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List of abbreviations and acronyms

ABS	Annual Business Survey
AC	Alternating Current
ACI	Approved Cable Initiative
ASDMA	Architectural and Specialist Door Manufacturers Association
ASFP	Association of Specialist Fire Protection
AVCP	Assessment and verification of constancy of performance
BASEC	British Approvals Service for Cables
BBA	British Board of Agrément
BCA	The British Cable Association
BCIS	Building Cost Information Service
BEAMA	British Electrotechnical and Allied Manufacturers' Association
BEIS	Department for Business, Energy & Industrial Strategy
BESA	Building Engineering Services Association
BIM	Building Information Modelling
BSC	Blue Sky Certification
BSI	British Standard Institution
BSRIA	Building Services Research and Information Association
BWF	British Woodwork Federation
CCTV	Closed Circuit Television
CDP	Contractor Design Portions
CE	Conformity Assessed (EU)
COSHH	Control of Substances Hazardous to Health

CPA	Construction Products Association
CPR	Construction Products Regulation
CSCS	Construction Skills Certification Scheme
CWCT	Centre for Window and Classing Technology
DC	Direct current
DHF	Door & Hardware Federation
DoP	Declaration of Performance
ECA	Electrical Contractors Association
EDA	Electrical Distributor Association
ELV	Extra low voltage
EPS	Expanded polystyrene boards
ETIM	ETIM Technical Information Model (*from German: Elektro Technisches Informations Model*)
EWI	External rendered wall insulation
FIA	Fibreoptic Industry Association
FIS	Finishes & Interiors Sector
GAI	Guild of Architectural Ironmongery
GDPR	General Data Protection Regulation
GPDA	Gypsum Product Development Association
GRP	Glass Reinforced Plastic
HMRC	Her Majesty's Revenues and Customs
HS	Harmonised System
HV	High voltage
HVAC	Heating ventilation and air conditioning

IFCC	International Fire Consultation Certification
LPCB	The Loss Prevention Certification Board
LSHF	Low Smoke Halogen Free
LSZH/LS0H	Low Smoke Zero Halogen
LV	Low voltage
MCRMA	Metal Cladding & Roofing Manufacturers Association
NACE	NACE Revision 2, statistical classification of economic activities in the European Community (European Commission, 2008)
NDA	Non-Disclosure Agreement
n. e. c.	Not elsewhere classified
NFRC	National Federation of Roofing Contractors
OEM	Original Equipment Manufacturer
ONS	Office for National Statistics
OPSS	Office for Product Safety & Standards
PAS	Publicly Available Specification
PIR	Polyisocyanurate
PRODCOM	"PRODuction COMmunautaire" (Community Production) statistics on the production of manufactured goods
PUR	Polyurethane
PVC	Polyvinyl chloride
REA	Rapid Evidence Assessment
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RIBA	Royal Institute of British Architects
RICS	Royal Institute of Chartered Surveyors
SIC	Standard Industrial Classification of economic activities

SIP	Structural insulated wall panels
SME	Small and medium sized enterprises
UKCA	UK Conformity Assessed
UKNI	UK Northern Ireland Conformity Assessed
UKTC	UK Testing and Certification
VE	Value Engineering
XPS	Extruded Polystyrene Boards

Definitions

Authorised representative	A person established in the United Kingdom by written mandate from a manufacturer, who is appointed to undertake specific tasks on the manufacturer's behalf. The manufacturer remains responsible for the proper performance of that task. The authorised representative must comply with all the obligations imposed on the manufacturer by the Regulations which relate to the tasks that the authorised representative is appointed by the manufacturer to undertake ('Construction Products Regulations 2022 (draft)', 2022).
Bespoke	Custom-made articles (Merriam Webster, no date)
Builders merchant	Another name for a distributor selling construction products.
Designer	An organisation or individual, who prepares or modifies a design for a construction project (including the design of temporary works); or arranges for or instructs someone else to do so. In the first instance, designers are likely to be members of the consultant team appointed by the client. Typically, this includes the architect, structural engineer and building services engineer (mechanical and electrical) (Construction (Design and Management) Regulations 2015 and the Construction (Design and Management) Regulations (Northern Ireland) 2016).
Distributor	Any person in the supply chain, other than the manufacturer, the manufacturer's authorised representative or the importer, who makes a construction product available on the UK market ('Construction Products Regulations 2022 (draft)', 2022).
Economic operator	Any person or public entity or group of such persons and entities, including any temporary association of undertakings, which offers the execution of works or a work, the supply of products or the provision of services on the market (*The Public Contracts Regulations 2015*, 2015). Any manufacturer, an authorised representative, an importer, a distributor or a fulfilment service provider ('Construction Products Regulations 2022 (draft)', 2022).
Fulfilment service providers	A person who: (a) is established in the United Kingdom; (b) offers, in the course of a commercial activity, at least two of the following services in relation to a construction product: (i) warehousing; (ii) packaging; (iii) addressing and dispatching; (c) does not have any property right in the construction product; and (d) is not solely any of the following: (i) a postal service provider; (ii) a parcel delivery provider; or (ii) a freight transport service provider ('Construction Products Regulations 2022 (draft)', 2022).

