Annex C UK input for T1.4

Built2Spec - WP 1.4 Methodology to assess change to the design/commissioning performance gap

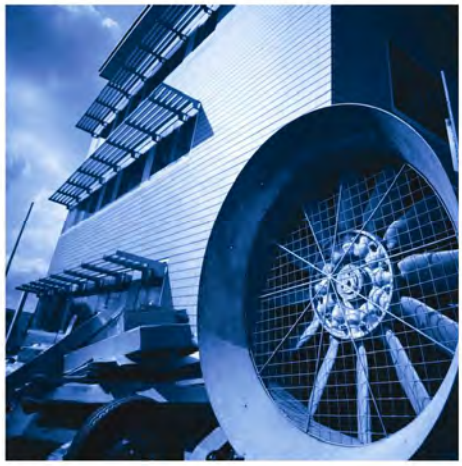
UK input to WP 1.4

Carried out for

Built2Spec

By John Sands

August 2015



Built2Spec - WP 1.4

Carried out for: Built2Spec

Contract: **58558-1.4/1**

Date: **August 2015**

Issued by: **BSRIA Limited**
Old Bracknell Lane West,
Bracknell,
Berkshire RG12 7AH UK

Telephone: +44 (0)1344 465600

Fax: +44 (0)1344 465626

E: bsria@bsria.co.uk W: www.bsria.co.uk

Compiled by:	Approved by:
Name: John Sands	**Name:** Ian Wallis
Title: Principal Consultant	**Title:** Research Manager

CONTENTS

1 Introduction

This report has been produced in support of Task 1.4 of the '*Built to specifications – self inspection, 3D modelling, management and quality check tools for the 21st century constructions work site*' project, and relates to practices and behaviours in the UK construction and asset operations markets. This document also presents BSRIA's input to D1.2, Performance Gap Assessment Methodology.

1.1 Background to Task 1.4

In section 1.3.3 *WT3 Work package descriptions* of the *Description of Actions* document, the scope of Task 1.4 is described as follows:

> 'Task 1.4: Methodology to assess change to the design/commission performance gap
>
> One impact specified in the call text is a "Reduction by at least 50% of the mismatch of energy performance between design stage and commissioning stage due to construction processes." This requirement generated some interesting discussions from the partners and a methodology will be required for that so that it can be communicated to the pilots, implemented and reported.
>
> In this task a methodology will be developed to assess which out of the large amount of normal activities within the design, detailing, implementation, commissioning and maintenance phases of a construction project can contribute significantly to reduce the energy performance gap.
>
> Apart from the call text requirement, such a task is worthwhile because it will increase the credibility and rigor of project results and the associated foreground for exploitation and impact.'

This report looks at these objectives in the context of the UK construction and asset operations markets, and describes related activities, processes and behaviours to support or reinforce them. The specific topics covered in this report are:

- Performance gap
- Construction processes including UK legislation, regulation, plans of work, construction procurement routes
- Recent changes to the construction process in the UK including construction initiatives, Building Information Modelling (BIM) and Soft Landings.

2 The Performance Gap

2.1 What is the performance gap and what are the main factors causing it?

The performance gap is the difference between the predicted energy performance of a house and its performance as-built. This gap is caused by many different factors as stated in recent reports[33] including:

1. A lack of training provided to the workforce that builds houses in energy performance and what affects it. This means that the expertise in energy performance that were available for the design stage of the process are no longer available for the construction stage, so unintended changes occur causing the performance gap to occur.

2. New entrants into this work force are not being trained in energy performance so do not know the reason why certain things are designed into a house.

3. The Government isn't leading the way to try to improve as-built energy performance.

The issue of the difference between energy consumption of an asset assessed during the design stage and what is actually consumed during operation has been evident within the UK construction industry for many years. This is often referred to as the "performance gap".

The reasons for this gap range and accumulate throughout the design and operation process to result in buildings that often use more than double their expected energy. Some examples of why and where the performance gap issues are occurring are:

Briefing stage

Performance gap issues can occur as a result of poor briefing – e.g. this can occur if the client fails to inform the design team of what they want and how they want to operate their new building.

Design stage – concept, developed and technical

Decisions at the design stage have a significant impact on performance in use. For example, changes in the design or value engineering in an attempt to save costs can interfere with rigorous design principles, compromising the performance of the final result. There may also be design errors or inaccurate assumptions which will create unrealistic baselines for expected performance.

Predicting how occupants will behave is a factor that comes into play at the design stage. Behaviour, particularly in domestic buildings, can vary significantly depending on the type and number of occupants, employment status and personal interests. If incorrect assumptions are made or the design team fail to understand the occupant's needs then differences between predicted and actual performance will occur.

Construction stage including installation

[33] Zero Carbon Hub publications

There are issues occurring at the construction stage of a project that impact on the performance once a building is in-use and therefore contribute to the performance gap:

- If the building fabric characteristics are different to those used in the design, variation in performance will occur.
- Installation errors or poor quality of installation.

Commissioning, handover and close-out

Commissioning is sometimes poor and can be the stage compromised the most in the construction process. If the timetable slips the commissioning period is often squeezed.

The focus at the handover stage should be on guides, manuals, walkthrough, support, all designed for usefulness, completeness, usability and sensitivity. However, similar to commissioning, handover is often rushed and incomplete.

In-use, post-occupancy stage

There is currently no widespread culture of reviewing what has been constructed and then using that knowledge to inform future projects. Initiatives within the UK are looking to change this – see Soft Landings, section 4.3.

2.2 Industry research into the Performance Gap

A number of studies have been carried out in the UK over the last 10 years or so, to try to identify the causes in order to be able to find solutions. This section includes research outputs and articles from a number of recent studies looking at this issue.

2.2.1 Closing the Performance Gap: First Signs of Good Research and Development – Director of the Leeds Sustainability Institute, School of the Built Environment and Engineering, Christopher Gorse, Leeds Metropolitan University

Closing the Performance Gap: First Signs of Good Research and Development

The 20 years of work undertaken at Leeds Metropolitan University has uncovered significant deviation between the designed and intended building performance and that achieved when buildings are actually constructed. The recognition of the deviation between that expected and that delivered has caused debate and confusion, with many professionals and trades not fully understanding the consequences of this finding and pressing ahead with construction practices that don't work. If buildings fail to meet the specified contractual requirements, they are not fit for their intended performance. The construction industry is now seeing its clients and tenants seeking redress for buildings that are costing more to operate than they should do. At the other end of the scale there are some notable exceptions that are engaging in intensive research and development and making significant improvements to building performance.

The Leeds building performance work, initiated by Professors Low and Professor Bell, now falls under the leadership of Professor Chris Gorse. The knowledge gained through this period of continuous research at Leeds Metropolitan University is substantial and progressing at a pace. While the research is sizable, there is still much work to be done to understand the built environment and measures needed to ensure negative impact on the environment is reduced.

With the legal commitment to reduce carbon emission, under the Climate Change Act, and the direct pressures of the Energy Performance and Building Directive, industry leaders are setting the agenda for change. However, in some cases, change has started prematurely without proper insight into the processes and innovations. Before new products are distributed they need to be tested and the knowledge gained through research should be used to inform future developments. Some knowledgeable professionals, have a good understanding or what is required whilst others demonstrate a level of inadequate understanding by the underperformance actually achieved. Interestingly, whilst the research has shown that many buildings underperform, the construction industry has not seen the product recalls which are typical in other industries. In other industries when reputable companies uncover problems with systems and components produced, their products are recalled and improvements made without cost.

Up-grading the building stock

The scale of the ecobuilding and upgrading of the building stock is substantial, requiring considerable research and development and a steep learning curve to maintain paces with the advances made. Currently, so few of the existing 22 million homes in the UK operate close to the standards expected and legislated for that the whole building stock is in need of an Eco upgrade.

The retrofit market for domestic buildings is estimated at £200 billion over the next 20 years (King, McCombie & Arnold 2012). According to King et al, with an average 10,000 for each building upgrade, a spend rate of £7 billion per year is required up to 2020 and £15 billion from 2020 to 2030. If this money is not to be wasted, the industry must design and build reliably and with confidence, to ensure the investment achieves the expected benefits. Unfortunately, the industry has a reputation for being weak on building quality, especially thermal building performance. However, we are now seeing notable good exceptions, supported by research, that demonstrate how we can reliably achieve low energy buildings with high thermal comfort standards.

Retrofit, Eco funded Refurbishment and Green Deal

Refitting the whole building stock has some significant challenges which industry has to overcome. Meeting design aspirations is more difficult with existing buildings as there are often aspects of the existing structure that we do not fully understand. Without costly detailed forensic investigation, the qualities of the existing structure remain largely unknown. The performance of an existing building and improvements achieved through a thermal upgrade is dependent on the condition of the existing structure, its size, building type, materials, components and the properties that manifest when new retrofit measures are introduced. For each building type the performance is likely to vary, however when interventions are carefully considered measured improvement is achievable. Through research and development, we are learning how to gain more consistent low energy behaviour and more consistent building behaviour over a wider range of buildings. Where interventions are successful and tangible benefits achieved the products go to market with confidence and valid building performance claims.

The Leeds Metropolitan University and Joseph Rountree Foundation study of the retrofit project at Temple Avenue shows significant and stepped improvement in the thermal performance of the building. The retrofit measures were undertaken in two distinct phases of thermal upgrade and benefits were achieved. As well as the thermal performance upgrades, the property also benefitted from improved aesthetics, new windows, finishes and an insulated cladding layer that prolongs the expected life and usefulness of the structure.

