden Wood for the Ministry of Justice (MOJ) as part of the Prison Estate Transformation Programme.

It was designed to be used on multiple building types, and versions of the platform have been adapted for sectors including healthcare, education and residential.

There is a structured approach to the use of information which allows a high degree of automation throughout the process of design, procurement, manufacture, and assembly. A digital library of the components (e.g. columns, beams, concrete slabs, and temporary works for structures up to 24 storeys) contains product information data such as maximum spans and tolerances, as well as method statements for manufacture and installation.

Design and configuration of a building can take place on using an app, such the open-source PRiSM app for residential schemes. This allows a BIM model to be generated in minutes, facilitating simulation and analysis of the building's performance against a range of metrics: for example, energy balance, and accessibility. Key components are robotically cut and welded direct from the digital files, allowing the production of components with sub-millimetre accuracy. This process is the first to receive BSI and UKCA accreditation for robotic welding of structural components. Automation is also used on site during assembly to reduce operative numbers and increase productivity.



EXEMPLAR CHARACTERISTICS:

Design for Manufacture and Assembly: process engineering is adopted to design and verify repeatable processes for the manufacture of kits of parts

Design information systems: digital/BIM library workflows embed standardised performance requirements into a reduced set of spatial blocks that work with platform systems

Deployment configurator: configurator apps have been designed to enable the configuration of the platform for deployment

6.3 CASE STUDY | GenZero

CASE STUDY: GENZERO

GenZero is a partnership between the Department for Education (DfE), Innovate UK and several private sector construction innovators to deliver an ultra-low carbon building and quality standard for schools.

The platform has been designed to facilitate construction, landscaping and building operation choices which help mitigate climate change and reduce environmental impact over a school's whole lifespan. It does this by using renewable resources (timber and glulam) for manufactured components, by specifying energy efficiency (e.g. insulation, cross-ventilation), and by the use of sustainable energy (heat pumps, solar PV).

Performance standards, across multiple building types, are built into the platform's open source standards along with a CQP (Critical Quality Point) process which any future additions to the platform would be expected to meet.

Interfaces are designed to reduce material waste and maximise flexibility, while variable design elements which are unique to an individual school (e.g. finishes, external cladding, loose or fixed furniture) would not affect the building's low-carbon credentials.

The standards built into the GenZero platform support the DfE's adoption of the S21 output specification introduced in the contractor's framework for schools in November 2021, which made it compulsory for all new school buildings in England to be net-zero carbon in operation.

EXEMPLAR CHARACTERISTICS:

Benchmarking and standardisation: school and classroom sizes are banded by range, allowing progressive rationalisation of demand

Aggregation of space: 1800x900 grids are used as the smallest consistent units, with everything nested within them

Design information systems: Digital/BIM library workflows embed standardised performance requirements into a reduced set of spatial blocks that work with platform systems

6.4 CASE STUDY | Mace - High Rise Solutions (HRS)

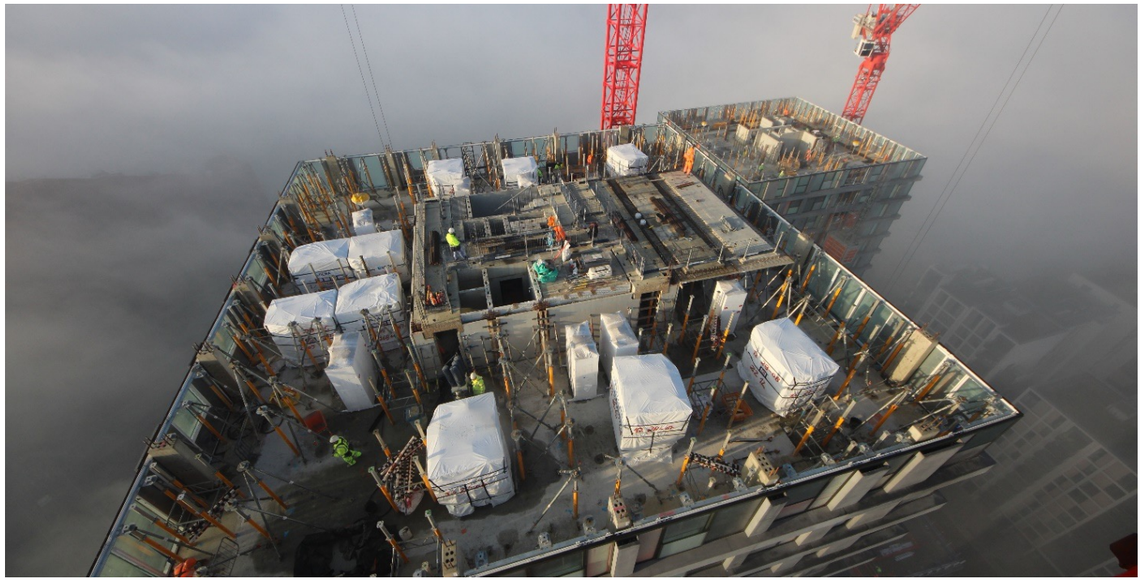
CASE STUDY: HIGH RISE SOLUTIONS (HRS)