Importer	A person who is established in the United Kingdom; and places a construction product from a country outside of the United Kingdom on the market ('Construction Products Regulations 2022 (draft)', 2022)
Licensed processor	A joinery company that takes a BWF-CERTIFIRE certificated fire door or door blank and adjusts the doorset according to the manufacturers fire test requirements. This includes resizing and re-lipping fire door blanks, whilst maintaining the certification of the fire doorset (British Woodworking Federation, no date)
Manufacturer	A person who manufactures a construction product or has a construction product designed or manufactured; and markets a construction product under their name or trademark ('Construction Products Regulations 2022 (draft)', 2022)
Proprietary	A product that is used, produced, or marketed under exclusive legal right of the inventor or maker (Merriam Webster, no date). Often protected by patent, trademark or copyright.
'Pick and mix'	The study team uses the term 'pick and mix' to refer to a system of components that have been assembled from a variety of sources, which has not been tested as a system and is not accompanied by a warranty.
Retailer	A person or business that sells things directly to customers for their own use (Merriam Webster, no date). In the construction products market, retailers are focussed on consumers, but also supply trade customers.
Small and medium sized enterprises (SMEs)	The UK government definition of SMEs businesses (Department of Trade, 2020): • micro (less than 10 employees and an annual turnover under €2 million), • small (less than 50 employees and an annual turnover under €10 million) and • medium-sized (less than 250 employees and an annual turnover under €50 million). The EU's definition (European Commission, no date) also covers subsidiary companies of a larger group. These ceilings apply to the figures for individual firms only. A firm that is part of a larger group may need to include staff headcount/turnover/balance sheet data from that group too.
Wholesaler	A merchant middleman who sells chiefly to retailers, other merchants, or industrial, institutional, and commercial users mainly for resale or business use (Merriam Webster, no date). In the construction products market, wholesalers are focussed on trade customers, but also supply consumers.

Executive summary

This report presents findings from an independent study conducted by Risk & Policy Analysts Ltd. (RPA) together with BWL Consulting (EAST) Limited. This study was commissioned by the Office for Product Safety & Standards (OPSS) which sits within the Department for Business, Energy & Industrial Strategy (BEIS).

The aim of this study was to review current practices across the construction products' supply chains and assess whether further guidance and/or regulatory action is needed to strengthen these practices. In particular, the research focused on estimating the size of the market, analysing the supply chain structures as a system, and understanding the technical information data flows in each tier of the supply chains process. The study focused on five specific construction products, namely: cables, cladding, fire barriers (firestoppers), fire doors and insulation.

This study involved a literature review and collecting information from key stakeholders across the UK through questionnaires, interviews and workshops. Due to a lack of secondary data, the study results were predominantly drawn from the primary data collected during consultation activities. However, engaging with stakeholders was challenging. All collected evidence was reviewed and analysed. The evidence gap mapping approach facilitated understanding of the strength of evidence and remaining knowledge gaps. All findings were summarised in five product-focused sections, illustrative case studies bringing insights on specific themes and issues, and comparative sections analysing and discussing key findings and lessons learnt. All product specific sections applied a similar structure to presenting evidence and included a definition of a product (or product types), a description of the legislation and voluntary initiatives regulating the use and application of each product, the estimations on the UK market size, and information on the supply chains and information flows.

Evidence collected in this study suggests that cable is a stable product with few major technical changes implemented over recent years. Cables are also considered to be highly regulated construction product. The UK is a net importer of all insulated wire and cable products, with approximately 70% of cables being imported into the UK and a trade balance of nearly -£870 million per year. The overall estimated market size was at £1.75 billion to £2 billion per year (medium confidence level). Large projects tend to have a different supply chain than other sizes of project.

Due to its complexity as a construction product, there is disagreement within the industry as to what constitutes a cladding product. This study adopted a broad definition and covered a broad range of proprietary cladding systems that currently exist in the UK. The estimated market size for one subset of cladding, composite sandwich panels, is £363 million per year (low confidence estimate) but it was not feasible to provide data on trade balances (imports and exports). Furthermore, cost information on average cost per m^2 was available only for specific cladding product types. The supply chain varied greatly depending on the type of cladding products and whether the cladding is sold as a system, or the components are bought separately.