Through our other retrofit research we are also seeing other, carefully considered and controlled, interventions that change the building enclosure from being unsealed, perforated and uncontrollable fabrics to building elements that are more able to restrict thermal and air movement, enabling the property to be controlled.

Nearly Zero Standards Achieved

The 2013 results published by Leeds Metropolitan University on the thermal performance of domestic buildings, show the Passivhaus dwellings outperforming all other buildings studied. Surprisingly the buildings studied also had one of the closest relationships between the expected designed performance and that achieved in reality. While many believe that as the design and regulatory standards become more stringent they become more difficult to achieve. However, the results suggest that it is possible to design and build nearly zero properties. Against the research that was responsible for identifying the performance gap and raising concern about the size of the discrepancy it is reassuring that thermally efficient designs can be drafted and built with confidence. The research undertaken over a 20 year period show that some properties studied experienced twice the expected heat loss, while recently the low energy properties studied were within acceptable tolerance. Obviously this does not need to be the case. The research shows that a failure to design and build properly results in significant underperformance, while clearly with the right attention low energy and carbon standards can be achieved.

References

King, D, McCombie and Arnold S (2012) The case for centres of excellence in sustainable building design. London, The Royal Academy of Engineering

LSi (2013) Centre for the Built Environment Resources and Publications, http://www.leedsmet.ac.uk/as/cebe/

2.2.2 The Performance Gap – want can we learn from Darwin? – Tom Kordel, Senior Energy Consultant at XC02 Energy, published on the UKGBC website

There is broad acknowledgement in the construction industry of late, that buildings tend not to perform in reality to the standards their design calculations predict. This is commonly known as the “performance gap”.

You might hope that the gap has been getting smaller as the building industry catches up with the pace of legislation, but in fact early indications are that it is growing at a worrying rate. This hasn’t gone unnoticed, and there are organisations in the industry (e.g. UKGBC, Carbon Buzz, Usable Buildings Trust etc.) who are attempting to reverse the tide.

There are a range of reasons for this gap that compound throughout the design and operation process to result in buildings that often use more than double their expected energy. Decisions at the design stage, that seem unimportant at the time, can have a significant impact on performance in use. Value engineering can water down sound design principles until the final built product quality is compromised. Occupant behaviour often confounds our expectations and leads to a building that, if operated as expected, might perform well, to disappoint us simply because we either failed to properly understand the occupant’s needs or because we did not successfully communicate to the client how best to operate their new building.

Commissioning is currently a notably weak link in the construction process. When timetables slip, the commissioning period is the first to get squeezed. Similarly in budgetary terms commissioning

is perhaps seen as less crucial than other areas. The commissioning engineer (CE) is typically hired by the main contractor, which inevitably leads to a pressure to sign off systems as the deadline of practical completion approaches. In smaller projects particularly, the CE is often the installer, which can be a mixed blessing. The installer knows their part of the install inside out, but they may not fully appreciate how their system integrates into the rest of the building design quite so well. Standard manufacturer settings might not be ideally suited to every installation.

How do we fix this situation? We don't yet have a clear answer, but some frameworks such as Soft Landings are producing promising results and there are perhaps other changes that can improve matters. If the client typically hired the lead CE rather than the contractor, they might end up with a commissioning process that is impacted less by completion deadlines. If the budget and time allocated for commissioning could be protected this might also help the situation. But these things are unlikely to become standard practice. Not without some incentive, some accountability, some feedback. On a broader scale, we know that the issues at each construction and design stage are affecting our buildings, but in a culture where buildings are handed over and forgotten about, there is little motivation, other than a time limited and often ill-used defects period, to fix things. Part L and EPCs focus on building design, not results; so as long as it looks good on paper as a designer, we're happy.

This status quo can't last. If we're to meet the ambitious CO_2 targets that have been set, we have to improve our buildings in reality as well as in theory. This can't happen if we don't learn as an industry from our own creations. There has to be feedback for things to improve, both quantitative and qualitative. How much energy does the building use, where does it go and why? Are the occupants comfortable in this building? If not, why not? What could have been done better? How can the building be optimised? – These are all questions we should be asking about every building we complete.

In short, as shown in the case of natural selection, feedback is essential. Without it we end up perpetuating the bad ideas, while the good ideas don't get their chance to multiply.

Building Performance Evaluation (BPE) is an attempt at providing this feedback, and in an ideal world we would carry it out on every new building. However, it can be an expensive and time consuming activity, and most clients or project teams will not be willing to invest the money required to carry it out unless it is compulsory or cost effective. I believe it can be cost effective if we examine it over a long enough period or a broad enough scope. The savings to the industry as a whole generated by working out what systems and designs are most effective are considerable. We just need to find a way to line up the interests of the individual parties involved with the interests of the industry.

There are growing calls in the construction industry for the government to implement mandatory DECs for all, and some even suggest removing the design targets in Part L altogether, and in their place introduce performance targets based on actual in use results. This would be a significant shake-up and could be just the medicine the industry needs to boost the feedback loop. With increasingly stringent performance targets, the industry would quickly learn to ensure buildings

perform in operation. As an inevitable side effect building design and construction would begin to evolve in the way it ought to.

2.2.3 Closing the gap. Lessons learnt on realising the potential of low carbon building design – Carbon Trust, part of their 'Sharing our experience' series

This booklet (see link below) was produced based on real data gained during 28 case studies from the Department of Energy and Climate Change's Low Carbon Buildings Programme and their work on refurbishments. The projects cover many sectors including retail, education, offices and mixed use residential buildings.

https://www.carbontrust.com/media/81361/ctg047-closing-the-gap-low-carbon-building-design.pdf

2.3 Summary of findings

The following section summarizes the findings gathered on the performance gap during a short research period looking at Zero Carbon Hub studies.

2.3.1 The Performance Gap

The performance gap is the difference between the predicted energy performance of a house and its performance as-built. This gap is caused by many different factors as stated in the Zero Carbon Hub's end of term report for July 2014. The report included many different reasons for the gap as well as what can be done by services in the housing industry and by the government to increase the shift towards houses that produce no performance gap. This report summarises the points made in the Zero Carbon Hub's end of term report about the causes of the performance gap and what can be done to close the gap and potentially eliminate it.

What is the performance gap and what causes it to occur?

The performance gap is the difference between the designed energy performance of a house and the as-built energy performance. This gap is caused by the lack of training provided to the workforce that builds houses on energy performance and what affects it. This means that the expertise in energy performance that were available for the design stage of the process are no longer available for the construction stage, so unintended changes occur causing the performance gap to occur. Another reason given for the performance gap is that the new entrants into this work force are not being trained in energy performance. A third reason given for the energy gap was that the Government isn't leading the way for improvements to the as-built energy performance.

2.3.2 Priority changes for industry

Change in continuity

The lack of continuity with regards to energy performance is one of the main causes of the performance gap as the expertise needed to keep the energy performance up to the level of the design of the house is not kept as unintended changes are made that reduce it. Zero Carbon Hub has therefore suggested that, what they described as, an 'energy champion' is appointed, and will

be involved in the entire process for the construction and design of the houses. This 'energy champion' would have the required expertise to make sure that all of the houses are built to the spec they were designed to be, this in turn would eliminate some of the energy gap and increase the continuity, therefore causing a reduction in the performance gap.

Change in processes

Currently in industry the moment the house design is ready to move onto the next stage of the process, it goes without a seconds thought about whether its energy performance is the same as it was before the start of that part of the process. Due to this lack of adequate checking Zero Carbon Hub have proposed that the design of the house should be checked as to whether it would have the same energy performance as the original design before it is allowed to continue to the next stage. This will mean that the performance gap is closed even more as the steady loss of energy performance from the original design will be mostly eliminated as it will be checked at each stage for any changes in its energy performance.

Change in training for new entrants and the current workforce

The new entrants into the workforce should be trained in energy performance so that they can contribute to the continuity of the energy performance expertise in the construction part of the process. More extensive training for them would mean that unintended changes would not occur as they would know what the consequences of that change would include and how it would affect energy performance. Furthermore the training provided to the current workforce would enable these changes in knowledge to occur in the construction stage before the new entrants arrive from their training. This would mean that the new entrants would just add to the knowledge of the current workforce, so the performance gap will be closed even more.

Change in attitudes towards competitors

Zero Carbon Hubs idea of the online 'Knowledge Hub' is a way of keeping a level playing field in the housing industry. The 'Knowledge Hub' is a proposed online service on which companies post their discoveries about causes and solutions to the performance gap. The hub would enable all companies to have access to the same data, so all should be able to build houses that have the energy performance levels that they were designed to have and not end up with unintended changes.

2.3.3 Priority actions for Government

Show clear direction

The government should show that they want the construction industry to implement measures to counteract the performance gap and to give the industry a reason to do it. Zero Carbon Hub suggest that they should not put any regulations in place to counteract it but let the industry have control over that until 2020, by which time industry should be addressing the situation with the performance gap and be able to prove it.

Show that they are serious about closing the Performance Gap

The government should show that they are serious about helping closing the gap. To do this they should help fund R&D into testing the energy performance of planned houses more accurately, in order to support the industry in providing the required information to quantify the performance gap, but also help create learning loops so that everyone in the industry gains from the government funding.

Strengthen the requirement for compliance

Zero Carbon Hub are encouraging the government to take action by 2016 to ensure that the Zero Carbon Hub revisions to energy modelling practises, SAP processes and verification procedures, along with a requirement for appropriately qualified personnel to carry out energy modelling, can be implemented. This will mean that there would be more persons with higher levels of qualifications working in the industry, so a greater proportion of the workforce would know what will and what won't affect the energy performance of a building.

