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BIM and Beyond

Digital Transformation in the Built Environment

## A BSI White Paper for business

Introduction

As the march of technological innovation continues to affect most areas of our lives, nowhere is its impact more keenly felt than in the built environment. From building design and construction projects to infrastructure development and ongoing asset management, the built environment is being transformed by new and evolving digital solutions.

BSI is supporting the success of digital transformation in the built environment through its traditional strengths – helping to develop and deploy standards that provide consistency and certainty in this changing sector. In particular, through the development of certification solutions, BSI offers the construction industry and its wider stakeholders, from owners and investors to occupiers and end-users, the assurance of best practice.

Building Information Modelling (BIM) is a key element of the built environment sector being transformed through digital technology – and this BSI White Paper explores the nature of BIM, and how and why a wide range of businesses should understand and embrace it.

Important though it is, BIM is by no means the whole story. In addition, BSI is supporting digital transformation in the built environment through several other change initiatives, from the promotion of Smart Cities, Digital Built Britain and the UK Government's 2025 construction strategy, to the quest for Organizational Resilience.
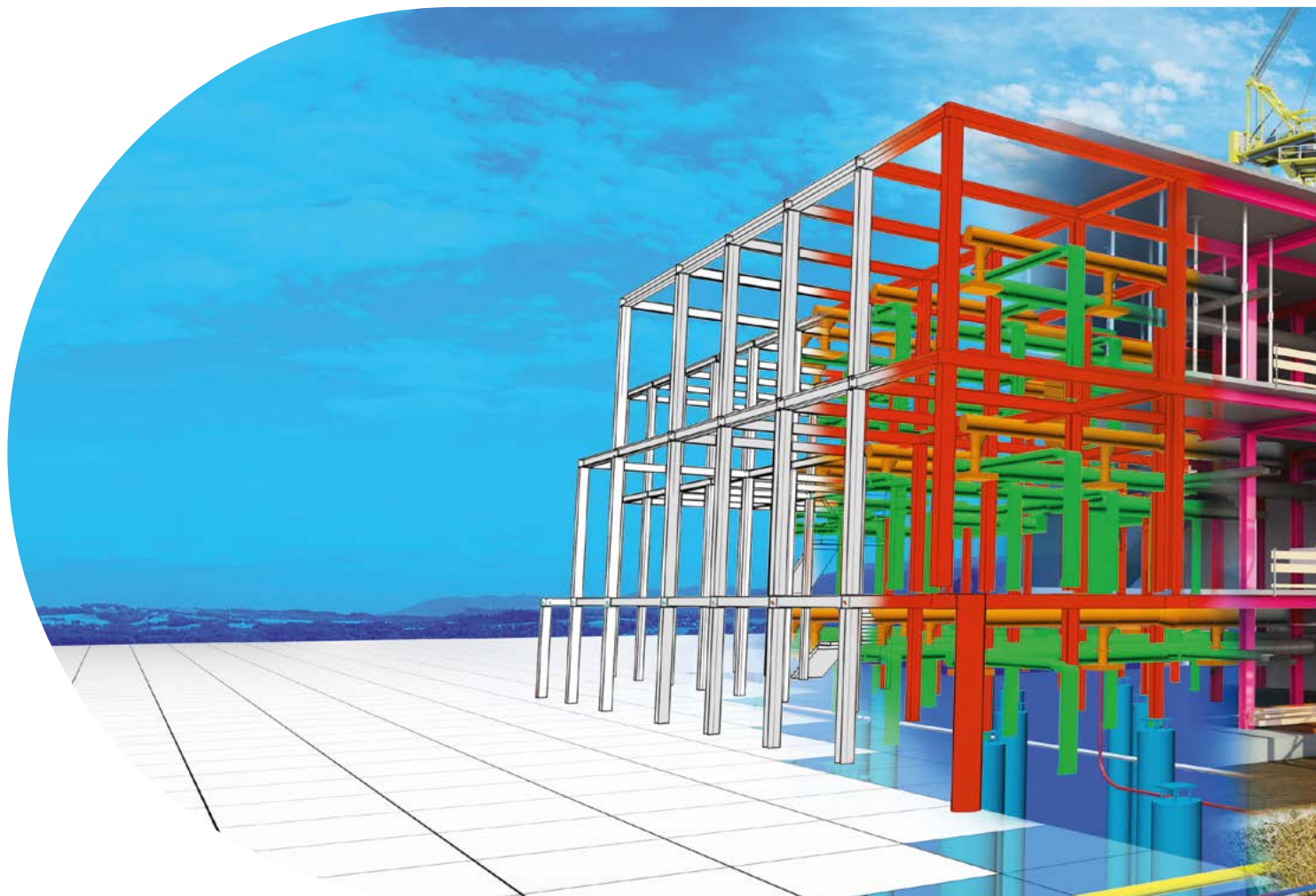
What is **BIM**?

