BRE: Why do we need a different approach

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Part of the BRE Trust

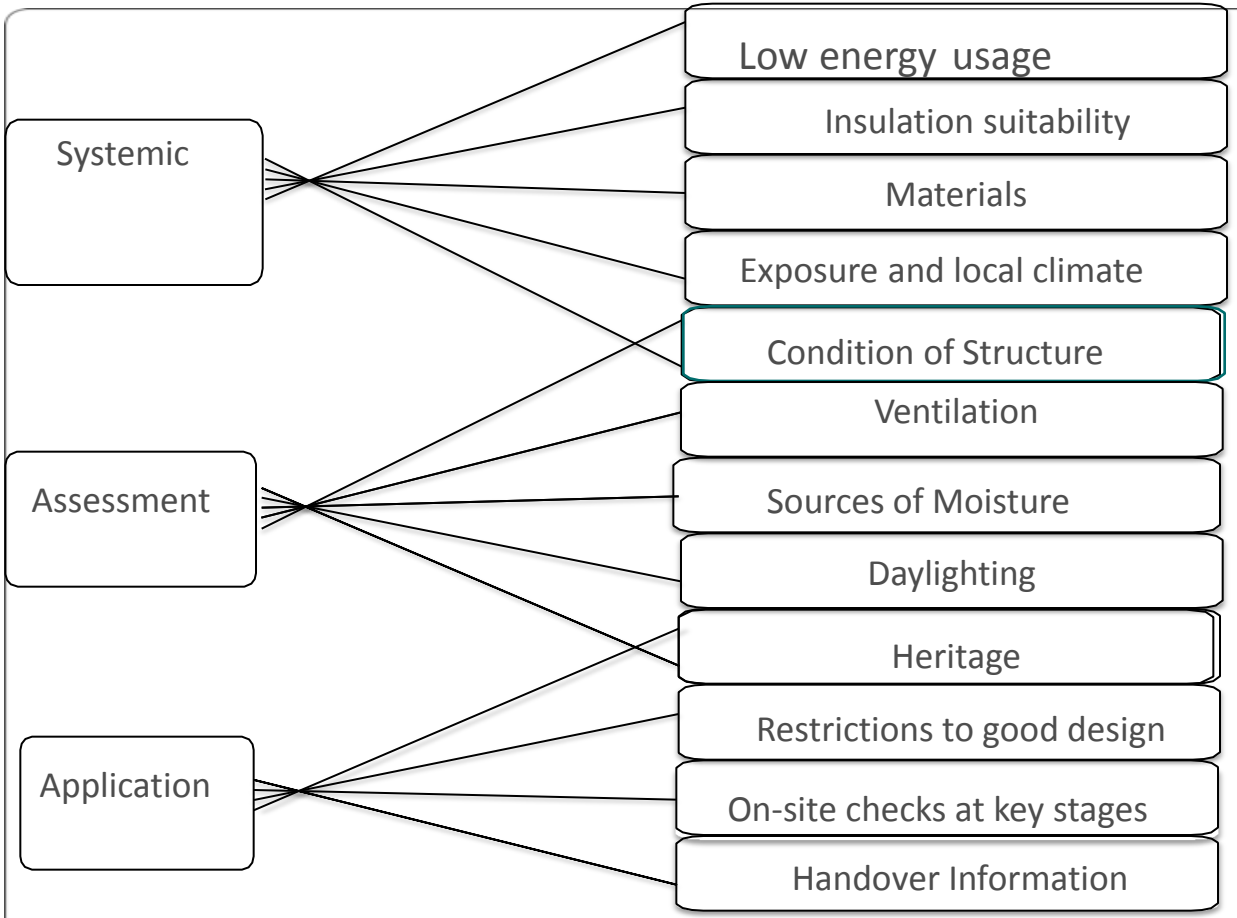
Evidence

- 73 sites visited
- Surveying, design and installation
- Over 1400 properties and rising
- Some schemes have been monitored for 5 years, and still on-going

Unintended Consequences

- Approximately 126 in total
- 37 that can have significant consequences
- All capable of being designed out
- Changes in process, independent checks, testing and assessment required to deliver the step change.

Classification of Unintended Consequences



Physical aspects of a good process with reduced risk.