This study focused on a subset of the whole broad fire barrier product range, which are known as firestops or firestopping. In the UK, there are currently no designated standards for these fire-stopping products, but several voluntary initiatives operate. The highly uncertain market size estimation for firestopping products is £1 billion per year. Most

firestopping products are sold via a product manufacturer to a subcontractor and/or installer, with delivery direct to the site. The specific product selection and installation depends on the project size and partly on the type of contract. Collected evidence suggests that there is no well-established installation training for firestopping in the industry in the UK.

There is uncertainty in the overall definition of a fire door as the definition of a fire doorset is dependent on the type of standard used. Whether the components for the doorset originate from one (fire doorsets) or many sources (fire door assemblies) was a key distinction for the study. For a door to be classified as a fire door it must have a fire rating. Fire doors are not necessarily part of the means of escape. There are designated standards for external fire doors. However, there are no designated standards for internal fire doors (only for external fire doors). However, there are no industry-wide standards for maintenance, servicing, and refurbishment of fire doors in existing buildings and this creates a regulatory void. Fire door products often use cascaded evidence of fire performance, and this can create some challenges for the performance and safety of products. The overall size of the market for fire doors have been estimated to be between £2.5 billion and £3 billion per year, and the trade balance at approximately -£323 million per year. The supply chain mapping and information flows varied between the fire doorset systems and fire door assemblies.

The study covered a broad range of physical thermal insulation products made from a variety of materials defined by a range of designated standards. The overall UK insulation market was estimated at £1 billion to £4 billion per year. The trade balance is £205 million per year as most insulation is manufactured in the UK. Insulation tends not to be transported long distances because it is bulky and light. Most insulation products are typically sold via distributors to a subcontractor, with delivery directly to the site. The distributors usually supply little information with the insulation products that they sell.

The study concluded that calculating the market size was a challenge as the construction products market is highly complex and interrelated. A top-down approach was taken and whilst this approach had significant issues, the study team believes that a bottom-up approach would be even more unreliable. Calculating market size information required using multiple sources to cover variety of product types, making multiple assumptions, and applying stakeholders' understanding of the market to sense check the estimations.

The supply chain mapping analysis highlighted the importance of having a clear understanding of responsibilities and accountabilities of stakeholders who specify, check, and enforce the design, installation, and handover of the building and its components. In addition, the study identified that the key determining factors for the supply chain mapping were the project size and whether the product was using components from single or multiple suppliers. When a product was assembled from multiple components, the safety of products often dependent on the presence or a lack of designated standards for the whole product/system.

The information flows were remarkably similar for all five construction products, with the linear information model most prevalent. The information about products and their correct installation methods was found to be often poorly disseminated through the supply chain. A risk related to original specification not being adhered to or becoming lost to select and install the correct product was also identified when procurement takes the lead rather than compliance and performance. The study also found some confusion among stakeholders relating to information provision requirements, with many construction workers believing that some voluntary standards/regulations are mandatory, thus requiring compliance.

1 Introduction

1.1 Background and study aim

The Office for Product Safety & Standards (OPSS) which sits within the Department for Business, Energy & Industrial Strategy (BEIS) has commissioned Risk & Policy Analysts (RPA), together with BWL Consulting (EAST) Limited to conduct an independent study. The study aims to build, develop, and inform the OPSS research evidence basis within a subset of five construction products.

This research reviews current practices across the construction products' supply chains and assesses whether further guidance and/or regulatory action is needed to strengthen these practices. In particular, the research focusses upon:

- Size and overview of the market, see section 2.7, covering:
  - What is the size of the market for each of the products?
  - How many types of products are available on the market and what is the market distribution?
  - Is the market for these products highly concentrated or not?
  - What proportion of the products are imported and exported?
- Supply chain structures as a system, see section 2.8:
  - What is the "cradle to gate+" (raw materials, production, marketing, distribution, sales and application/installation of products) systems process for each of the five products?
  - Does the end use of the product and size of the project have an impact on the supply chains process? For example: domestic, non-domestic buildings or large infrastructure projects.
  - Does the type of contract used have any influence on the supply chain process for construction products? For example: traditional contract, design and build, management contract or PFT contract.
  - Where do businesses in the supply chain delineate between the five different construction products?
- Overview of technical information data flows in each tier of the supply chains process, see section 2.9, covering:
  - What technical information is provided between each of the tiers in the supply chains process (raw materials, production, marketing, distribution, sales and application/installation of products)?
  - What is the quality of technical information and instructions provided at each of the tiers in the supply chains process?
  - What are the mandatory quality assurances processes during each of the tiers in the supply chains process?
  - Are there existing industry standards or are they done on a per business basis using tailored contracts?