Support of skills and knowledge improvement

The government should be encouraged to accelerate the demand for personnel with higher levels of education and more specialised qualifications. This would drive the industry to develop its skills and knowledge so that the performance gap can be driven to close up as more specialised skills will be required.

2.3.4 Improving skills of the existing workforce

Site operatives

Site operatives need to be educated in energy performance so that they know what they can and can't do to the design of a building. They also need to be taught not to drastically change the design of a building so that the finished building is as close to the original design as physically possible. They also need to be taught that when the drawings and designs they are given to construct the building from are inadequate they should take them back to site management. The best order to build the buildings in so that the energy performance isn't affected during the construction also needs to be taught.

Other construction managers and building professionals

Stakeholders in the housing industry must be made suitably aware of low energy designs and the performance gap. This would mean that more money would be put into funding houses that are

more energy efficient and have less of a performance gap. It is apparent that there are often issues between design and construction teams due to a lack of specific collaborative planning sessions involving both teams. If these planning sessions were to happen then the construction team would be able to understand clearly what the design team want the house to be like and which sections of the house are vital to its energy performance and which sections aren't.

3 The Construction Process

3.1 The UK construction market

The UK construction market is very mature, and is regulated by a combination of primary legislation and local rules and practices.

3.2 Legislation and Regulations

3.2.1 Primary legislation

The main piece of primary legislation controlling construction in the UK is *The Building Act 1984*. This primary requirement is interpreted further through secondary requirements such as the Building Regulations. Specific requirements exist for three areas within the UK - England and Wales, Scotland and Northern Ireland, but generally follow the overall requirements.

Other legislation includes:

Sustainable and Secure Buildings Act 2004

This introduced new powers and requirements with respect to a range of building related issues

The Party Wall etc. Act 1996

This covers issues around work on a wall or building element which may be part of more than one structure

Building Regulations

The legislative framework of the Building Regulations is principally made up of the Building Regulations 2010 and The Building (Approved Inspectors etc.) Regulations 2010

Local Acts

There are many Local Acts in operation in various areas in England and Wales. The local authority will be the arbiter of relevant Acts under their jurisdiction

Charges for Building Control

The Building (Local Authority Charges) Regulations 2010 enable local authorities in England and Wales to charge for carrying out their main statutory building control functions relating to the Building Regulations

3.2.2 Planning permission

The construction of new buildings and facilities in the UK must be in accordance with policies determined by central Government, aimed at allowing development which is sustainable and in the interests of the communities in which they may be located.

In 2012 the previous planning requirements were replaced by the National Planning Policy Framework. This change was aimed at simplifying the planning process and giving local communities a greater say in what development is permitted locally.

The National Planning Policy Framework sets the minimum requirements from a central Government perspective, and the local authorities and communities have the freedom to produce further requirements to suit the particular needs of the local environment.

The National Planning Policy Framework constitutes guidance for local planning authorities and decision-takers both in drawing up plans and as a material consideration in determining applications. It states 12 'core planning principles' that should:

- be genuinely plan-led, empowering local people to shape their surroundings, with succinct local and neighbourhood plans setting out a positive vision for the future of the area. Plans should be kept up-to-date, and be based on joint working and co-operation to address larger than local issues. They should provide a practical framework within which decisions on planning applications can be made with a high degree of predictability and efficiency;

- not simply be about scrutiny, but instead be a creative exercise in finding ways to enhance and improve the places in which people live their lives;

- proactively drive and support sustainable economic development to deliver the homes, business and industrial units, infrastructure and thriving local places that the country needs. Every effort should be made objectively to identify and then meet the housing, business and other development needs of an area, and respond positively to wider opportunities for growth. Plans should take account of market signals, such as land prices and housing affordability, and set out a clear strategy for allocating sufficient land which is suitable for development in their area, taking account of the needs of the residential and business communities;

- always seek to secure high quality design and a good standard of amenity for all existing and future occupants of land and buildings;

- take account of the different roles and character of different areas, promoting the vitality of our main urban areas, protecting the Green Belts around them, recognising the intrinsic character and beauty of the countryside and supporting thriving rural communities within it;

- support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change, and encourage the reuse of existing resources, including conversion of existing buildings, and encourage the use of renewable resources (for example, by the development of renewable energy);

- contribute to conserving and enhancing the natural environment and reducing pollution. Allocations of land for development should prefer land of lesser environmental value, where consistent with other policies in this Framework;

- encourage the effective use of land by reusing land that has been previously developed (brownfield land), provided that it is not of high environmental value;

- promote mixed use developments, and encourage multiple benefits from the use of land in urban and rural areas, recognising that some open land can perform many functions (such as for wildlife, recreation, flood risk mitigation, carbon storage, or food production);

- conserve heritage assets in a manner appropriate to their significance, so that they can be enjoyed for their contribution to the quality of life of this and future generations;

- actively manage patterns of growth to make the fullest possible use of public transport, walking and cycling, and focus significant development in locations which are or can be made sustainable; and

- take account of and support local strategies to improve health, social and cultural wellbeing for all, and deliver sufficient community and cultural facilities and services to meet local needs.

Local planning authorities set out the strategic priorities for the area in a Local Plan. This should include strategic policies to deliver:

- the homes and jobs needed in the area
- the provision of retail, leisure and other commercial development
- the provision of infrastructure for transport, telecommunications, waste management, water supply, wastewater, flood risk and coastal change management, and the provision of minerals and energy (including heat)
- the provision of health, security, community and cultural infrastructure and other local facilities, and
- climate change mitigation and adaptation, conservation and enhancement of the natural and historic environment, including landscape.

Planning applications are to be submitted for each qualifying project via the appropriate local authority planning department. Typically in England and Wales, a decision on a particular application will be given within eight weeks of submission of all required planning documents. This period may be extended if further information is needed due to the nature of the application.

3.2.3 Building Regulations

Whereas the planning process is concerned with the form and location of development, the technical quality of what is constructed is dealt with under Building Control requirements.

Once planning permission has been granted, a submission must be made to the appropriate building control body for approval prior to starting work. The Building Regulations is the primary legislation for controlling the quality of construction in the UK. The Regulations themselves consists of 14 technical 'parts' which set overall objectives, but do not prescribe how to achieve them.

The Building Regulations are made under powers provided in the Building Act 1984, and apply in England and Wales. The current edition of the regulations are 'The Building Regulations 2010' and the Building (Approved Inspectors etc.) Regulations 2010 and the majority of building projects are required to comply with them.

Further amendments made to the Building Regulations 2010 and the Building (Approved Inspectors etc.) Regulations 2010 are:

- The Building Regulations etc (Amendment) (No.2) Regulations 2013 (SI2013/1959) comes into force as set out in the regulations
- The Building (Amendment) Regulations 2013 (SI 2013/1105), comes into force on 3 July 2013
- The Building Regulations etc (Amendment) 2013 (SI 2013/181), and correction slip, came into force on 5 February 2013
- The Building Regulations etc (Amendment) 2012 (SI 2012/3119), and correction slip to come into force at various times in 2013
- The Building (Amendment) Regulations 2012(SI 2012/718),
- The Building (Amendment) Regulations 2011(SI 2011/1515),

The Building Regulations contain definitions, procedures, and what is expected in terms of the technical performance of building work.

For example, they:

- Define what types of building, plumbing, and heating projects amount to 'building work' and make these subject to control under the Building Regulations
- Specify what types of buildings are exempt from control under the Building Regulations
- Set out the notification procedures to follow when starting, carrying out, and completing building work
- Set out the 'requirements' with which the individual aspects of building design and construction must comply in the interests of the health and safety of building users, of energy conservation, and of access to and use of buildings

Checking that the Building Regulations have been complied with is done by Building Control Bodies - either the Building Control department of the local authority or a private sector Approved Inspector. Certain types of building work close to or directly affecting the boundary or party wall of premises may also be covered by the "Party Wall Act" which places obligations on people carrying out work.

Some non-domestic premises may also be subject to requirements in Local Acts.

3.2.4 Approved Documents

Guidance on how to achieve compliance with the Building Regulations is provided in the form of Approved Documents. These describe approved methodologies for achieving the broad requirements of the

Regulations, and are used by the building control authorities to assess compliance of any relevant proposed building project. The full list of Approved Documents is:

Approved Document A (Structural safety)

This section covers the technical guidance that supports Part A of schedule 1 of the Building Regulations concerned with the requirements with respect to structural safety.

Approved Document B (Fire safety)

This section covers the technical guidance that supports Part B of schedule 1 of the Building Regulations, concerned with the requirements with respect to fire safety.

Approved Document C (Resistance to contaminants and moisture)

This section covers the technical guidance that supports Part C of schedule 1 of the Building Regulations, concerned with the requirements with respect to site preparation and resistance to contaminants and moisture.

Approved Document D (Toxic Substances)

This section covers the technical guidance that supports Part D of schedule 1 of the Building Regulations, concerned with the requirements with respect to toxic substances.

Approved Document E (Resistance to sound)

This section covers the technical guidance that supports Part E of schedule 1 of the Building Regulations, with the requirements with respect to resistance to sound.

Approved Document F (Ventilation)

This section covers the technical guidance that supports Part F of schedule 1 of the Building Regulations, concerned with the requirements with respect to ventilation.

Approved Document G (Sanitation, Hot Water Safety and Water Efficiency)

This section covers the technical guidance that supports Part G of schedule 1 of the Building Regulations, with the requirements with respect to Sanitation, Hot Water Safety and Water Efficiency.

Approved Document H (Drainage and waste disposal)

This section covers the technical guidance that supports Part H of schedule 1 of the Building Regulations, with the requirements with respect to Drainage and waste disposal.