When undertaking thermal improvements these should be

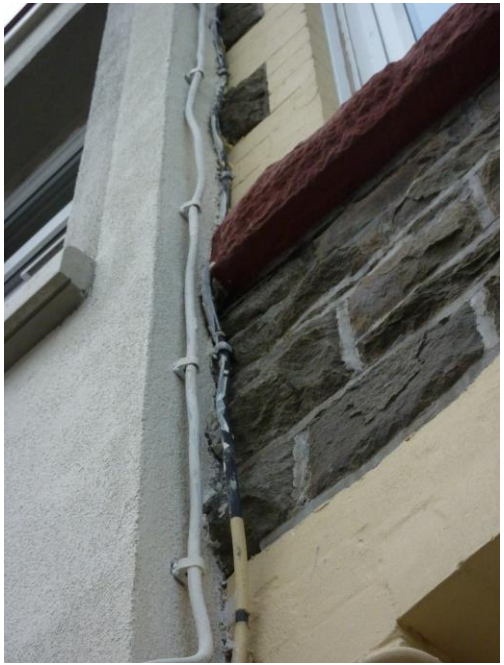
Considered at every stage: planning, procurement, design, construction, operation and maintenance.

- **External insulation**
- *Initial Preparatory Works*
- Inconsistent identification/removal of areas of delaminated render (pre-installation)
- Limited assessment of characteristics of building and siting prior to specification
- Signs of movement in building ignored
- Parge coating essentially never undertaken, regardless of wall surface introducing micro cavities

- Detailed assessment of moisture content in the structure, evidence of condensation and mould ignored
- No assessment of ventilation provision in place, including the presence of trickle vents, working mechanical extraction, or delivered extraction rates, or availability of opening windows.
- Local climatic conditions not fully considered (wind driven rain, exposure etc.)

- *Design Weakness*
- Reveals and other two dimensional junctions not considered or included in the proposed scheme and then not insulated
- Meter boxes left in place, services boxed around rather than moved to outside of system
- Significant thermal bridging left at eaves – both with soffit and without. Heads of top-floor windows often left uninsulated if at roof level

- Thermal bridge at area over porch roofs, etc. (often >100mm left uninsulated to reduce rain splash-back dirtying render and saturation from snow)
- Flashing over conservatories, shed roofs, etc. not boarded over with insulation, instead insulation is left above level of flashing
- No insulation below DPC (often starts 50mm above)
- Gaps in insulation around services



- Fences, gates and other abutments not isolated from the building to allow the insulation to be continuous.
- Introduction of conductive material (metal) into system designs, resulting in introduced cold bridges.
- Poor details produced at roof line and gable end, resulting in the use of mastic sealant to deliver the water resistance strategy.

- *Inconsistent Workmanship*
- Weep holes/channels of windows covered by oversills
- Gaps between boards, at times up to 10-15mm
- Mesh not fully embedded
- Stress patches of inadequate size
- Bond pattern of boards not in line with spec (e.g. <200mm vertical edge to vertical edge between courses)
- Fixings: specified pattern not followed, over drilled, over sunk, etc.

- Adhesive (where specified) not applied consistently to board
- Inconsistency of pattress placement for hanging baskets, etc.
- Sills, verge trim, etc. not adequately sealed, or mistakenly left unsealed
- Capillary grooves on sills compromised
- System stops, base rail, trim etc. not firmly fitted
- Poor/no ground clearance, particularly around doorsteps, ramps, etc.

Testing							
		Issue	**Type**	**Cause & Likelihood**	**Risk & Consequences**	**Guidance on reducing the risk**	**Additional research needed**
1	General	**Testing of insulation materials in unrealistic laboratory environments**	EWI, IWI	Limitations of current testing standards. Materials are not tested in a realistic environment, leading to the possible use of wrong insulation materials, and enhanced comfort of performance.	Insulation may not provide the most durable solution, becoming saturated and delivering less than anticipated energy savings. Can mean increased maintenance costs and cycles, can result in lower return on investment, or fuel poverty alleviation.	Clear guidance on the limitations of materials in certain conditions. Or changing the material testing protocols to reflect more accurate in-situ conditions in the UK	Materials tested in more realistic environment.
2	Air quality	**Increased Radon risk**	EWI, IWI	Increasing airtightness following the installation of external wall insulation. Could present a problem in high radon areas, little evidence of the effect of wall insulation on air infiltration rates.	Increasing airtightness and therefore reducing air infiltration following the installation of solid wall insulation could potentially result in an increase in the risk of exposure to occupants.	Existing properties difficult to deal with by using a ventilated sub floor only real option is to ventilate properly, no guidance exists on dealing with the possible increase in radon concentrations	Additional research in areas of high radon, pre and post insulation. To ascertain impact and means of providing clearer guidance on ventilation requirements
3	Air quality	**Short-term impact on concentrations of Formaldehyde and other VOCs, and potential long-term CO, CO2 levels, resulting in a reduction of indoor air quality following installation of external wall insulation**	EWI, IWI	Effect on indoor air quality, deterioration of internal finishes and associated health problems either introduced or if pre-existing being exacerbated by increased levels of VOCs.	There is a risk of increased levels of toxic volatile organic compounds (VOCs) including formaldehyde, without adequate consideration of ventilation and indoor air quality. In the long term, this may lead to increases of Carbon Monoxide and Carbon Dioxide, both of which can have long term effects on physical and mental health of occupants.	Better testing and guidelines on ventilation requirements to maintain indoor air quality and required air changes.	Measurement pre and post insulation VOCs, and other toxins.