Mace's HRS system is described as a next-generation construction method for high-rise residential buildings. Mace developed the system with Australian firm Hickory, which has been used initially to construct N06, a build-to-rent scheme in East Village, the former London 2012 Athletes' Village in Stratford, built by Mace on behalf of client Get Living.

The HRS system combines the latest advances in digital technology with an offsite manufacturing approach to construct buildings faster, safer and to a consistently higher quality. At the centre of the system is a reinforced concrete frame, around which can be fitted integrated floors and façades, standardised precast elements (columns, cores, stairs, internal walls), and standardised fit-out elements (bathrooms, utility cupboards, wiring looms and internal serviced walls).

The use of the system means that there is a highly integrated design process between architect, engineer and contractor which consists predominantly of configuration. Parametric modelling tools and artificial intelligence are used to draw from a catalogue of these components to design and manufacture the structure and façade sub-assemblies offsite.

There is an integrated supply chain for each of these standard and common elements, which is engaged in product development and continuous improvement. Manufacturing of these components takes place in an offsite assembly hub with preconfigured processes. Mace says that at N06 the system was able to reduce the length of design and construction programmes by 25%, vehicle movements by 40%, and waste by 70% compared to traditional methods. The project has been measured at 54% pre-manufactured value (PMV) by Cast.



EXEMPLAR CHARACTERISTICS:

Design for Manufacture and Assembly: process engineering is adopted to design and verify repeatable processes for the manufacture of kits of parts

6.5 CASE STUDY | NG Bailey - M&E kit of parts, The Forge, London

CASE STUDY: NG BAILEY – M&E KIT OF PARTS FOR THE FORGE, LONDON

The Forge is an innovative office development for Landsec in Southwark, London; it is the world's first large scale office building to be designed and constructed using a kit of parts led solution built on a platform design for manufacturing and assembly (P-DfMA) structural frame.

NG Bailey became involved with the Forge project in December 2019 when they were chosen to work with Bryden Wood Technology, multi-disciplinary design consultants for the project, to develop a mechanical and electrical (M&E) Kit of Parts, which they were subsequently appointed to manufacture and install.

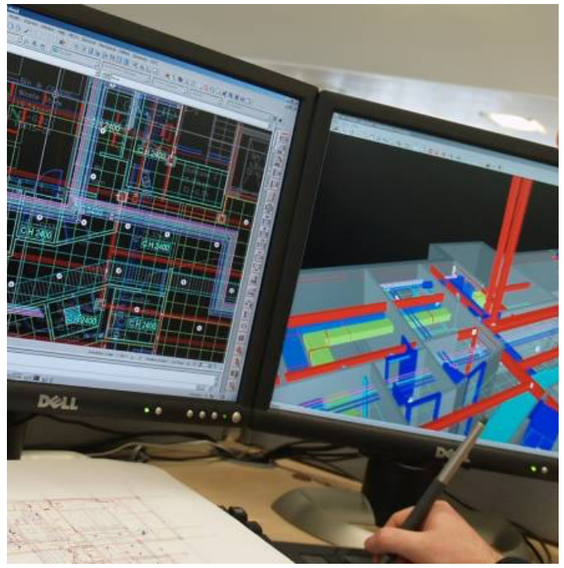
The Forge has ambitious targets - aiming for the construction and operation of the 139,000 sq ft development of two nine-storey office buildings to be net zero carbon – a first for the UK. Working collaboratively with Bryden Wood, they've designed five types of Cat A M&E modules in various sizes including pipework, fan coil units, lighting and acoustic ceiling modules along with ductwork kits.