Approved Document J (Heat producing appliances)

This section covers the technical guidance that supports Part J of schedule 1 of the Building Regulations, with the requirements with respect to heat producing appliances.

Approved Document K (Protection from falling)

This section covers the technical guidance that supports Part K of schedule 1 of the Building Regulations, with the requirements with respect to protection from falling.

Approved Document L (Conservation of fuel and power)

This section covers the technical guidance that supports Part L of schedule 1 of the Building Regulations, with the requirements with respect to Conservation of fuel and power.

Approved Document M (Access to and Use of Buildings)

This section covers the technical guidance that support Part M of schedule 1 of the Building Regulations, with the requirements with respect to Access to and use of buildings.

Approved Document N (Glazing safety) From 6 April 2013 - Only relevant to Wales

This section covers the technical guidance that supports Part N of schedule 1 of the Building Regulations, with the requirements with respect to glazing safety.

Approved Document P (Electrical Safety)

This section covers the technical guidance that supports Part P of schedule 1 of the Building Regulations, with the requirements with respect to electrical safety.

Part Q (Security: Dwellings)

This section covers the technical guidance that supports Part Q of schedule 1 of the Building Regulations, with the requirements with respect to the security of dwellings.

3.3 Plans of Work

The general construction process in the UK is reflected in the various plans of work which exist. Organisations such as the RIBA (Royal Institute of British Architects) and the CIC (Construction Industry Council) have produced broadly similar plans of work, with the RIBA document being the most widely used.

The plan of work is used to describe what the various parties are required to do throughout the project, either in terms of activities or outputs. However, it should not be confused with the form of contract which is the legal contract used to employ the parties.

3.3.1 RIBA Plan of Work 2013

The RIBA Plan of Work 2013 organises the process of the briefing, designing, constructing, maintaining, operating and using building projects into a number of key stages. It details the tasks and outputs required at each stage which may vary or overlap to suit specific project requirements. This version of the Plan of Work replaces the previous version, which had been in use since 2007.

The RIBA plan of Work, previously the 2007 version but now the 2013 version, has been the predominant plan of work used throughout UK construction for building projects. However, it is not as widely used for infrastructure projects where more specialist forms have been used, often produced by particular clients to reflect their own practices and requirements.

3.3.2 CIC Scope of Services

The CIC Scope of Services, first published in 2007, was a detailed scope of services (what people do rather than what they produce) from inception through to post practical completion, and could be used by various members of the project team including consultants and constructors.

In line with other developments around BIM in 2013 and 2014, the CIC modified its stages with those detailed in PAS 1192-2. The revised version is shown below.

3.4 Construction procurement routes

3.4.1 What is procurement?

Procurement is a term which describes the activities undertaken by a client or employer who is seeking to bring about the construction or refurbishment of a building.

This section describes the various forms of procurement currently used in the UK construction market, and is based on an article produced by JCT (Joint Contracts Tribunal), publishers of contract forms for use throughout the construction industry.

On most projects, clients (usually through their advisers or in-house teams) will start the procurement process by devising a project strategy. The strategy entails weighing up the benefits, risks and budget constraints of a project to determine what the most appropriate procurement method is, and what contractual arrangements will be required.

With every project, the client's concerns focus on time, cost and quality (or performance) in relation to both the design and construction of the building.

The client's policies, resources, organisational structure, and preferred contractual arrangements will all need to be taken into account in choosing the right procurement method for their project.

Understanding risk is essential, as although each procurement method follows a well-established set of rules and procedures, there are risks associated with choosing any particular route.

Successful procurement relies on all parties involved in the project complying with their respective obligations, and identifying and dealing with risk appropriately from the outset.

Procurement Method

There are four main procurement methods:

- Traditional/Conventional
- Design and Build
- Management
- Integrated

Traditional/conventional:

The traditional or conventional procurement method has been a standard practice in the construction industry for 150 years, following the emergence of general contracting firms and independent client consultants. There are two main features of the traditional method:

1. The design process is separate from the construction (although JCT contracts provide for design of specific parts of the works to be carried out by the contractor)

2. Full documentation (i.e. drawings, work schedules, bills of quantities) must be supplied by the client before the contractor can be invited to tender for carrying out the work.

Other features of the traditional/conventional procurement method are:

- A contractor is usually selected and appointed by competitive tender, but sometimes by negotiation.
- The terms of many traditional contracts require the client to appoint a professional consultant (i.e. architect, quantity surveyor, contract administrator) to act as an independent contract administrator.
- Full documents are needed for the tendering process – including that from specialist sub-contractors. Time is needed to adequately prepare this.
- The client has control over the design through their appointed consultants (i.e. architect). Generally there is no design responsibility on the contractor.
- Design and construction are separate sequential processes – this can increase the overall time of the project.
- There is reasonable certainty on the cost of the project because the contract figure is usually known at the outset. The contract does have provision for cost to be adjusted later, if required.
- Speculative risks are balanced between the parties. A lump sum contract is more in favour of the client whereas a measurement contract is less so. A traditional lump sum approach in terms of design, quality and cost is relatively low risk procurement option for a client, however the time required for the project overall is likely to be longer than other procurement methods.

Types of traditional/conventional contracts include:

- **Lump sum contracts** - With lump sum contracts, the contract sum is determined before construction work is started. Contracts 'with quantities' are priced on the basis of drawings and firm bills of quantities. 'Without quantities' means a contract priced on the basis of drawings and usually another document, such as a specification or work schedules.
- **Measurement contracts** - The contract sum for measurement contracts is not finalised until completion of the project, where it is assessed on measurement to a previously agreed basis. This type of contract can arise where the works to be carried out by the contractor cannot for good reason be accurately measured before tender. Normally the design will be reasonably complete and an accurate indication of quality will be available to the tenderer. The contract of this type with least risk to the client is probably that based on drawings and approximate quantities. Measurement contracts can also be based on drawings and a schedule of rates or prices. A variant of this is the measured term contract under which individual works can be initiated by instructions as part of a programme of work, and priced according to rates related to the categories of work likely to form part of the programme.
- **Cost reimbursement contracts** - Sometimes referred to as 'cost-plus' or 'prime cost' contracts, these work on the basis that the sum is calculated from the actual costs of labour, plant and materials to which an amount is added to cover overheads and profit. The overhead and profit amount can be a fixed-sum, percentage, or some other reimbursement payment. This type of contract is only generally used where the circumstances of the project preclude other alternatives or where a partnering ethos is in place, as it can be quite high risk for the client.

Design and build:

Design and Build procurement works on the basis that the main contractor is responsible for undertaking both the design and construction work on a project, for an agreed lump-sum price.

Design and build projects can vary depending on the extent of the contractor's design responsibility and how much initial design is included in the employer's requirements. Nevertheless, the level of design responsibility and input from the contractor is much greater on design and build projects than a traditional contract with a contractor's designed portion.

Adequate time must be allowed to prepare the employer's requirements (the employer usually appoints consultants to facilitate this), as well as time for the contractor to prepare their proposal and tender price. It is vital that the proposal matches all of the employer's requirements before any contract is entered into.

The employer has control over any design elements of the project that are included in their requirements, but once the contract is let responsibility over design passes to the contractor, so the employer has no direct control over the contractor's detailed design.

The contractor can carry out the design in a number of ways. Often they will appoint their own consultants or use their own in-house team. It is also common practice for the contractor to take on the employer's consultants and continue to use them to complete the detailed design under what is known as a novation agreement.

Other features of the design and build procurement method are:

- As design and construction can be carried out in parallel, the overall programme time of design and build projects can be shorter. However this depends on how much design the contractor is responsible for.
- There is reasonable certainty over costs because the contract price is known at the outset. Provided the employer does not order changes during the construction of the work, the contractor will be obliged (subject to the conditions) to complete the project for the contract sum. If the employer does require design or specification changes during the construction period, the contractor advises as to the effect this may have on costs or additional time needed.
- Design and Build is a relatively low risk procurement option for the employer, in terms of cost and time. There can be a risk related to design and quality, particularly if the employer's requirements were not properly gathered and if insufficient time went into examining the contractor's proposal.

Types of traditional/conventional contracts include:

- **Package deal or turnkey contracts -** This is where the employer accepts a proposal based on a standard design from the contractor, effectively providing a single point of

responsibility as the contractor is responsible for the design and construction of the entire project.

- **Design and build contracts** - This is where project documents are compiled with the contractor's design obligations relating to the whole of the works in mind.

Management:

Management procurement is a method where construction work is completed using a series of separate works or trade contracts which the main contractor is responsible for managing. The contractor does not actually do the physical work, but is paid a sum for managing the project through the various works packages.

The employer starts by appointing consultants and a contract administrator to prepare drawings, a project specification and cost plan. The employer has control over design throughout the project through their professional team. The contractor is appointed by negotiation or tender, and interview. The works packages are usually let by competitive tender.

It is beneficial for the proposed contractor to be involved as early as possible as they will provide expertise in terms of buildability and programming of the works packages.

Other features of the design and build procurement method are:

- Design can proceed in parallel with construction, and much of the design might be of a specialist nature related to a specific package of work. Early starts on site are often possible and overall project time can be reduced as a result.
- There is no certainty over cost at the outset and work proceeds on the basis of the cost plan. The final cost of the project will not be known until the final works package is let, however costs can be monitored and controlled by the employer's professional team.
- Design changes are possible during the construction phase, provided that the changes do not affect work on packages already let, which can result in aborted work.
- Completion within the contract period is an obligation of the contractor, and extensions of time cannot be granted without permission from the contract administrator.
- Risk is largely with the employer, in respect of costs and time. A degree of trust and in-house expertise is required for management procurement projects. However this is a low risk option for the employer in terms of design and quality because of the control they have over the professional team.