4	Structure	**Failure of external finishes, due to increased moisture content of the wall, leading to freeze /thaw/frost damage.**	EWI	Moisture trapped or present in the walls can cause structural damage. One mechanism for damage is 'frost damage' to the brick as the water in the wall freezes.	Early decay and deterioration of structural elements face damage to wall structure, increased risk of saturated buildings, moisture ingress and the build-up of toxic mould at the interface of the wall and the insulation.	It is important to understand the building physics of how solid walls of a breathable nature perform and deal with moisture transference, in both directions.	
5	Structure	**Internal moisture**	IWI	There is a concern about too much internal insulation preventing heat flow into walls which may be needed to help drive out latent moisture and thus prevent external surface or interstitial condensation.	Lack of breathability, moisture trapped within the structure of the wall, interstitial condensation, frost damage, movement, premature decay. Surface condensation.	The presence of an un sealed Vapour Control layer (VCL) could lead to the movement of moisture from the exterior to the interior, and vice versa.	
6	Structure	**Cold-bridging**	EWI	The use of current standard industry details to deliver external wall insulation does little to address the issues of cold bridges being introduced into buildings.	Introduction of cold bridges, under performance of insulation, less reduction in fuel costs, accelerated damage to the property. Reduced efficiency of insulation, cold spots in the properties, mould and condensation forming.	There is a general gap in the understanding and the effect of actual thermal bridging in existing traditional buildings, and of the consequences of thermal bridging in retrofit. More testing is required.	Verification of the performance of good detailing, and the production of proven standard and non-standard details.
7	Structure	**Pollution risk**	EWI	Poor selection of finishes to external wall insulation, failing to consider the extent of industry and air borne pollution that may be evident in the locality of the properties. Can be important in heavy industrial areas, properties close to busy major roads and chemical production areas, commuter routes etc.	Soot and nitrogen compounds form the main part of pollutants that are deposited on building surfaces. Reaction of atmospheric hydrocarbons with nitric oxide (NO) leads to the formation of ozone. Ozone reacts with nitric oxide and leads, in the end, to the formation of nitrogen dioxide (NO_2) and nitric acid (HNO_3).	Risk assessment for high risk areas of industrial and motor pollution	Research of the effect of soot and nitrogen on external finishes.

Surveying

		Issue	Type	Cause & Likelihood	Risk & Consequences	Guidance on reducing the risk	Additional research needed
8	General	**Failing to assess the actual condition of the property to be insulated**	EWI	Failing to assess accurately the thickness of material, and thermal performance that will be needed to ensure that no cold bridges are introduced, resulting in steps and staggers at high level, and around other two dimensional junctions, this can be linked to the underestimation of the impact of this poor detailing or selection of solution.	High risk of introducing designed in failure to organic materials (timber). Can be important in high exposure areas.	Guidance on correct surveying and on-going measurement and observation principles to use when assessing for external wall insulation.	
9	General	**Failure to recognise the construction form adequately**	EWI	Lack of understanding of early construction techniques used in the UK, such as the use of snapped headers, rat trap bond and other unusual construction forms, leading to mis- diagnosis of construction form. Other issues on recognising the construction form might include: • doors jamming on insulation • uninsulated window reveals • and other	Increased likelihood of thermal bypass effect, resulting in little or reduced energy savings when using external wall insulation. Warm air escaping into the roof void causing increased risk of moisture and condensation issues in the roof timbers.	More detailed training on identification of early brick construction properties, and wider understanding of early construction methods widespread in the UK.	
10	Structure	**Reduction in durability of the chosen insulation system**	EWI	Finish chosen may not suitable for the level of exposure and wind driven rain in the area. Likely to happen if the local climatic conditions and exposure risk are not fully considered.	Accelerated weathering of finish coats can lead to less resilient layers being exposed allowing the ingress of wind driven rain. Can also lead to unsightly deterioration and mould, lichen growth on walls with less exposure to the sun and its drying affect.	Guidance on the durability of different finishes for different levels of exposure and weather.	Investigation into the accuracy of BS 8104. • Weather data • Relevance of topography