The study team has taken "production" to mean the manufacturing process from components to final products, whether this is done by one company or a series of manufacturing companies.

This study involves the collection of information from key stakeholders across the UK through questionnaires, interviews, focus groups and workshops.

1.2 The five construction products

This study focuses on five specific construction products:

- Cables;
- Cladding;
- Fire barriers;
- Fire doors; and
- Insulation.

Detailed definitions of these products in their broadest sense, within the scope of this study (if different) and of the product sub-types, are given in the relevant sections below.

1.3 Structure of the remainder of this report

The following sections of this report are structured as follows:

- Section 2 provides the methodology for the data collection;
- Section 3 covers the findings for cabling;
- Section 4 covers the findings for cladding;
- Section 5 covers the findings for fire barriers;
- Section 6 covers the findings for fire doors;
- Section 7 covers the findings for insulation;
- Section 8 summarises the results for all five products;
- Section 9 discusses the results;
- Section 10 contains the references;
- Section 11 contains the annexes:
    - 11.1 – Background to the study;
    - 11.2 – Literature review reporting template;
    - 11.3 – Stakeholders participating;
    - 11.4 – Interview guide;
    - 11.5 – Privacy statement;
    - 11.6 – Email to survey participants;
    - 11.7 – Online survey;
    - 11.8 – Survey questions and question numbers;
    - 11.9 – Survey analysis – cables;
    - 11.10 – Survey analysis – cladding;
    - 11.11 – Survey analysis – fire barriers;
    - 11.12 – Survey analysis – fire doors;
    - 11.13 – Survey analysis – insulation; and
    - 11.14 – Imports and exports – trade balances.

2 Methodology

2.1 Introduction

The following section sets out the methodology developed specifically for this study. The work splits into three main sections:

- Data collection; with two elements:
    - Literature review; and
    - Stakeholder consultation, with three main parts:
        - Online survey;
        - Interviews; and
        - Workshops.
- Case studies; and
- Analysis and reporting, with five parts reflecting the product sections:
    - Definitions;
    - Legislation and voluntary initiatives;
    - Market size;
    - Major players; and
    - Supply chain mapping and information flows.
- Evidence mapping

The methodology is described graphically with a methodology flow chart (simplified) in Figure 2-1.