They've been designed so they can be replicated on each floor of the building – these standardised modules can be taken forward and used on future projects. The components, assemblies and modules are in production at NG Bailey's specialist offsite manufacture facility in Bradford with onsite installation in 2022. The project partners have worked together to build a prototype model of the building at the Construction Platform Design Research Centre in Ropley, a facility jointly developed by Bryden Wood and prototyping specialists Easi-space. This has confirmed exactly how the M&E equipment integrates into the building, what it looks like from a design point of view and crucially, perfecting the efficiency of the install. The approach has removed circa 20,000 operative hours from the project and will deliver substantial carbon benefits by avoiding 35,600km of vehicle movements, which saves six tonnes of carbon alone.

EXEMPLAR CHARACTERISTICS:

Output platform: The M&E kit of parts developed for The Forge will act as its own output platform, in the future being used on platform projects independent of The Forge work.

Design for Manufacture and Assembly: process engineering is adopted to design and verify repeatable processes for the manufacture of kits of parts, using Easi-space to validate the onsite assembly process



7. DEFINITIONS

TERM	DEFINITION OR SOURCE DESCRIPTION
Assembly	A combination of components.
Component	A constituent part of a building (or other built asset) which is manufactured as an independent unit that can be joined or blended with other components to form a more complex item. Generally, components are 'self-contained' and sourced from a single supplier, typically the complete unit provided by that supplier rather than its constituent parts. *(Source - designingbuildings.co.uk)*
Demand (As referenced within the Product Platform Development Framework)	The use of product platforms requires aggregation of demand across a range of assets – typically where there are high volumes of similar features – and an ability to rationalise design requirements. This is done away from the project environment and is critical to establishing requirements and providing confidence to the supply chain that the solutions they develop will have a market.
Deploy (As referenced within the Project Platform Development Framework)	The development of product platforms happens away from the project environment and hence is not undertaken in relation to the requirements of one specific asset. The deployment of product platforms on projects therefore relies on how well the requirements collected during the develop stage reflect the specific needs of that project (and the flexibility of the product platform). Once a product platform is developed, a significant proportion of design is replaced by 'configuration' of these standardised components and assemblies, although an element of bespoke design is always likely to be required. A Product Platform Deployment Manual will be produced for each particular product platform using the Product Platform Rulebook.
Develop (As referenced within the Product Platform Development Framework)	It is expected that there will be multiple product platforms serving different market segments and client requirements (and hence deliver different performance and value). The process through which product platforms are developed is not widely understood or consistent in construction. The product platform rulebook will set out this process, ensuring different product platforms use the same language, share the same data, and thus allow for comparison, ease of configuration, and levels of interoperability/interchange. The Hub is also working with existing product platform providers to identify early opportunities for standardisation and interoperability. As part of the develop stage, all product platforms will produce a Product Platform Specification and Deployment Manual in line with the Product Platform Rulebook.

TERM	DEFINITION OR SOURCE DESCRIPTION
Harmonise, Digitise and Rationalise (As referenced within the Construction Playbook and TIP Roadmap to 2030)	The Construction Playbook states that *"Contracting authorities should seek opportunities to collaborate in order to develop and adopt shared requirements and common standards. This should be done to enable standardised and interoperable components from a variety of suppliers to be used across a range of public works. This will create a more resilient pipeline and drive efficiencies, innovation and productivity in the sector."*
Kit of Parts	A collection of repeatable, standardised building components that are pre-engineered and designed to create a variety of assemblies which define part or all of a finished building.
Platform	A term that is widely used but with consistent elements including: a set of low variety core assets (i.e. components, processes, knowledge, people and relationships); a complementary set of peripheral components that exhibit high variety; stable interfaces that act as a bridge between the stable core and variable peripherals; and a set of rules or standards governing how components can be integrated.
Platform Programme	Overarching tag for all Hub programme work relating to platforms.
Principles	Within the Product Platform Rulebook, the Principles are requirements which should be applied in conjunction with the Rules. Compliance with the Rules determines whether something can be considered a product platform or not. Performance against the Principles determines how advanced a product platform is.
Product Platform (PP)	A kit of parts, associated production processes, and the knowledge, people and relationships required to deliver all or part of construction projects using a platform approach. A product platform provides a stable core which is configured and combined with complementary components (via defined interfaces) to suit a particular project. A product platform also includes the processes tools and equipment required for assembly.