11	Structure	**Introduction of cold bridges**	EWI	Potential for introducing cold bridges such as fences, walls, satellite dishes, meter boxes, incoming service mains, proximity of telephone boxes, telegraph poles, external window sill, and other external obstructions. Failing to detail adequately at joints and junctions, around reveals, heads, gable ends, floors, the junction between insulated and un-insulated walls and other constructional joints.	Reduction in thermal performance delivered, high risk of condensation and mould growth, as well as the risk of shifting of condensation, mould, and cold spots to the adjoining property. Failure of timbers and other structural members, lintels etc. Expensive repairs, movement in the building, increased maintenance costs and cycles.	Improved standard and non-standard details and the requirement for detailed assessment of penetrations and service entry points in application for external wall insulation applications. Improve the ability of the insulation supplier and contractor to address thermal bridging issues. Improve the understanding on the part of the retrofitting supply/delivery chain to address thermal bridging risks.	
12	Structure	**Introduction of cold bridges (2)**	IWI	Thermal bridges sometimes not eliminated, caused mainly by the difficulty in detailing in two dimensional junctions and the depth of window reveals and or thickness of wall structure. In areas where the architectural external features are kept to retain character, or in conservation areas, or client request.	Condensation risk shifted to junctions that cannot adequately deal with increased moisture, accelerated deterioration of internal finishes, in the event of timber windows or timber sub frames being present the premature failure of the material. Increased maintenance costs, premature replacement cycles for building elements. Mould and condensation formation with associated health risks if severe.	Guidance required on detailing for internal wall insulation.	Further research into the optimum level that can be achieved when cold bridging is not addressed.

13	Moisture	**Increased relative humidity, and associated damp and mould growth due to lack of adequate and suitable ventilation**	EWI, IWI	Failing to assess for adequate ventilation in the original survey, operation or existence of trickle vents, and/ or mechanical ventilation, either interfered with by the resident or underperformance.	Increased mould growth, associated health problems, exacerbation of existing conditions, cosmetic damage to finished, early decay of timber elements. This can lead to damp problems, and mould growth, with associated health problems for the occupants.		Deciding what the appropriate level of ventilation is. (Minimum Part F?)
14	Moisture	**Rot of internal floor and roof timbers**	IWI, EWI	With internal insulation timber ground floors, intermediate floors and roof joists can become significant thermal bridges. Due to increases in humidity, these thermal bridges can then introduce rot into the timber as the temperature drops and moisture condenses.	Premature rotting of timbers, causing condensation in concealed spaces. Can lead to significant structural problems.	Particular care should be taken when considering the detailing around hidden spaces. Attention should be made on assessing timber moisture content and possible condensation or rot.	Measurement of moisture content in organic materials pre and post insulation.
15	Other	**Overheating**	EWI, IWI	It is recognised that overheating can be a problem in all dwellings which have received solid wall insulation. This is particularly a problem for (but not restricted to) those that have been treated with internal wall insulation as a result of decoupling of thermal mass from the dwelling.	Reduced or no fuel savings from the introduction of insulation cooling load in the summer seasons. Uncomfortable conditions.	Guidance on assessing useful available thermal mass and additional guidance on behaviour change actions required to deal with change of the buildings effective thermal mass.	Research of IWI properties to quantify if overheating is a significant risk, when the thermal is decoupled.