Management procurement generally works on the basis of two different methods:

Management contracts - With management contracts, the employer appoints a professional team and a management contractor who is responsible for managing the works. The management contractor does not directly undertake any of the construction, this is spilt into packages and carried out by works contractors. The management contractor appoints the works contractors, and they are directly and contractually accountable to the management contractor. A pre-construction phase will allow a programme of works packages to be developed from the drawings, specification and cost plan, which are then let out by competitive tender.

Although contractually responsible for the works contractors, the management contractor is not liable for any default by a works contractor, provided they have complied fully with the terms of the management contract.

A variation on this method is 'design and manage' where the management contractor is responsible for the design team as well as the works contractors.

Construction management - With construction management contracts, the employer will appoint a professional team with either an in-house manager, or enters an agreement with a construction manager to oversee the work. The construction manager does not directly undertake any of the construction work, this is split into packages and carried out by trade contractors. The employer appoints the trade contractors and is directly responsible for them. The construction manager manages the works, but the employer has a major role in directing the project.

Integrated:

Integrated procurement, sometimes known as collaborative procurement or partnering, is intended to focus the participants of a project on the mutual objectives of delivering a project on time, to budget and to quality. It is about working as a team, regardless of organisation or location, to meet a client's needs.

JCT's range of partnering documents set the standard for collaborative contract working. Partnering is a principle that can be applied to most JCT contracts and provision is made for this in our Non-Binding Partnering Charter (PC/N).

4 Changes to the construction process in the UK

4.1 UK Construction initiatives

In May 2011, the UK Government Cabinet Office published its Government Construction Strategy. It stated that there was widespread acknowledgement across Government and within industry – backed by studies – that the UK did not get full value from public sector construction; and that it had failed to exploit the potential for public procurement of construction and infrastructure to drive growth.

The strategy detailed a programme of measures which the Government would take to reduce costs for construction projects by up to 20% within the lifetime of that parliament. A number of these measures had the ability to impact directly on construction performance, and therefore the gap between what was designed and what realised in operation.

A key aspect of the strategy was to replace adversarial cultures with collaborative ones, and one specific initiative identified was BIM (building information modelling). This should promote collaborative processes, resulting in better performing built assets, together with savings in costs and carbon emissions.

4.2 Building Information Modelling (BIM)

4.2.1 Government BIM requirements

In preparing the Government Construction Strategy, a number of source documents and reports were considered. The BIM Industry Working Group published a paper in March 2011 to brief the Government's Client Construction Group (replaced by the Government Construction Board) on its progress and findings. This document described BIM in terms of maturity levels and set their suggested target at Level 2, defined as:

> 'Managed 3D environment held in separate discipline "BIM" tools with attached data…'

The UK Government's BIM strategy set the target of achieving Level 2 BIM on central departmental construction projects by 2016, and embarked on a 5-year programme to develop the necessary tools and processes to enable the industry to achieve their target.

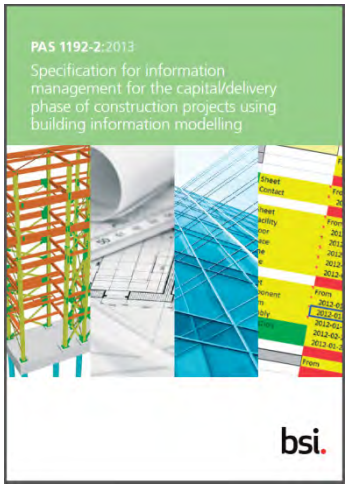
This work is now nearing completion, and the BIM Level 2 requirement is defined by a number of standards and documents published over the last two years or so. These are:

1. **PAS 1192-2:2013** Specification for information management for the capital/delivery phase of construction projects using building information modelling

2. **PAS 1192-3:2014** Specification for information management for the operational phase of assets using building information modelling
3. **BS1192-4:2014** Collaborative production of information. Part 4: Fulfilling employer's information exchange requirements using COBie – Code of practice
4. **PAS 1192-5:2015** Specification for security-minded building information modelling, digital built environments and smart asset management
5. **Building Information Model (BIM) Protocol**
6. **GSL (Government Soft Landings)**
7. **Digital Plan of Work**
8. **Classification**

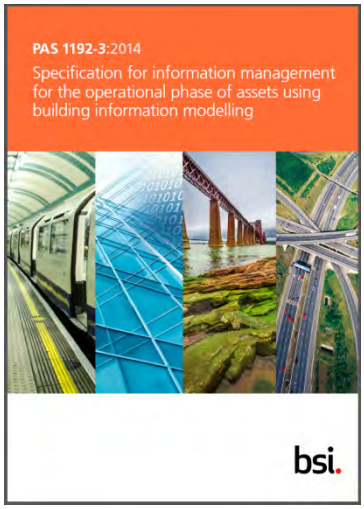
PAS 1192-2:2013 builds on the processes described in BS 1192:2007, and introduces new concepts such as employer's information requirements (EIR) – the employer's expression of what information they require from the project and the format it should be in, and BIM execution plans (BEP) – the supply chain's response to the EIR showing how it will meet its requirements.

It also describes the project information model (PIM), defined as the information model developed during the design and construction phase of a project. It is developed initially as a design intent model and then becomes a virtual construction model.



PAS 1192-3:2014 takes the processes descried in earlier 1192 publications and develops them for use in the operational life of assets. In turn, this leads to the use of new concepts such as organizational information requirements (OIR) – the information which the organisation needs to know in order to run the business, the asset information requirements (AIR) – the information the organisation needs about the asset it is responsible for, and the asset information model (AIM) – the information or data set which describes the asset.

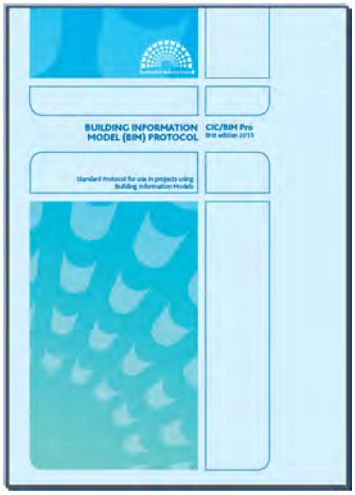
This is an important document for the FM industry as it sets out the need for comprehensive and accurate information, the AIM, which can be used as the basis for all asset-related decision making. However, it also requires that the AIM is kept up-to-date to accurately reflect the status of the asset.



BS 1192-4 defines requirements for the exchange of information throughout the lifecycle of an asset, and includes requirements for reviewing and checking for compliance, continuity and completeness. COBie is the UK Government's chosen information exchange scheme for federated BIM Level 2, alongside graphical BIM models and PDF documents.

PAS 1192-2015 has been written to help all those involved in providing and operating assets to understand the security implications – both physical and cyber – that sharing increasing amounts of data may have. This PAS was in preparation at the time of writing and is due for publication in summer 2015.

The BIM Protocol was published by the CIC in February 2013 and identifies building information models that are required to be produced by the project team and puts in place specific obligations, liabilities and associated limitations on the use of those models. The protocol can also be used by clients to require the adoption of particular ways of working – such as the adoption of a common naming standard.



Soft Landings is a form of graduated handover for new and refurbished buildings, where the project team is contracted to watch over the building, support the occupant and to fine-tune the building's systems, for up to three years post-completion.

The link with a Soft landings process – or **GSL** (Government Soft Landings) in the case of the Government – may initially seem a tenuous one, but the data gathered during the operational phase of an asset can be very important in helping to shape project needs through effective EIRs. It is vital that the way the asset is used and maintained is considered during the briefing and design process to help provide assets which work as required by the occupants.

The UK Government has taken the principles of Soft Landings and developed it for use within its own procurement strategy. This particular version has been termed Government Soft Landings, or GSL, and its key objective, as stated in *The Government Soft Landings Policy – September 2012*, is:

> "Aligning the interests of those who design and construct an asset with those who subsequently use it"

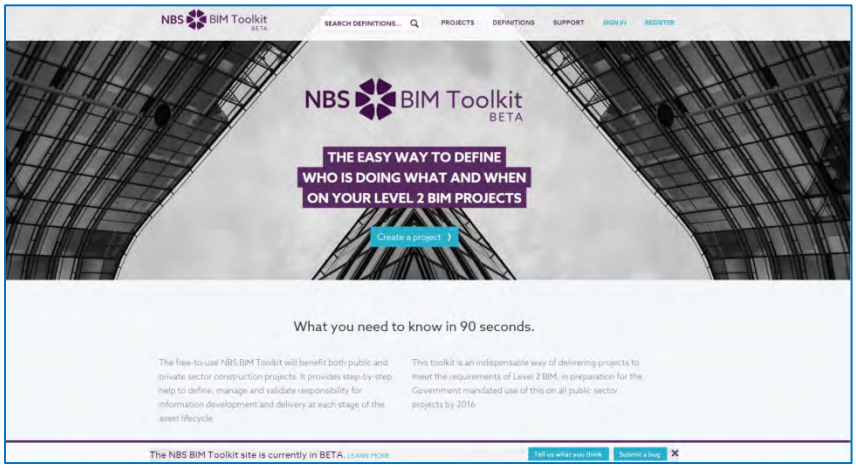
Although the GSL process generally follows the Soft Landings methodology described by the Usable Buildings Trust (UBT) and BSRIA, it differs in one very significant way – it includes the use of metrics to demonstrate compliance with the stated project outcomes. More information on Soft Landings and GSL is contained in 4.3.