BIM is a software-based system that enables improved collaboration between companies throughout the supply chain for large building and infrastructure projects. As such, BIM represents a significant evolution in the construction and asset management markets.

The system brings together all the components that make up a project in the development stage, creating a common language, shared knowledge and increased transparency between all the parties involved, from the main contractor through to sub-contractors, specialists and professionals. It provides the framework to manage costs, timescales, material quantities and optimized construction plans.

Importantly, the use of BIM extends beyond the planning and design phase. Specifically, through the use of three-dimensional digital modelling, BIM defines a set of procedures for the production, management and exchange of information generated in the design, construction and management phases of a built asset, and throughout the whole lifecycle of that asset, from initial drawings all the way through to final decommissioning.

BIM can be used for a wide range of projects, including both new and existing assets from buildings (eg. offices, shopping centres, schools etc.) and infrastructure (eg. roads, railways, power stations etc.) to a development masterplan (eg. a group of buildings and infrastructure).

The UK has been leading the way in the use of BIM, having introduced a Condition of Contract in April 2016 requiring the use of BIM on all public projects. But BIM adoption has not only been growing in the UK. It has been significantly increasing over the past few years in international markets including the US, Middle East, Asia and Australasia.

Collaboration is **key**

While three-dimensional models lie at the heart of BIM, the system is fundamentally about information — it provides a set of processes and standards for managing information through collaboration, underpinned by technology. It allows the entire supply chain to communicate and co-ordinate effectively. BIM can be used by:

- Owners and developers

- Contractors

- Designers and architects (including landscape architects)

- Engineers — structural, civil, mechanical, electrical, public health and infrastructure engineers

- Cost consultants

- Specialist contractors (eg. lift manufacturers)

- Surveyors

- Asset/facilities management organisations

- Government agencies and specifiers.

Just as design software can provide three-dimensional drawings of a potential building, BIM can model every component part of a proposed project in a three-dimensional coordinated environment. It then enables sharing of information between organizations. This allows, for example, the main contractor to see in advance — and on an ongoing basis as the project develops — where any conflicts are likely to occur.

"We've been able to spread our brand wider by marketing the company as a Certified Practitioner of BIM Level 2 for Design and Construction. Client assurance is a major benefit of BSI certification for us."

Rob Dingwall, Head of Planning and Design, VolkerFitzpatrick

Benefits of **BIM**?

By collating accurate information, from drawings and specifications to materials and measurements, problems can be avoided throughout the supply chain, driving up the efficiency of the construction and asset management processes. BIM can:

- Save time through fast and efficient processes
- Reduce waste and uncertainty
- Increase consistency of information
- Increase collaborative working
- Increase productivity and delivery times
- Reduce costs
- Improve safety
- Drive modernisation through digital working.

Key questions at every stage of a project include:

- What information is required?
- Who is responsible for producing the information?
- What format must the information be in?
- How should the information be named?
- How should the information be used?
- What level of detail must the information include?
- Who is responsible for managing the information?
- When is the information required?
- How should the information be exchanged?
- How should the information be managed?