19	Structure	**Introduction of modern materials in old buildings**	EWI	Introduction of modern materials affecting the breathability of the structure, creating an imbalance in hygrothermal performance which previously existed. Very common in work on buildings constructed prior to 1930's of a lime based mortar construction.	Lack of breathability, moisture trapped within the structure of the wall, interstitial condensation, frost damage, movement, premature decay of timber elements.	Clear guidance on appropriate preparation methodologies and site application of flexible sealants to ensure water tightness barrier is achieved.	Research is on-going.
20	Moisture	**Moisture trapped behind the insulation**	EWI	Insulation applied in less than ideal climatic conditions, or insufficient protection provided during the application process.	Moisture trapped behind the insulation causing issues with ingress. Insulation becoming saturated and ineffective.	Strict guidance on site working practices, a mandatory requirement to either stop work in poor weather or adequately protect the building when bad weather is anticipated.	
21	Moisture	**Increased condensation risk in roof space**	EWI	Poorly detailed and placed external wall insulation blocking ventilations provision to the roof, or severely restricting ventilations to such an extent that condensation forms. Can be common where the roof line is not extended.	Condensation forming on timbers, premature rotting of timber members in locations not regularly observed or visited. Guidance on checking for ventilations continuity in roof spaces. Guidance on checking for ventilations continuity in roof spaces.	Guidance covering the importance of maintaining ventilation to roof spaces, when undertaking SWI	
22	Other	**Underperformance of systems due to incorrect material storage.**	EWI	Materials stored incorrectly on site, common on large schemes, not so prevalent on one off properties.	Warping and damage to the insulation systems, leading to poor installation, introduction of micro cavities through material warping.	Clear requirements and checking on site to ensure proper storage techniques.	

In Use							
		Issue	**Type**	**Cause & Likelihood**	**Risk & Consequences**	**Guidance on reducing the risk**	**Additional research needed**
23	Structure	**Reduced floor area**	IWI	Internal insulation will reduce the floor area of any rooms in which it is applied (the thickness of the insulation is around 100mm.	Already small property made smaller leading to dissatisfaction	Consultations with residents before IWI installation	
24	Structure	**Reduced daylight quality**	IWI	Building façade refurbishment can significantly alter daylight quality in the interior spaces of the refurbished buildings, even when windows are not replaced, if the geometry of the aperture in which the window is inserted changes, such as reduction in the width of the aperture by insulating the reveals and heads.	Little risk attached unless being undertaken on a property with small windows or windows that are set back deep into the reveal.	Consultations with residents before IWI installation, effect on daylighting assessed as a principle when considering thermal upgrades.	
25	Structure	**Damage made by plants**	EWI	Roots can grow down to the base of the insulation and damage EWI. Aggressive rooting bottomland species are more likely to cause subsidence than slow growing upland species.	Ingress of moisture and reduction in efficiency of insulation.	Guidance to cover the removal of close proximity plants and shrubs to reduce the damage caused to EWI	
26	Structure	**Hard to fix heavy items to inside walls**	IWI	The introduction of internal wall insulation can lead to difficulties for the end user in fixing shelves, curtain rails, and other objects on certain walls.	Lack of knowledge by the resident on the limitations of weight bearing capacity of IWI could lead to damage and dissatisfaction.	Information included in any hand over documents on the limitations of the walls ability to hold heavy items.	

Aesthetic							
		Issue	**Type**	**Cause & Likelihood**	**Risk & Consequences**	**Guidance on reducing the risk**	**Additional research needed**
27	Structure	**Significant impact on the character**	EWI	Applying external wall insulation externally changes the appearance of properties significantly. Introduction of multiple colours and finishes in one area, significantly changing the appearance of an area.	Reduction in character and acceptance of the principles of solid wall insulation	Residents need to be comfortable with any proposed changes.	
28	Structure	**Stripping off finishes**	EWI	Stripping off finishes, such as plaster from brick, rubble stone or timber-framed wall.	Significant changes to the appearance of a property that may not have been fully appreciated by the resident or home owner when the work was agreed too	Guidance on the scope of information that needs to be handed to the resident and agreed to when detailing with internal wall insulation.	
29	Structure	**Vandalism**	EWI	EWI being used as a surface for graffiti, defacement and other anti-social behaviours due to the introduction of a smooth finish to properties walls that were not there before.	Resistance to changing external appearance of walls, increased maintenance costs for housing provider or owner.	Guidance on the use of textured finishes and other material finishes that hinder the chance of graffiti	

A Route Map for Change

- 12 key steps that need to be made
- Covering testing, surveying, installation, on – going maintenance
- All are achievable

Process for change route map

Testing

Materials using EN15026

Process

Protocol for ASHRAE 160 and EN15026

Review BS 5250:2011

Workmanship

More rigorous process of checks and balances on work. Emphasis on spot checks at key stages

Certification

On site controls and sign off. Creation of proven thermal bridging details and principles. Conventions for psi value input into RdSAP.