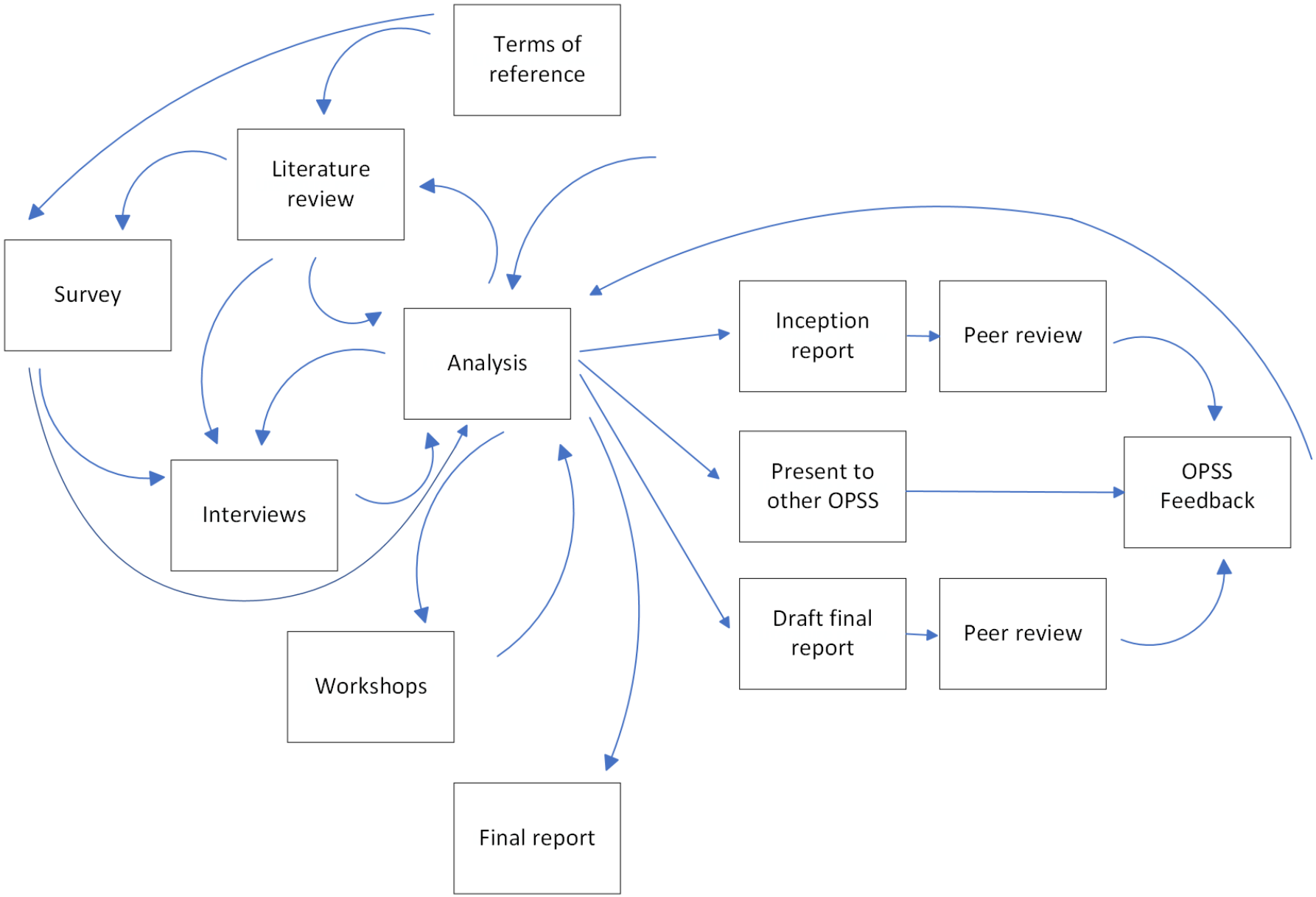

Figure 2-1 Flow chart of the methodology (simplified)

2.2 Data collection - literature review

Literature review constituted the first step in evidence generation for this study and its aim was to assess what is known on the subject in the academic, policy and wider literature and data. The review was intended to gather the key features characterising each construction product, the products' supply chain and information flows. Gathered evidence enabled the study team to understand the remaining knowledge gaps and data needs, which were to be filled via primary data collection methods such as the stakeholder consultation approaches, comprising interviews, an online survey, and workshops.

2.2.1 Literature review

The literature review task consists of two stages of desk research:

- Rapid Evidence Assessment (REA) of academic literature; and
- Targeted review of policy and wider literature.

REAs are a type of systematic literature review using the adapted principles of reviewing scientific and policy literature, as set out in the guidance published by and (The Campbell Collaboration, 2021) (Collins *et al.*, 2015). The review followed a number of steps, including:

- Formulation of research questions and development of the REA protocol;
- Identification and selection of relevant academic literature via scholarly databases (e.g. Scopus);
- Gathering of complementary policy evidence via targeted Google and Google Scholar searches (first twenty pages);
- Data extraction and review; and
- Analysis and synthesis of evidence.

To capture the most up-to-date and relevant evidence, the study team developed the REA research protocol's inclusion/exclusion criteria, key search words and search strings (see section 2.2.2).

A targeted literature review was adopted to identify relevant published reports, papers and other written material from other sources. It focused on four main sources of literature:

- Policy documents published by government departments;
- Legislative and regulatory documents issued by regulatory and certification bodies;
- Documents published by associations, member organisations and other networking bodies relevant to the five construction products; and
- Documents produced by main companies (in terms of market share) in the five construction products' supply chain, including manufacturers, distributors, wholesalers and retailers, installers, building contractors and construction designers/consultants.

A targeted review was executed by carrying out Google searches at the first twenty pages and examining websites of relevant bodies, organisations and companies.

Evidence gathered from all sources was critically assessed for quality, extracted, and reported in the interim, draft final and final reports. The literature review reporting included:

- Summary of findings for each product;
- Policy and practice implications and impacts of findings; and
- Identification of remaining knowledge gaps and uncertainties that were addressed via stakeholder consultation and included as suggestions for further research in the follow-up studies (Collins et al. 2015).

2.2.2 REA search keywords

The search was guided by the protocol's inclusion/exclusion criteria, and included sources that were:

- Published in English;
- Reporting on the developments and situation in the United Kingdom; and
- Published recently (since 2010).