TERM	DEFINITION OR SOURCE DESCRIPTION
Product Platform Definition	Rules which define the boundaries of a particular product platform, developed using the Product Platform Rulebook and defining key drivers, objectives, requirements and architecture.
Product Platform Deployment Manual	The manual for deploying a specific product platform in a project setting, including configuration, ordering, supply chain management, assembly and how complementary components interface to form all or part of a finished building.
Product Platform Development Framework	A common framework to support the development of product platforms. The framework sets out a series of activities across three stages (Demand, Develop, Deploy) covering the identification of market demand through the development of a product platform to its eventual deployment on multiple projects. The Product Platform Development Framework is governed by the Product Platform Rulebook.
Product Platform Roadmap	A detailed breakdown of activities to inform planning and investment decisions, that sets out the order in which the product platform provider needs to develop product families and constituent parts.
Product Platform Rulebook (The Rulebook)	Rules, requirements and a guide to the development of all product platforms in construction.
Product Platform Specification	The component, interface and production specifications for a particular product platform, developed using the Product Platform Rulebook and based on the rules set out in the Product Platform Definition.
Rules	Within the Product Platform Rulebook, the Rules comprise general statements and definitions for which there is no alternative; as well as requirements for which no alternative is permitted unless specifically stated. Compliance with the Rules determines whether something can be considered a product platform or not.

1. DEPLOYABLE

Product platforms shall be **deployable** across multiple, non-identical assets so that it is possible to physically deliver non-identical buildings or parts of buildings using the product platform - to distinguish from a one-off or a cookie cutter repetition.

2. CONFIGURABLE

Product platforms shall be **configurable** to suit individual project requirements so that it is possible to comply with variations in requirements across different projects while still using the common repeatable elements of the platform.

3. COMMON REPEATABLE ELEMENTS

Product platforms shall comprise **common repeatable elements** including a kit-of-parts, production processes, knowledge and people and relationships so that there is holistic consideration of improving productivity and risk across all aspects of the delivery process, whilst accepting that different product platforms will share elements to differing degrees.

4. INTERFACES

Product platforms shall have defined **interfaces** which can be made available to the designers and suppliers of peripheral or complementary products, to enable the product platform to be reliably integrated with other parts of a building without being wholly dependent on the platform provider.

5. QUALITY

Product platforms shall have a defined **quality** standard to define a minimum level of quality to be achieved, and have documents and procedures in place (requirements, specifications, guidelines, or characteristics) that can be used consistently to ensure that materials, products, processes, and services (as appropriate) are fit for their intended purpose.

6. STRUCTURED INFORMATION

Product platforms shall have a **structured approach to information** for: Product information; Deployment information; Organisational information; including capability and credibility.
To enable those in the client domain to make an informed choice about the use of the platform and how it will affect outcomes; and to enable those in the product domain to feed in their information seamlessly.
To enable those in the project domain to correctly evaluate, configure and deploy platforms.

7. OPEN

For a product platform to be deemed an **open** product platform, it shall enable any party to make, use and buy the common, repeatable elements, for legitimate purposes.
To enable a consistent understanding of what it means to be an open platform.

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BRE
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BSI Group
Build Eco
Build Offsite
BuroHappold
Cast Consultancy
Churton Studio
CIOB
Civil Engineering Contractors Association
Connected Places Catapult
Construction Leadership Council
Construction Products Association
Construction Scotland Innovation Centre
Cornerstone Assets
Costain
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Environment Agency
Foot Anstey LLP
Get It Right Initiative
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LHC
Loughborough University
Mace
McAvoy Group
McLaughlin & Harvey
Mid Group
Ministry of Defence
Ministry of Housing, Communities and Local Government
Ministry of Justice
Modular Building Developments
Modularize
Morgan Sindall Group
Mott MacDonald
National House Building Council
NG Bailey
Offsite Alliance
Operance
Polypipe
Postive Homes
Ramboll
RICS
Roger Bullivant
Royal Town Planning Institute
Saxon CBE
Scottish Water
Sir Robert McAlpine
Skanska
Stewart Milne
Supply Chain Sustainability School
The Construction Industry Training Board
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WSP
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