Digital Plan of Work (dPoW) and Classification have been seen as the two missing pieces of the BIM Level 2 jigsaw, and are the subject of a research project funded by Innovate UK (formerly the Technology Strategy Board). This delivered the first beta version in April 2015.

The output is an on-line tool which enables clients to prepare a plan of work for a project, which can then be exported for use in other documents such as EIRs. This plan of work allows the user to identify the different outputs required at each stage of the project process, and also to assign the delivery of those to a member or members of the project team.

The tool also has the ability to provide classification codes for various aspects of the construction process, and a number of classification tables were available as part of the beta release, including those for complexes down to products.

It is expected that a more complete version of the tool will be available later in 2015, taking into account feedback from the beta version.



4.3 Soft Landings

4.3.1 Introduction to Soft Landings

The following content has been published by BSRIA in their guide BG 54/2014, and is reproduced here to help articulate the current situation with Soft Landings in the UK construction sector. The content is included largely as originally published, but some minor editing has been done to better suit this application.

Background to Soft Landings

There is a growing realisation that sustainability, energy efficiency and the overall performance of new and existing buildings needs to improve radically. Clients, governments, and society are looking to the construction industry to meet increasingly challenging targets: for owners as robust sustainable investments, to satisfy occupiers, and to tread lightly on the environment.

Unfortunately, the construction industry and its clients do not yet have the right structures in place to deliver these improvements reliably. **Surveys of recently completed buildings regularly reveal massive gaps between client and design expectations and delivered performance (the performance gap), especially energy performance.**

There are many reasons for this, including:

- Many designers do not take sufficient account of how occupiers use and manage buildings and the equipment they introduce.
- Achieved performance is becoming increasingly dependent on technology, which often needs careful attention if it is to work as intended. Pre-handover commissioning is seldom enough.
- Solutions that look good in design calculations can often prove to be too complicated to be manageable, both through the design and delivery process and particularly in use. Designers can

easily forget that management is a scarce resource, as can those procuring clients who do not have a direct involvement in building operation.

An underlying problem is that designers and builders are normally employed to produce or to alter buildings, and are expected to go away as soon as the work is physically complete and handed over. They are seldom asked or paid to follow-through afterwards, to pass on their knowledge to occupiers and management, or to learn from the interaction. Consequently, the industry does not unlock all the value in the buildings it creates. Nor does it fully understand what it is creating, what works well, and what needs to be improved.

In the process, the industry is also missing opportunities for improving the knowledge base for its people, its organisations, and indeed for everybody. One might be tempted to blame the industry for this, but the causes are more deeply rooted, making it difficult for anybody to step far out of line.

The rigid separation between construction and operation means that many buildings are handed over in a state of poor operational readiness and suffer a hard landing, particularly – as often happens – when delays have led to the telescoping of the commissioning period. Problems can be worst where complicated or unfamiliar techniques and technologies are used and nobody can understand why, or what they need to do. If the problems are not dealt with rapidly, occupants' initial enthusiasm can easily turn into disappointment.

Doing things differently

To meet these changing expectations, and to reduce the gaps between predicted and achieved performance, the design and construction professions must not only focus on technical inputs, but put much more emphasis on in-use performance strategies. The desired operational outcomes need to be considered at the very earliest stages of procurement, managed right through the project and reviewed in use.

This culture shift in the way buildings are delivered will require:

- Better and more direct understanding of how buildings are actually used and managed
- Integration of follow-through and feedback into clients' appointments and industry procurement processes
- Better review and reality-checking and fine-tuning during the procurement process
- Closer links between design, construction, operation, research and development, so that experience gained on all projects is rapidly internalised, digested and fed-forward to inform existing projects and future work.

The industry and its clients must move fast: especially to reduce greenhouse gas emissions, which otherwise threaten to trigger rapid climate change. The challenge is immense and time is short: buildings last a long time, but the industry changes slowly. The required alterations are radical, but we need ways of making an orderly transition from existing procedures to improved procedures.

The purpose of Soft Landings

Soft Landings can be used for new construction, refurbishment and alteration. It is designed to smooth the transition into use and to address problems that post occupancy evaluations (POE) show to be widespread. It is not just about better commissioning and fine tuning, though for many buildings commissioning can only be completed properly once the building has encountered the full range of

weather and operating conditions.

Soft Landings starts by raising awareness of performance in use in the early stages of briefing and feasibility, helps to set realistic targets, and assigns responsibilities. It then assists the management of expectations through design, construction and commissioning, and into initial operation, with particular attention to detail in the weeks immediately before and after handover. Extended aftercare, with monitoring, performance reviews and feedback helps occupants to make better use of their buildings, while clients, designers, builders and managers gain a better understanding of what to do next time. Soft Landings can run alongside any procurement process, potentially in any country. It also provides a natural route for POE and feedback.

Soft Landings provides additional support throughout the process, especially:

- During inception and briefing, to establish client and design targets which are better-informed by performance outcomes in use on previous projects. It also commits those joining the design and building team to follow-through after handover and for project management to begin to allocate responsibilities for ongoing reviews of design intent and anticipated performance, and to prepare for the other activities required.

- Alongside the design and construction process, to review performance expectations as the client's requirements, design solutions, and management and user needs become more concrete and the inevitable changes are made. In addition the team must plan for commissioning, handover and aftercare, and involve the occupier much more closely in decisions which affect operation and management.

- In the weeks before and after handover. Although practical completion is important legally and contractually, with Soft Landings handover is no longer the end of the job, but just an event in the middle of a more extended completion stage. Before handover, the team prepares to deliver the building and its systems in a better state of operational readiness. When the occupants begin to move in, the aftercare team (or team member) will have a designated workplace in the building and be available at known times to explain design intent, answer questions, and to undertake or organise any necessary troubleshooting and fine-tuning. Both before and after handover, the design and building team will work closely with client, occupiers, and facilities managers to share experiences and smooth the transition into use.

- During the first three years of occupancy: to monitor performance, to help to deal with any problems and queries, to incorporate independent post occupancy surveys (such as occupant satisfaction, technical and energy performance), and to discuss, act upon and learn from the outcomes. Achievements and lessons should then be carried back to inform the industry and its clients.

4.3.2 Introduction to the Soft Landings process

Why use Soft Landings?

Soft Landings helps clients and occupiers to get the best out of their new or altered buildings. It is designed to reduce the tensions and frustrations that so often occur during initial occupancy, and which can easily leave residual problems that persist indefinitely. At its core is a greater involvement of designers and constructors with building users and operators before, during and after handover of building work, with an emphasis on improving operational readiness and performance in use.

Soft Landings is not just a handover protocol. It also provides the golden thread which links between:

- The procurement process: setting and maintaining client and design aspirations that are both ambitious and realistic, and managing them through the whole procurement process and into use
- Initial occupation, providing support, detecting problems, and undertaking fine-tuning; and
- Longer-term monitoring, review, post-occupancy evaluation (POE) and feedback – drawing important activities into the design and construction process which are both rare in themselves and often disconnected.

Other important but less directly tangible benefits include client retention owing to the improved levels of service, greater mutual understanding between designers, builders, clients, occupiers and managers, education of design and project team members in what works well and what may be causing difficulties. It also helps to develop industry skills in problem diagnosis and treatment.

What is special about it?

Soft Landings is embedded in the entire procurement process from initial scope to well beyond project completion. Conventionally, buildings are simply handed over to the client and the design and building team walk away, never to come back, except to deal with snags or reported failures. By contrast, Soft Landings helps to:

- Minimise the chances of unsatisfactory performance by strengthening the vulnerable areas of traditional scopes of service, which too often result in occupier complaints downstream.

- Address and even pre-empt problems during the early occupation phase, by providing an on-site designer/contractor representative or team that can assist occupiers and management.

- Ensure that lessons from closer interaction with the occupiers – and from evaluating actual building performance in use – are learnt and shared to the benefit of all stakeholders.

Soft Landings helps to bring things together

Many techniques of project feedback and post-occupancy evaluation (POE) are aimed at one particular stage of a project or to suit a single discipline or element such as building services engineering. Many are used solely in the post-occupation phase when it is too late to tackle the strategic problems that originated in briefing, design and project management. Soft Landings provides a process carrier for these techniques, so helping to unite all disciplines and all stakeholders and to extend the procurement process beyond handover.

As POE becomes more routine, findings and benchmarks from previous POE surveys can be used to help calibrate client and design expectations. Where practicable, results from these surveys can also provide metrics that allow these expectations to be tracked from briefing, through design development, construction and commissioning, and into operation.

How do contractual duties change?

Soft Landings extends the duties of the team before handover, in the weeks immediately after handover, for the first year of occupation, and for the second and third years. In order to improve the chances of success, it reinforces activities during the earlier stages of briefing, design and construction. The overall objective is better buildings, with better performance which matches more closely the expectations of the client and the predictions of the design team.

Soft Landings creates opportunities for greater interaction and understanding between the supply side of the industry and clients, building users and facilities managers. It helps everybody concerned to improve their processes and products, and to focus innovations on things that really make a difference.

Is there a standard scope of service?

Soft Landings procedures are designed to augment standard professional scopes of service, not to replace them. They can be tailored to run alongside most industry standard procurement routes to create the most appropriate service to suit the project concerned.

Major revisions to industry-standard documentation are not necessary. The main additions to normal scopes of service occur during five main stages:

1. **Inception and briefing** to clarify the duties of members of the client, design and building teams during critical stages, and help set and manage expectations for performance in use.

2. **Design development and review** (including specification and construction). This proceeds much as usual, but with greater attention to applying the procedures established in the briefing stage,

reviewing the likely performance against the original expectations and achieving specific outcomes.