Table 2-1 REA protocol search keywords

Search category	Initial keywords	Adapted keywords
A. Product type	• ((electric cabling) OR (electric cable) OR (construction cable) OR (building cable)) • (cladding) • (thermal insulation) • (fire door) • (fire barrier)	• (cabling OR cable) • ((fire barrier) OR (fire stopping) OR (fire stopper))
B. Tier in supply chain	(production OR distribution OR sales OR application OR installation OR (supply AND chain) OR tier OR supplier OR buyer OR manufacturer)	
C. Information flow in the supply chain	((information flow) OR (information provision) OR (information requirement) OR regulate OR legislation OR regulation OR guideline OR certification OR certificate OR declaration OR industry OR standard OR scheme OR obligation OR assessment OR compliance OR conformity OR (Quality Assurance) OR mechanisms OR monitor OR enforcement OR restriction OR sanction OR safety OR hazard)	• (Information flow)
D. Market analysis	(market AND (size OR distribution OR trend OR growth OR increase OR decrease OR decline OR value OR volume) OR (total employment) OR	((market AND (size OR distribution OR value OR volume) OR employment OR import OR export

Search category	Initial keywords	Adapted keywords
	import OR export OR turnover OR (value of trade)	OR turnover OR (value of trade))
E. Key components of each product	((natural resource) OR material OR component OR composition))	
F. Geographical location	((UK OR (United Kingdom) OR England OR Wales OR Scotland OR (Northern Ireland))	
G. Broad construction / building category	(construction OR build)	
H. Broad supply chain category	(supply chain)	
I: Construction chain category	(construction product supply chain)	
J: Construction chain integration	(supply chain integration)	
K: Procurement	(procurement)	

Source: RPA study team

2.2.3 Conducting literature searches

During the study inception phase when running REA and targeted literature review searches using Google and Google Scholar, the study team reviewed the first ten pages of search results. Upon receiving feedback from the client, the search was extended to the first twenty pages. In addition, identified relevant papers were examined via the Connected Papers website[1] to further identify other relevant sources via the forward and backward citations (Connected Papers, no date). All searches were restricted to documents published since 2010 to ensure that the most recent sources are captured.

The initial search was first conducted in November 2021 for one product (cables) to assess the feasibility of this approach in terms of quantity and quality of identified sources. The study team initially ran searches using a string containing the initial key words from all of the categories A to H together, but this search did not produce any results. Subsequently, the number of categories was gradually reduced and adapted key words were added. The searches prioritised key words from search category A (product type) and F (geographical location) and found that including search categories B (tier in supply chain), C (information flow in the supply chain), D (market analysis) and E (key components of each product) were not identifying relevant papers. Upon feedback received from the client, search terms I (construction chain category), J (construction chain integration) and K (procurement) were added when running searches.

The following searches were run for all construction products and identified a total of 19 sources (see 11.1 for a list of identified sources):

- A (or A adapted) AND F
- A (or A adapted) AND F AND G
- A (or A adapted) AND F AND H
- A (or A adapted) AND F AND I
- A (or A adapted) AND F AND J
- A (or A adapted) AND F AND K

All searches were completed in January and February 2022, and subsequent searches were run alongside interviews conducted during February - April 2022, focusing predominantly on backward and forward searches of reports shared by interviewees.

In sum, it seems that a literature review approach only partially supported the evidence requirements of this project. The number and breadth of available sources only answered some of the research questions, and for that reason, the study team had to rely to a great extent on evidence obtained via the primary data collection methods: interviews, online survey and validation workshops.

2.3 Data collection – stakeholder consultation

The consultation gathered and verified data, assumptions and data sources for the market size, supply chain mapping, information flow and the associated case studies. This was undertaken via:

- An online survey;
- Telephone interviews; and
- Workshops.

Consultation took place with key stakeholders in the supply chain for each product. The stakeholder selection covered the main actors identified in the supply chain tiers and those responsible for the information flow in all the tiers except raw materials and materials processing. The list of stakeholders was developed through existing connections of the project team, via contacts being made by the OPSS project team, through attendance at the London Build 2021 exhibition held on 17-18 November 2021, and from other stakeholders at interviews and attending workshops. Throughout the process of finding and contacting stakeholders, GDPR was respected. The stakeholders remained anonymous to OPSS throughout and the study team worked hard to ensure that the source of any information provided could not be identified (unless their specific permission was granted), see section 2.3.5.

The consultation enabled the team to gather data about the technical information flow throughout the supply chain (cradle-to-gate) and missing data on market size. Much of the data are confidential to each company and cannot be obtained by other means.

2.3.1 Stakeholders

Several types of key stakeholder were identified: some are relevant to a specific product; others cover all product types. Those relevant to a product are:

- Product manufacturers;

- Product trade associations; and
- Product installers or sub-contractors.