By working collaboratively using BIM:

- Each team has the ability to add to and reference back all the information they acquire during their period of contribution to the building information model process.
- Each team is fully aware of what is the most current version of information referred to as the 'single source of truth', preventing potential reworking and silo working that can create errors.
- The likelihood of clashes is reduced, as each team member can coordinate with other team members eg. The services engineer can coordinate with structural engineer to ensure routing of services infrastructure does not clash with location of foundations through a single 'federated' services and structural model.

BIM Levels

Ultimately, there will be four levels of BIM maturity, essentially moving the production of building information from an individual, non-collaborative, two-dimensional approach (Level 0) to a fully digital environment encouraging full collaboration (BIM Level 3). Currently, however, Level 3 has not yet been fully defined and no organization is yet recognized as working beyond Level 2.

In the UK, the Government has become sufficiently persuaded of the benefits of BIM to set a clear condition of contract that construction companies demonstrate BIM Level 2 capability, or else be excluded from public sector tenders. It estimates it has already saved £840m through the use of BIM, representing average project savings of 20%.

BIM Level 2 capability is based on the Publicly Available Specification known as PAS 1192-2 (Specification for information management for the capital/delivery phase of construction projects using building information modelling). Under BIM Level 2:

- All parties use their own 3D CAD models, not necessarily working on a single, shared model.
- Collaboration takes place. Data is exchanged between parties and design information is shared in a single file format.
- A federated BIM model is created. Each party can combine pooled data with their own in order to make checks.

Applying **BIM**

The three main components of BIM Level 2 are design and construction, asset management and information security. The diagram below outlines the simplified lifecycle of an asset, from initial brief to ultimate decommission:
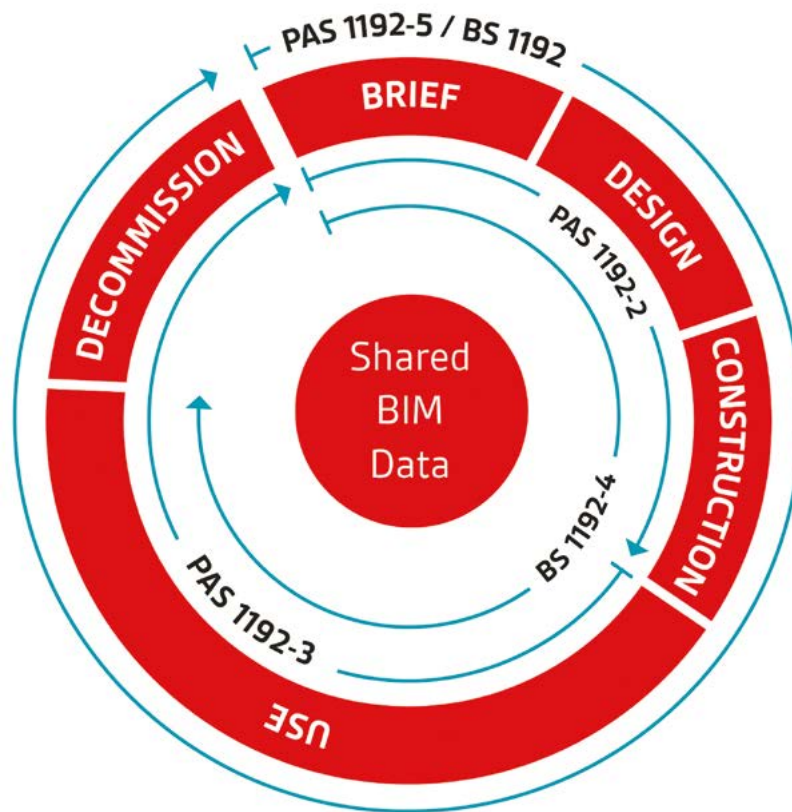
The diagram shows how PAS 1192-2 outlines the requirements for BIM Level 2 for the design and construction phase of a project, while PAS 1192-3 outlines the requirements for the specification, production and management of information during the 'in use' phase of the asset. It will typically be in this phase that the vast majority of savings from a BIM-led project will be made, because of its potentially lengthy duration (often 20 years or more).