3. **Pre-handover**, with greater involvement of designers, builders, operators and commissioning and controls specialists, in order to strengthen the operational readiness of the building.

4. **Initial aftercare** during the users' settling-in period, with a resident representative or team on site to help pass on knowledge, respond to queries, and react to problems.

5. **Aftercare in years 1 to 3 after handover**, with periodic monitoring and review of building performance.

The following section explains how Soft Landings aligns with RIBA Plan of Work and BSRIA BG 6/2014 Design Framework for Building Services, and outlines the content of the five stages in Soft Landings.

Annex 2

Table 1: How Soft Landings aligns with the 2008 and 2013 editions of the RIBA Plan of Work and the workstages of BSRIA BG 6/2014 Design Framework for Building Services.

RIBA 2008 Stages	RIBA 2013 Stages	CIC stages 2012	Soft Landings	Soft Landings supporting activities	BSRIA BG 6/2014 *Design Framework* pro-formas
	0 - Strategic definition	0 - Strategic definition			0 - Strategic activities
A Appraisal	1 - Preparation and brief	1 - Preparation and brief	Stage 1. Briefing: identify all actions needed to support the procurement	Define roles and responsibilities	1 - Preparation
B Design brief				Explain Soft Landings to all participants, identify processes and sign off gateways	
C Concept	2 - Concept design	2 - Concept design	Stage 2. Design development: to support the design as it evolves	Review past experience. Agree performance metrics. Agree design targets	2 - Concept
D Design development	3 - Developed design	3 - Developed design	Scheme design reality-check	Review design targets. Review usability and manageability	3a & 3b - Developed design
E Technical design					
F1 Production information	4 - Technical design	4 - Technical design	Technical design reality-check(s)	Review against design targets. Involve the future building managers	4a, 4b & 4c - Technical design
F2 Production information					
G Tender documentation	Information exchanges will vary depending on the procurement route and building contract. Designers can create a bespoke Plan of Work for the client's chosen procurement route in order to set out specific tendering and procurement activities for each stage.		Optional tender stage reality-check	Include additional requirements related to Soft Landings procedures	
H Tender action			Tender award stage reality-check	Include evaluation of tender responses to Soft Landings requirements	
J Mobilisation	5 - Construction	5 - Fabrication design		Confirm roles and responsibilities of all parties in relation to Soft Landings requirements	5 - Construction
K Construction to practical completion	6 - Handover and close-out	6 - As constructed	Pre-handover reality-check	Include FM staff and/or contractors in reviews. Demonstrate control interfaces. Liase with move-in plans	6 - Handover
			Stage 3. Pre-handover: Prepare for building readiness. Provide technical guidance		
			Post-handover sign-off review. Ensure all outstanding reality-checked items are complete and system is signed off and operational		
L1 Post-practical completion	7 - In Use	7 - In use	Stage 4. Aftercare in the initial period: support in the first few weeks of occupation	Incorporate Soft Landings requirements	7 - In use
L2 Post-practical completion				Set up home for resident on-site attendance	
L3 Post-practical completion			Stage5. Years 1 to 3 Aftercare: Monitoring review, fine-tuning and feedback	Operate review processes. Organise independent post-occupancy evaluations	

The workflow table above has been revised to make it compatible with other Soft Landings publications. It also includes reality-checking worksteps (shown in green) as outlined in BSRIA BG 27/2011 Pitstopping – BSRIA's Reality-checking Process for Soft Landings. Additional guidance is freely available from www.softlandings.org.uk and www.usablebuildings.co.uk.

Stage 1: Inception and briefing

Briefing is the most crucial stage of procurement. If it is not done well, it is all too easy to sow the seeds of future misunderstanding and discontent. A common problem is to put too much emphasis on the intended product, at the expense of the general background, performance requirements (both qualitative and quantitative), and the processes by which solutions should be developed and tested. The more time that can made available for constructive dialogue, the greater the likelihood of success.

To obtain the greatest value from Soft Landings, the expectations and performance targets that emerge from the briefing process should be arrived at within a well-structured, logical and recorded context. However, for various reasons it may not always be possible to give the briefing stage all the time it deserves at the outset. Consequently, Stage 1 of Soft Landings also establishes tasks, responsibilities and review procedures that allow the brief to be re-examined in response to new findings, and to help ensure that critical issues are not lost along the way.

Stage 1 checklist:

B1. Define roles and responsibilities

B2. Review past experience

B3. Plan for intermediate evaluations and reality checks

B4. Set environmental and other performance targets

B5. Sign-off gateways

B6. Incentives related to performance outcomes

Stage 2: Design development and review

Once a project team has adopted Soft Landings at Stage 1: Inception and briefing, then design development, technical design, production information and tendering will proceed much as usual. However, people will need to bring a somewhat different approach to the process. In particular:

- Everyone joining the client, design and construction teams will need to be made aware that Soft Landings is in operation and commit to adopting its principles.

- All team members will be encouraged to obtain and contribute insights from the performance-in-use of comparable projects.

- Client and design targets will be informed by actual performance in use, reviewed at intervals as the project progresses, and have any adjustments agreed and signed-off.

- Requirements for independent post-occupancy evaluation (POE) services will need to be verified. To assist comparability and transparency, where appropriate and practical, the same metrics should be used for the design targets and what the POE will measure.

- The design process should include reality-checking workshops, including reviews by experts in building performance.

- To accompany the design data, an illustrated narrative will be developed on how the building will work from the point of view of the manager and the individual user. This can evolve into the technical and user guides that will be issued to managers and occupiers at handover.

- Close attention needs to be given to the usability and manageability of the proposed design solutions, and in particular moving parts, electrical components and their control interfaces. Where the occupiers are known, their facilities managers and user representatives should be involved in reviewing the proposals and commenting not just on the design intent but also on the details of the management and user interfaces, including the equipment selected and its location.

- Suitable preparations must be made during design and construction to plan, programme and resource the critical periods in the weeks immediately before and after handover.

To make sure that all angles are covered, tender documentation may require unfamiliar interventions by other design team members.

Stage 2 checklist:

D1. Review past experience

D2. Design reviews

D3. Tender documentation and evaluation

Stage 3: Pre-handover

The main purpose of the pre-handover stage is to help to ensure that by the time the building is handed over it is not just physically complete, but ready for operation. A building readiness sub-programme therefore needs to be developed in good time, and well ahead of the start of commissioning work. Activities by the design and building team must also include static commissioning (such as inspections of airtightness details, checks of window opening devices and linkages, and envelope pressure tests). Commissioning of building services needs extending to include, for example, natural ventilation, renewable energy systems, metering installations and effective user interfaces. Great care needs to be given to demonstration, training and documentation. Proposed activities by the client and occupier also need to be reviewed, such as staffing, operation and maintenance contracts, and move-in plans including fit-outs where relevant.

It is essential that the client's management team takes over the operation of the building in a timely fashion. Problems that occur after handover can often be traced back to insufficient understanding by the occupier's staff of technical systems (particularly building services) and their user interfaces, or where solutions have been developed without enough understanding of user and operator requirements. Too often, buildings start their operational lives with too few operating staff, who are not sufficiently trained, know little about the design intent, have had no opportunity to attend a demonstration, and are unfamiliar with the systems provided and how to use them.

To avoid problems, the project team should take more care in design and specification and to pay more attention to the contractor's proposals for commissioning and handover. They will also need better understanding of operator skills and requirements and better arrangements for demonstrating interfaces and systems properly to operating staff before handover. The time spent will lay the foundations for future co-operation.

Clients play a vital part in ensuring building readiness. If they leave staffing too late (as they often do), problems with initial performance is very likely. However much the designer and constructor do to help, resolution is nearly impossible if there are no good operators available on site.

A design and construction team is often told very little about how the occupier intends to move themselves into the building. As a result, occupiers can easily make incorrect assumptions about how ready the building will be to receive them, and what access and services will be available. This in turn can cause clashes and disappointments while the move is under way, and sour initial user experiences of their new or altered building. With Soft Landings, designers and builders need to be involved with the occupier's logistics planning, if only to a small extent.

Even in the best-managed projects, the commissioning period can get squeezed, owing to delays outside the control of the design and building team, and an occupier's business requirement for a non-negotiable handover date. Soft Landings will help to reduce the effects of any such slippages as the continuity it

provides between the pre-handover and aftercare stages makes it much easier for any outstanding commissioning activities to be continued after handover.

Stage 3 checklist:

P1. Environmental and energy logging review

P2. Building readiness programme

P3. Commissioning records check

P4. Maintenance contract

P5. Training

P6. Building management system interface completion and demonstration

P7. Migration planning

P8. Aftercare team home

P9. Compile a guide for occupants

P10. Compile a technical guide

P11. O&M manual review

Stage 4: Initial aftercare

The service during the initial aftercare period is intended to help the occupiers to understand their building, and the facilities managers to operate its systems. The aftercare team is there to provide information and support, to respond to any questions that arise and to investigate any problems that emerge. It is important that the building's facilities or management team is properly resourced, so they have the skills and time to take advantage of this service. Soft Landings will not work properly if the occupiers think they can sit back and leave things to the aftercare team.

During the initial aftercare period, one or more members of the design and building team will be present on site for typically four to six weeks immediately after move-in. After this initial period, the residential presence of design and construction team members will taper off, but periodic reviews will continue, as outlined in Stage 5.

The size and complexity of the project and the occupants' move-in timetable will determine how much time will be required, over what period, and for how many people. It could be as little as one day per week, but much will depend on what actually happens once the occupier moves in.

One of the team should act as the main point of contact for overall liaison. This will usually be the architect, but that depends on the project. Building services and commissioning engineers always need to be closely involved and readily available, because many initial queries are often related to the use and performance of unfamiliar mechanical, electrical and control systems and environmental control strategies.