Surveying

Training on in-situ assessment. Use of moisture risk method ABIS (As Built In Service)

Independent verification

Process for checking a specified number of all properties insulated, with funding withheld if incorrect

Data

Weather data and UK material database for EN15026 tools

Training of professionals

Review course content for professionals to cover the principles of condensation and moisture movement in structures

Building Regulations requirements

Part C and Part L1 and L2B must be reviewed and relevance of Part F for retrofit

Moisture professional

Training on in-situ assessment and correct methods of sign off at key stages to reduce risk

Specification

The use of standard specifications for multiple construction types to be discouraged. All assessments to be based on in-situ conditions

Occupant behaviour

Requirement for guidance on hand over to the occupants of improved properties

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Solid wall heat losses and the potential for energy saving

Consequences for consideration to maximise SWI benefits: A route-map for change

Prepared for: Dr Elizabeth Milsom
Date: 02 Mar 2016

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SOLID WALL INSULATION
Unlocking Demand and Driving Up Standards

A report to the Green Construction Board and Government
by the Chief Construction Adviser
Peter Hansford FREng

November 2015

HM Government
Chief Construction Adviser

Each Home Counts

An Independent Review of Consumer Advice, Protection, Standards and Enforcement for Energy Efficiency and Renewable Energy

Dr Peter Bonfield, OBE, FREng

Department for Business, Energy & Industrial Strategy

Department for Communities and Local Government

December 2016

- Worst of all, and despite the good intentions of the Government and activities of responsible companies, there have been too many instances of poor quality installations being made by companies who do not have the skills, quality levels or core values required to operate responsibly in this market. An example of this was highlighted in a review by Peter Hansford, former Government Chief Construction Adviser, which focused on solid wall insulation installations and informed this Review.

Every Home Counts

- 27 key recommendations
- BSi Task Force for implementation
- Implementation Board
- A change in the way we do business

Key area for improvement	Addressed by
Making more of opportunities for engaging consumers	An Information Hub, Data Warehouse and related services, and improved consumer engagement at trigger points
Better use of property assessments	Integration of a holistic property consideration approach into standards and training, and integration of assessment information into the Data Warehouse
Ensuring simpler branding in the sector	A new quality mark for the energy efficiency and renewable energy sector
Improving selling practices to consumers	A new Consumer Charter and Code of Conduct covering mis-selling and fraud
Delivering quality installations	Codes of Practice and standards to improve and align technical standards and skills requirements
Ensuring consistent and robust monitoring	Robust monitoring requirements in the Codes of Practice and standards
Improving long-term consumer protection and creating a simplified redress system	A new Consumer Charter and Code of Conduct to include requirements for a single point of contact for redress and guarantees
Making better use and availability of data	Improved accessibility of EPC data and use of Data Warehouse and related services
Ensuring the benefits of emerging technologies are realised	A Strategic Governance Board to assess inclusion and integration of new technologies into the Framework and its elements, including advice, skills and standards

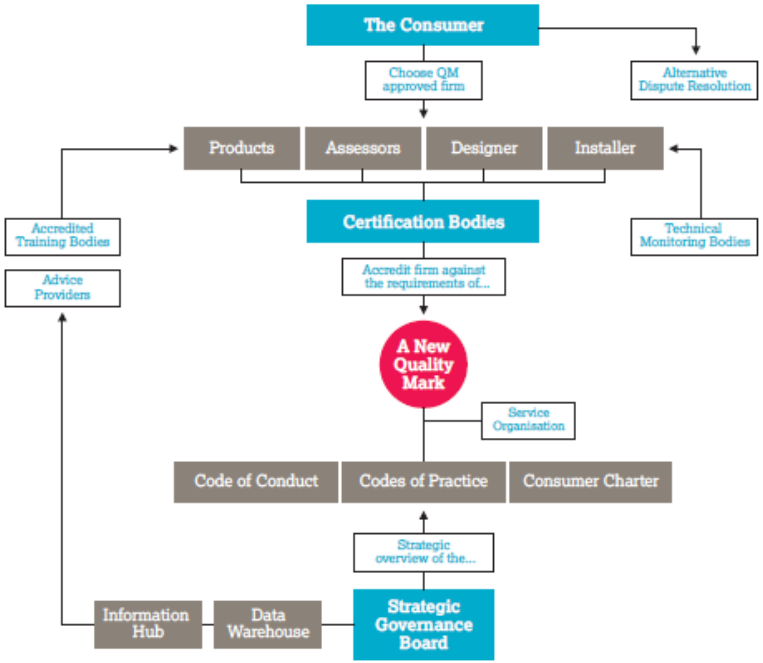

Figure 1: Summary of the workstreams under the Review