BS 1192 defines how information should be shared in one common data environment. It defines a set of standard methods and procedures (such as naming conventions, version control, classifications, etc.) to be adopted for all information generated within the lifecycle of a project.

BS 1192-4 defines how information on 'maintainable assets' (boilers, windows, etc.) should be transferred in a structured way. Information of this kind may be transferred at different times through the lifecycle of an asset.

PAS 1192-5 covers security – people, process, physical and technological security under BIM for sensitive built assets. It spans the entire lifecycle of a built asset.

"Digital integrity is an important part of delivering social and economic infrastructure as it reassures our customers that we are delivering the highest quality of information. Balfour Beatty was one of the first organizations to achieve the BSI Kitemark, which demonstrates our ongoing commitment to digital transformation and our ability to lead in the industrialization of information management in infrastructure."

Tom Loader, Head of Digital Transformation at Balfour Beatty
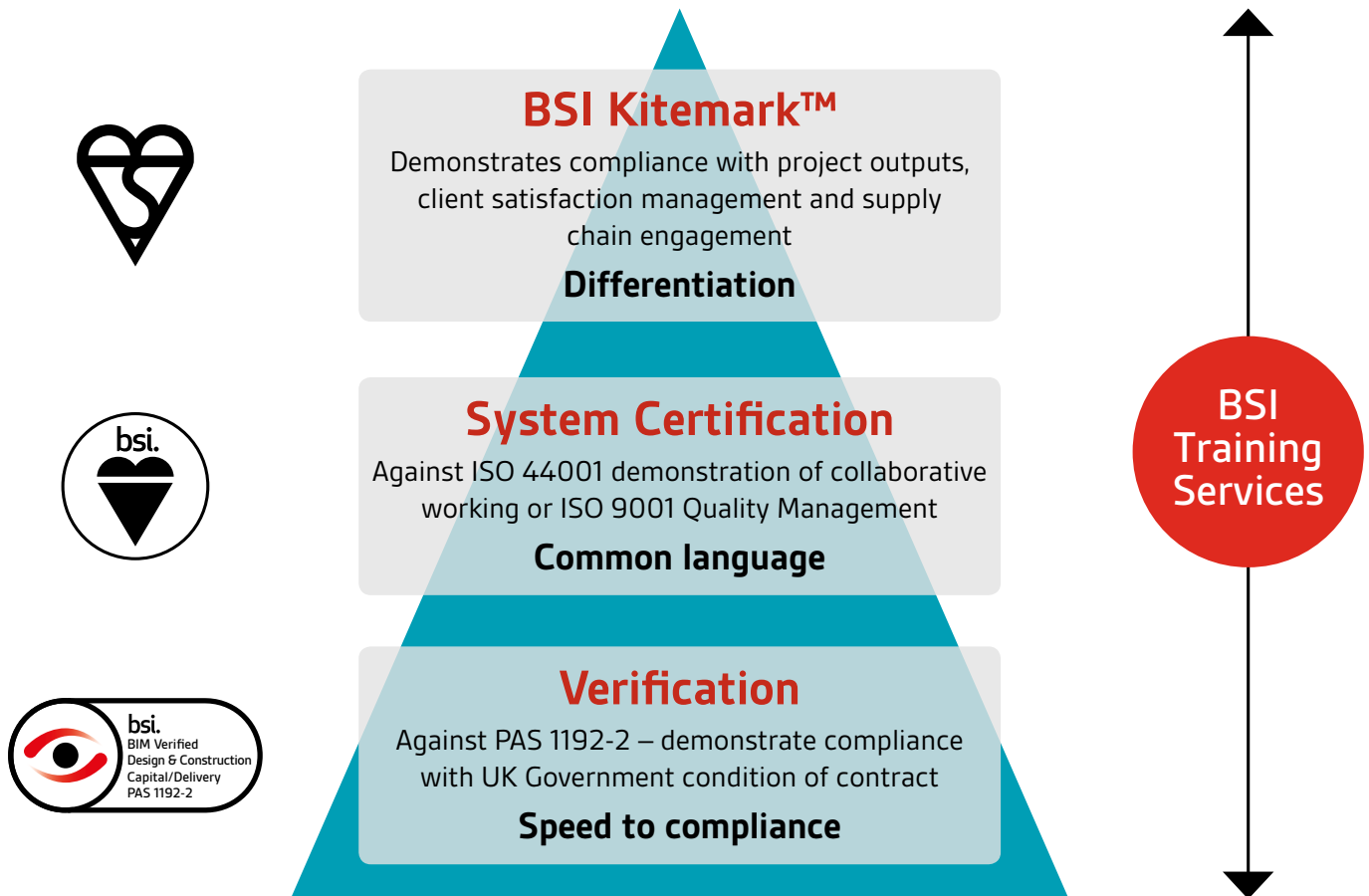
The Compliance **Challenge**