The aftercare team must be visible, with a workplace in a readily-accessible location and not hidden away. Team members must work not just with the facilities management team, but be accessible to everyone. Occupants must therefore be told that the aftercare team is operating, what it will be doing, where it will be, and when. The times of residence need to be regular (such as every morning, or every Tuesday) so everybody knows what to expect.

Team members must make themselves available to deal pre-emptively with queries and misunderstandings. The observations they make, the questions they answer, the responses they get and the insights they derive will help prevent minor problems developing into longer term chronic irritants for the occupants and the client alike. Their period of residence also provides an opportunity to observe and learn from initial feedback and problem-solving.

Visibility also includes sessions at which the aftercare team describes the building and its systems to groups of occupants as soon as possible after they move in, and introduces them to the guide for occupants (see box). The aftercare team will also provide news on issues, problems and progress, normally via the occupier's intranet.

Aftercare is not an administrative exercise nor should it be a superficial attempt at marketing. Instead it should be a proper professional service. Where it is done effectively it will generate a lot of goodwill. Being seen to be on the side of the users helps a lot – and ensures a meaningful invitation to the official opening.

Stage 4 checklist: The aftercare checklist covers the initial period of occupation, typically four to six weeks after handover.

A1. Resident on-site attendance

A2. Provide workplace and datacomms links

A3. Introductory guidance for building users

A4. Technical guidance

A5. Communications

A6. Walkabouts

Stage 5: Years 1-3 Extended aftercare period

Once the initial aftercare period is over, the Soft Landings service moves from regular visits to periodic reviews. The aftercare team is there to provide insights, review performance, and help the users and operators to get the best out their building, not to run it on their behalf. Responsibility for operation and provision and initial review of routine information (such as BMS logs and meter readings) must lie firmly with the building's facilities management team.

In Year 1, the primary focus should be on settling everything down, making sure that the design intent is well understood, identifying any problems, and logging usage and change. There may well also be a need to fine-tune systems, particularly lighting controls and HVAC systems, in order to optimise effective and energy-efficient operation and to take account of occupant feedback and changes in weather and occupancy.

In Years 2 and 3 the reviews become less frequent, concentrating on recording the operation of the building and reviewing performance. By then the facilities management team should be fully in command of the building's systems, be dealing with all problems (usually without reference to the design and building team). They should also be collecting and reviewing their own data, and refining their operational strategies. The Soft Landings process will have helped them to overcome any initial difficulties.

The aftercare period will also include a number of (preferably independently conducted) post-occupancy surveys. The type, coverage, method and timing of these surveys will depend on what has been agreed for each project. Where the design and building team has committed to undertaking an occupant survey or surveys, and following-up on any problem areas, the brief should include suggested survey timings. In general terms:

- The timing of the first occupant survey depends on the project. It is best to wait until occupants have experienced one full heating and cooling season. Phased handover, phased occupation, or additional fit-out works may also justify a delay beyond 12 months. The Soft Landings team need to judge carefully the point at which survey results are likely to reflect the building's steady pattern of operation. Performing the first survey too soon may mean the results have too many caveats to be of much value.

- Occupant focus groups held in the initial aftercare period can provide valuable initial reactions and help to target early action. However, these can also be held prematurely, particularly if initial teething problems are still fresh in the memory. Focus groups can also be dominated by a vocal minority who set the agenda on behalf of the others who may be more meek. Focus groups therefore need to be properly facilitated and the results used with caution. Combining focus groups with occupant questionnaires can lead to survey fatigue.

- Year 3 is the best time for a second survey to summarise the occupants' views on the long term performance of the building. It allows enough time for the building and its systems to have settled down, for fine-tuning in year 2 to have had an effect, and for any initial problems to be long past.

Everybody involved in the extended aftercare service will gain valuable information and insights. This feedback will help the building to work better and the client and occupiers to get the best out of the design. The feedback also provides valuable intelligence that all those involved will take back to their work, their organisations and the industry. This in turn will help to improve the goods and services they and the industry provide and make sure that their future efforts are targeted more accurately on the things which will really make a difference.

Stage 5 checklist: These activities are repeated each year, though at a reducing frequency.

Y1. Aftercare review meetings

Y2. Logging environmental and/or energy performance

Y3. Systems and energy review

Y4. Fine tune systems

Y5. Record fine-tuning and usage change

Y6. Communications

Y7. Walkabouts

Y8. Measure environmental, energy and human factors performance

Y9. End of year review

4.3.3 GSL (Government Soft Landings)

A briefing note has been prepared by the Soft Landings User Group which compares Soft Landings and GSL, and an extract is included here.

Background to GSL (Government Soft Landings)

The Government Soft Landings policy was driven by the Government Construction Board and evolved during the period 2011/12. It was seen as an opportunity to incorporate principles of the soft landings concept into the procurement of centrally funded projects. Interestingly, GSL policy doesn't explicitly recommend the adoption of the BSRIA Soft Landings Framework, but makes reference to it, thus allowing the Government to manage its own policy independent of any third party and to stress its own interpretation for soft landings.

In September 2012 the Cabinet Office formally announced the policy that by 2016 all centrally funded projects should be delivered in accordance with Government Soft Landings.

It should be noted that GSL is designed to cater for the procurement needs of central government departments. It will not be mandatory for local authority procurement, schools or hospitals.

GSL is promoted by the Government's BIM Task Group and its adoption is intended to be integrated with Government's implementation of BIM.

The Government Construction Strategy has set a target for projects procured by Government Departments to deliver 20% lower costs. The adoption of GSL is part of the Government's effort to help reduce total project costs through the lifetime of the asset.

Five key features of GSL, as stated at the BIM Task Group website, are:

1) GSL will be used to reduce cost and improve performance of asset delivery and operation.
2) All departments will appoint a GSL Lead to manage the GSL Golden Thread on all projects.
3) All departments will actively manage aftercare during early operations, supported by the design and construction team.
4) Post Occupancy Evaluation will be used as a collaborative tool to measure and optimise asset performance and embed lessons learnt.
5) BIM will be progressively used as a data management tool to assist the briefing process.

Source: http://www.bimtaskgroup.org/gsl/

GSL policy requires a GSL Champion, or Champions, to be appointed. This may be an individual or the responsibilities can be distributed across members of the project team.

According to the Government's Departmental Brief, GSL Champions should have the following responsibilities:

- Represent the needs of the End Users; Occupiers, Visitors and Facilities Managers
- Actively engage with the End Users to ensure their needs are input into all stages of the project
- Actively engage with the Project Team to ensure these needs are considered at all stages of the brief, design, construction, handover and in use support
- Support the Project Manager in developing and implementing the Aftercare Plan and Post Occupancy Evaluation studies
- Support the ongoing development of GSL through membership of the GSL Champion Stewardship Group

The GSL policy requires specific objectives and measures of success to be determined at the strategic briefing stage. Project targets, according to GSL policy, should cover:

a) Social outcomes (e.g. functionality and meeting user requirements)
b) Economic outcomes (e.g. capital and operational costs)
c) Environmental outcomes (e.g. energy, water and waste targets)

Comparison of GSL and Soft Landings Framework

There are many similarities between the Government's interpretation of soft landings and the BSRIA Soft Landings Framework. These similarities include:

- An emphasis on the need for better collaboration between the procurement team (designers and constructors) and end-user/ operational representatives.

- The need to review and agree project outcomes at the beginning of a project. (On this matter the GSL policy is very specific about identifying a range of economic, social and economic objectives/metrics).

- The adoption of Soft Landings should be used by industry to learn lessons from the evaluation process and the lessons should inform better design practice.

- Particular attention should be given to the pre-handover stage, with regards to testing, commissioning, training and hand-over documentation, and the initial aftercare period, so that building management representatives are better prepared for moving in to the building.

- There should be a period of extended post-occupancy evaluation. This will typically be up to three years, although this should be determined on a project by project basis. (The motives for the evaluation are slightly different in the BSRIA Framework and GSL policy. The BSRIA Framework sees this evaluation as a component of extended aftercare by the professional team; the GSL policy views the evaluation as a crucial means to check that performance metrics have been met).

Some of the differences are:

- GSL policy recommends the Soft Landings Champion is an appointed member of relevant Government Department, unless another arrangement is more practical. The BSRIA Soft Landings Framework guidance recommends the client has a Soft Landings representative, or Champion, and the project delivery team has a Soft Landings Champion (it could be a consultant, project manager or someone else in the delivery team with an interest in the end-user activities).

- The implementation of GSL is aligned with the Government's public sector policy for the implementation of BIM in 2016, although GSL could still be implemented on a project without BIM. The BSRIA Soft Landings Framework does not inherently require BIM to be adopted for a soft landings project or make reference to it.

- GSL contract guidance requires objectives to be set for capital cost and operational costs, and for these costs to be reviewed and updated as the project progresses. GSL also therefore helps to provide a mechanism for clients monitor project costs. While the BSRIA Soft Landings Framework does not require costs to be regularly evaluated, project teams have the freedom to include cost control as a specific objective.

- GSL requires targets to be set at the strategic briefing stage (RIBA stages 0 and 1) which can be reviewed again by the Government Department at Stage 2, whereas the Soft Landings Framework recommends targets are set at the concept design stage (RIBA stage 2), after the strategic principles have been established and options have been reviewed.

- GSL requires, as a minimum, the following key aspects to be addressed: functionality, environmental performance, FM operations, training, commissioning and hand-over. The BSRIA Soft Landings Framework is less prescriptive, and gives more freedom to the project team to determine the key project objectives.