Those that cover all products include:

- Distributors;
- Retailers;
- Main contractors;
- Test certifiers and accreditors;
- Designers (architects and consulting engineers); and
- Trade or professional associations for the five types of organisations above.

The number of each type of stakeholder contacted and participating in the different aspects of the consultation is shown in 11.3.

2.3.2 Online survey

The online survey was launched on 18 February 2022 and closed on 6 April 2022.

Five online surveys were constructed using Smart Survey and tailored to each of five groups of stakeholders:

- Trade associations;
- Raw materials suppliers;
- Manufacturers of components and end products;
- Distributors, wholesalers, and retailers; and
- Installers, sub-contractors, and main contractors:

Initially the intention had been to have one survey, because many of the questions are broadly similar between the different groups of stakeholders. However, two issues made this particularly difficult. Firstly, the routing became complex and secondly, to make the questions work for all levels of the supply chain from raw materials to main contractor, the questions became so “high level” that they were meaningless for each tier. Therefore, the study team decided it was easier to separate the survey into five questionnaires and then recombine the questions before analysis.

The survey collected information for each of the products with a focus on the information that is not available from published literature and internet searches, or to validate this data; the information was used to establish the market size, supply chain mapping and the information flows between tiers in the supply chain.

To reduce the participation “burden”, the online survey used logic questions throughout, to ensure that the respondents were only asked relevant questions.

The survey questionnaires are available in section 11.7 as one combined survey: a code is used to indicate the tier to the study team. This makes it easier to work out which questions relate to each other. The interrelationship between the questions in the different surveys is also shown in section 11.8.

Many of the questions were the same, or similar, in all surveys and were analysed together for each of the five products in sections 11.9 to 11.13. In total, there were 384 responses, including 83 fully completed, 136 partially completed and 165 completed with

only the initial questions answered. The majority of respondents represent manufacturers of components and end products, installers, sub-contractors, and main contractors. As the total number of survey responses was relatively low for the number of the size of business organisations that provide products and services related to the five products under investigation, the survey results have to be read with this caveat in mind.

Finally, respondents were asked if they were willing to be contacted for a telephone follow-up interview to collect more specific information or qualitative information, which in some cases is easier to obtain by spoken communication. Many of those who gave their details were contacted to ask further questions or invite them to participate in a detailed interview or workshop.

Surveys were sent to consultees through emails containing a hyperlink to the survey (see 11.7). This allowed people to forward the email containing the link to other interested parties, thus potentially increasing the response rate. This was particularly relevant for trade and professional associations, who were asked to forward the email on to their members. Many organisations did forward the email. Several reminder emails were sent.

A detailed engagement log was kept, detailing groups and individuals contacted, by whom and when; this log was regularly updated with any new contacts provided, stakeholder comments and when a stakeholder has completed the survey.

2.3.3 Interviews

The telephone interviews built upon information provided during the online survey and found at the London Build trade show in November 2021: they focussed on closing data gaps. Overall, 23 interviews were undertaken, with a total of 31 interviewees. In addition, two stakeholders were interviewed more than once. Eight interviews were with organisations that cover all products and 15 with product-specific organisations.

Table 2-2 Interviews by product and stakeholder type

	Trade association	Other interviewee type	Total
Cables	3	1	4
Cladding	3	-	3
Fire barriers	1	-	1
Fire doors	4	-	4
Insulation	2	1	3
All product types	4	4	8
Total	**17**	**6**	**23**

Source: RPA

The semi-structured interviews offered the opportunity to ask more targeted, tailored questions and to receive far more detailed responses. Some of the participants had already completed the survey; however, some organisations or individuals that had not completed the survey but were identified as holding information that is of particular interest to the study were also contacted.

To ensure consistent collection of data, an interview guide was drafted, (see Annex 12.4), which was sent to interviewees before their interviews. The interview guide focuses on the main gaps in the information collected through desk research.

Data obtained during interviews were confidential and, if required, anonymity was granted to individuals taking part in the interviews. Systems for data storage, which are overseen by RPA, comply with GDPR.

Most telephone interviews lasted a maximum of 90 minutes and interviews were arranged around the availability of the consultee. After the telephone interview, a write-up of the interview was sent to the interviewee for them to check that they agreed with the study team's understanding and to enable them to add further information, if appropriate.

2.3.4 Workshops

Four half-day workshops took place in late April and early May 2022, with a fifth in early July 2022. The primary objective of the workshop was to verify the study team's analysis of the market, supply chains and information flows.

After the workshop, a write-up of the workshop was sent to the attendees to check that they agreed with the study team's understanding and to enable them to add further information, if appropriate.