Today, the challenge for organizations globally is how best to become BIM Level 2-compliant. A particular problem has been so-called 'BIM-wash', whereby companies globally have made false claims about their BIM capability.

How **BSI** can help

BSI has been taking a lead in helping organizations to meet the compliance challenge. For example, BSI has been running workshops, finding out contractors' 'pain points' and developing potential solutions, not just for the UK market but also for other global markets where BIM is now being implemented and regulated.

Above all, BSI offers a key way to counter BIM-wash – through certification that reviews all areas of BIM implementation:

BSI certification solutions for BIM

BSI Kitemark™
Demonstrates compliance with project outputs, client satisfaction management and supply chain engagement
Differentiation

System Certification
Against ISO 44001 demonstration of collaborative working or ISO 9001 Quality Management
Common language

Verification
Against PAS 1192-2 – demonstrate compliance with UK Government condition of contract
Speed to compliance

BSI Training Services

BIM verification certification

BSI has developed a verification solution for contractors and their supply chains to show BIM process compliance through certification to PAS 1192-2. The verification product is aimed at businesses just starting out with BIM, which may not have undertaken any BIM projects yet. A Verification Certificate can be awarded when BSI has determined whether a product, process, or service meets the specified requirements of a standard, specification, or a code of practice that has been determined by a client. This must be a publically available document, and for BIM it is PAS 1192-2.

System certification

Covering BIM process compliance and more, certification by BSI to ISO 9001 and ISO 44001 (formerly BS 11000) remain the 'gold standards' for, respectively, Quality Management and Collaborative Business Relationships. As the world's most popular standard, the iconic ISO 9001 requires little introduction. ISO 44001 provides a robust framework for a contractor to:

- Identify how relationship management can help achieve its business objectives

- Evaluate the benefits of entering into a single or multiple wwpartnerships

- Select the right partner to complement its objectives

- Build a joint approach based on mutual advantage

- Develop added value from the relationship

- Highlight the problem areas in a collaboration

- Create and execute an exit strategy.
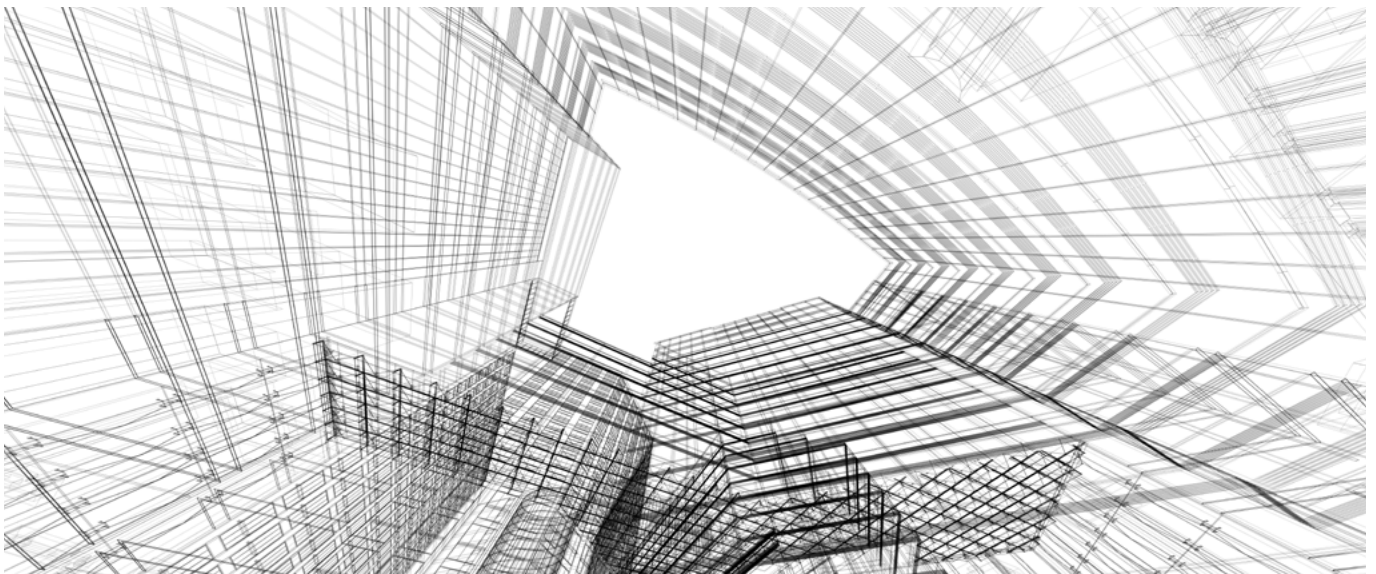
"Certification to BIM Level 2 for Design and Construction, backed by the BSI Kitemark, will strengthen our position as a market leader. It will help differentiate us from our competitors and prove, again, our commitment to the highest standards and to using cutting-edge technologies to serve our customers better. It will give customers confidence in our ability to work collaboratively with others in the supply chain, and prove we have the expertise to provide a service that goes above and beyond the standard BIM offering."

Alan Harris, Quality Manager, voestalpine Metsec

BSI Kitemark **certification**

For over a century, BSI Kitemark-approved products and services have been seen to achieve the highest standards, providing holders with differentiation from competitors making unsubstantiated claims. The new BSI Kitemark PAS 1192 acts as a seal of approval for construction businesses around the world, confirming that they are able to provide BIM Level 2 capabilities, and giving them a competitive edge.

Design and construction

While BIM compliance can be achieved through PAS 1192-2, this alone may not provide assurance to specifiers and end-users of successful project completion and final delivery under BIM. A new BSI Kitemark certification scheme represents the next step in providing main contractors with the evidence they need to give their clients this assurance.

The BSI Kitemark is integrated with BSI's existing certification solutions for the construction industry. It has several components that move it beyond product assurance to provide a much more robust level of certification for an organization. In particular, it uses management system standards, such as ISO 44001 Collaborative Business Relationships and ISO 9001 Quality Management, as well as PAS 1192-2 and assessment of completed projects.

Asset management

The new BIM Kitemark for asset management, showing compliance with the requirements of PAS 1192-3, provides assurance beyond the design and construction phase of an asset. While the estimated savings BIM level 2 generates for construction are around 20%, this is only a fraction of the savings likely to be achieved through use of BIM to better manage assets. For example, Patrick Bossert, who leads EY's UK infrastructure asset intelligence practice, has estimated that, for the UK as a whole, the potential savings from digital technology from an asset lifecycle perspective could be as much as 6% of GDP.

Information security

The BIM Level 2 suite will be completed later this year when BSI launches the BIM Kitemark for information security.

BIM **objects**

BIM is having a significant wider impact on the manufacturing sector, as architects and designers use digital versions of products, 'BIM objects', in the development and design process. For manufacturers, this represents a significant change in product supply and offers new routes to market. It is increasingly essential that manufacturers engage with the BIM process by producing BIM objects.

Product data + Product geometry = BIM Object
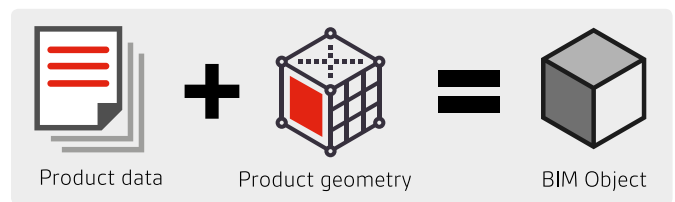
The new BSI Kitemark has been designed to help the manufacturing sector access these new market channels by providing assurance that suppliers' BIM objects are an accurate representation of the physical products they represent.

BIM **certification** through **BSI**:

- Enables construction clients to demonstrate compliance with the UK Government's 'condition of contract'

- Can provide clients with a 'global passport', utilizing BSI's extensive global network of regional offices

- Is being adopted by many of the major Tier 1 organizations, including Skanska, Balfour, Mace, Carillion, Kier, Wates, Bechtel and BAM

- Is modular, leading to the BSI Kitemark, providing differentiation and significant commercial value and credibility

- Is aligned with existing systems certification and adopts a common language for ease of understanding

- Includes comprehensive training that links directly to industry standards

- Is competitively priced.

Case study 1: Roads and Transport Authority, Dubai

BIM Kitemark certification from BSI

The Roads and Transport Authority (RTA) in Dubai has become the first government entity in the world to achieve BSI Kitemark certification for BIM (Kitemark PAS 1192-2:2013, BS 1192-4:2014 and BS 1192:2007).

Mattar Al Tayer, Director-General and Chairman of the Board of Executive Directors of RTA, says the Kitemark rewards RTA's efforts to nurture an advanced asset management environment, helping it to communicate clearly and work collaboratively, both internally and with external parties. "This certificate prompts us to enhance effective communication between RTA's officials and entities of relevance to our scope of business," he says.

Al Tayer explains that the Kitemark helps RTA to take complex decisions quickly and efficiently. "It paves the way for taking non-conventional decisions and assists us in realizing our objectives in a short time, in line with the Smart Government initiative," he says. "The initiative seeks to rank Dubai as the smartest city in the world using state-of-the-art techniques for achieving distinctive government performance."

Saeed Al Ramsi, Director of Asset Management for RTA, says the BSI Kitemark "is testament to the implementation of BIM best practice in a creative style that cements RTA's leading profile across the nation and the world in the use of this system".

RTA's Kitemark was awarded following a comprehensive 5-day assessment of its BIM-related procedures by BSI, which found that the organization's implementation of BIM was of a high standard, with no non-conformities.

Al Ramsi concludes, "The Kitemark is a reflection of the advanced level of BIM working achieved by RTA over the past three years, in terms of carrying out the analyses required, developing viable strategic plans and manuals, and the practical implementation of BIM in several strategic projects."

هيئة الطرق والمواصلات
ROADS & TRANSPORT AUTHORITY **RTA**
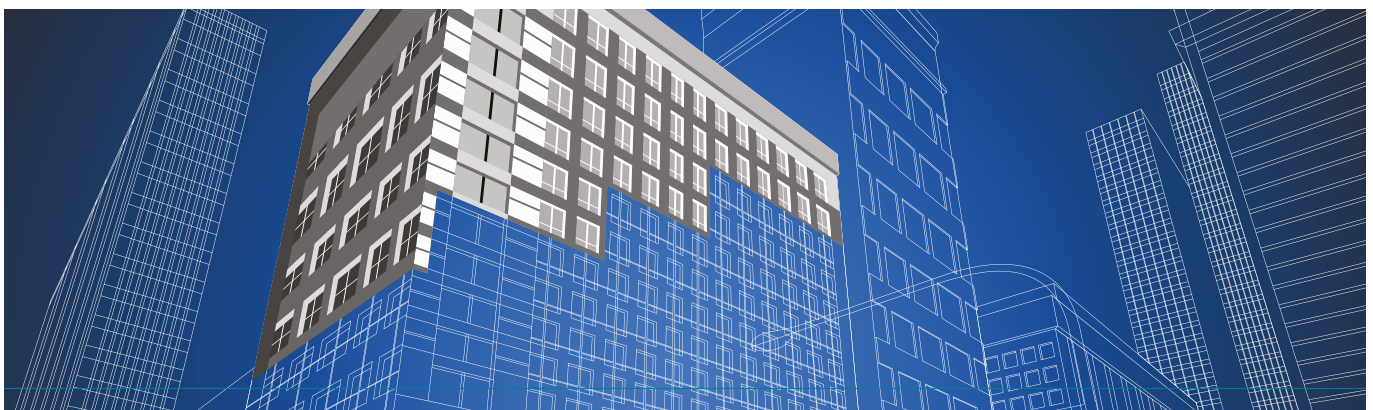
"BIM is a major driver for the digitization of the construction industry, influencing its direction both in the UK and abroad. We were pleased to work with BSI and our peers to develop the certification, providing a clear assessment pathway to achieve the BSI Kitemark. This will reassure clients and partners that we are working efficiently to the highest possible standards and that BIM processes are embedded within our systems."

**Mark Taylor, Digital Construction Manager at BAM Construct UK**

Why BSI?

BSI has been at the forefront of BIM since the start, developing a range of BIM standards. Covering all the key elements from design, information management, facilities management and security. And we're continuing to work with the industry to develop and evolve the suite of standards to cover all life cycle aspects – from design to final de-comissioning. That's why we're best placed to help you understand the standard.

At BSI we create excellence by driving the success of our clients through standards. We help organizations to embed resilience, helping them grow sustainably, adapt to change and prosper for the long term. We make excellence a habit.

For over a century our experts have been challenging mediocrity and complacency to help embed excellence into the way people and products work. With over 80,000 clients in 182 countries, BSI is an organization whose standards inspire excellence across the globe.
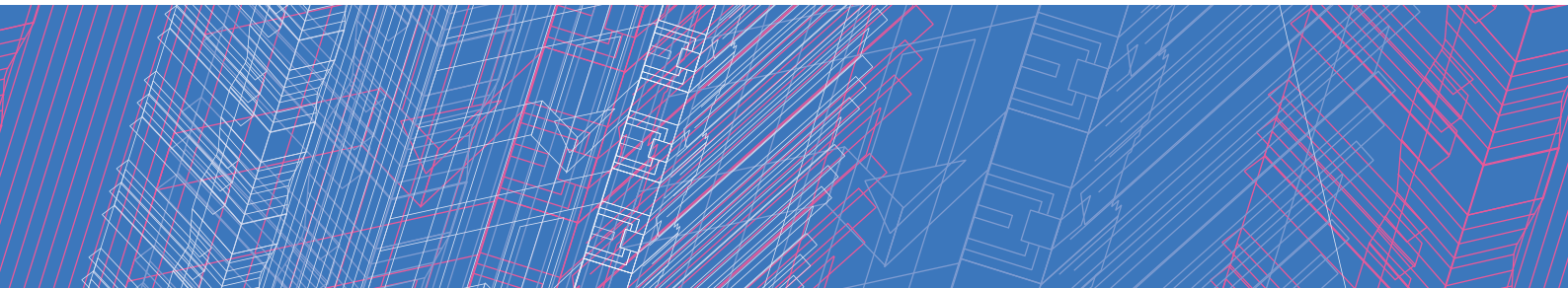
Our products and services

We provide a unique combination of complementary products and services, managed through our three business streams; Knowledge, Assurance and Compliance.

Knowledge

The core of our business centres on the knowledge that we create and impart to our clients. In the standards arena we continue to build our reputation as an expert body, bringing together experts from industry to shape standards at local, regional and international levels. In fact, BSI originally created eight of the world's top 10 management system standards.

Assurance

Independent assessment of the conformity of a process or product to a particular standard ensures that our clients perform to a high level of excellence. We train our clients in world-class implementation and auditing techniques to ensure they maximize the benefits of our standards.

Compliance

To experience real, long-term benefits, our clients need to ensure ongoing compliance to a regulation, market need or standard so that it becomes an embedded habit. We provide consultancy services and differentiated management tools to facilitate this process.

Find out more

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