2.3.5 Confidentiality

The study team expected some stakeholders to be concerned about questions related to their market share for the different raw materials, components, products, and sub products information which is key to understanding the market size and answering other study research questions. The study team is used to working under strict adherence to confidentiality. In the reporting, the study team endeavoured to ensure that no organisations could be identified as having provided commercially sensitive data. However, confidentiality rarely arose as an issue: occasionally a stakeholder did not want to share some information for reasons of confidentiality, but none asked for a Non-Disclosure Agreement (NDA).

2.4 Case studies

Case studies enable the study team to describe detailed supply chain mappings and information flows using real-life examples. The evidence collected during desk research and stakeholder consultations provides building blocks for the case study research. Particular attention was paid to the evidence around the supply chain mapping and information flows, procurement practices and how all these aspects have an impact on the information flows and the safety of construction products. The study team conducted eight case studies. The process of selecting case studies and selection criteria is presented in the subsequent sections.

2.4.1 Case study selection criteria

Table 2-3 outlines the criteria that guided the process of case study selection. The criteria were based on available literature, and the study team experience of conducting case studies and understanding of the objectives of this project.

The case studies were selected to cover as many criteria as realistically possible, weighting up criteria across examples as required to ensure that a variety of elements were covered, such as construction products, the tiers in the supply chain, involvement of different stakeholder types etc. However, given the relatively small number of case studies to be investigated, there is a risk of a selection bias. As explained in the subsequent paragraphs and sections, this risk was mitigated by selecting case studies from across

potential categories, using a variety of inputs to create a long list of potential case studies, and involving stakeholders and the client in the final shortlisting and selection of case studies.

Table 2-3 Case study selection criteria

Criterion	Explanation on potential categories
Construction product	One or two case studies per construction product: • Cables • Cladding • Fire barriers • Fire doors • Insulation
Unit of analysis	Unit of Analysis of each case study focused on a singular perspective from the list below: • Focal point: product-centric, company-centric, industry/sector-centric, tier/function in the supply chain • Organisation: company-level vs. association /industry /membership network • Flow: specific tier/function in the construction supply chain, e.g. manufacturers, distributor(s), installers • Process, e.g. the compliance procedure(s) to ensure the product meets requirements of a specific regulatory framework, preparation of information material by suppliers

Supply chain characteristics	• Orientation (reverse and forward): flow of goods/products, information and money
	• Measures (at high-level): volume (of products and sourced materials), cost/prices, and lead-time, and the impact of these measures on supply chain resilience, integration and performance
	• Links between tiers/relationships:
	  • direction in the coverage in the channel of distribution (upstream, midstream, downstream), e.g. supplier-oriented, customer-oriented, both industry and customer
	  • length: the number of levels in each direction
	  • breadth: cradle-to-gate analysis (from raw materials (cradle) until installation), or just part of this process
	  • number of links/relations between tiers: single vs. multiple links
	  • strength and dynamics between tiers, e.g. how the materials are produced, engineered to order, assembled to order or made to stock.

Analysis type / timeframe	• Focusing analysis on a specific unit of analysis, e.g. a specific company, an application of a specific regulatory/legislative framework for a specific construction product etc. • Comparatively looking at two or more specific units of analysis (e.g. two building merchant companies, procurement processes/practices in two or more companies), or across two

Criterion	Explanation on potential categories
	points in time (e.g. procurement processes/practice in a specific company ten years ago and at the present time)
Underlying legislative / regulatory / policy principles and embeddedness	The case study is embedded in and underpinned by: • legislative / regulatory / policy frameworks that require compliance, • voluntary compliance • self-certification. There are no legislative / regulatory / policy frameworks shaping the operation / provision /services described in this case study
Geographic coverage	Examples for case studies may be selected from organisations operating in the UK or outside of the UK (e.g. a production tier in the supply chain that exports components/products to the UK)
Transferability of knowledge	The case study has the potential to be replicable to other geographical/sectoral/construction product contexts

Sources: developed by RPA, based on terms of reference for current study, and (Gardner and Cooper, 2003; Theodore Farris, 2010; Nasir et al., 2017; Mubarik et al., 2021)

2.4.2 Identification of specific examples (long-list and shortlist)

The study team used three complementary methods to identify, select and analyse case studies. Firstly, as part of the desk review (literature and market data), the team identified examples of typical challenges in the supply chains of construction products, as well as promising examples that could be replicated. Secondly, when conducting interviews, the team asked stakeholders to identify examples of specific policies and practices applied in their organisations and the construction sector at large. Stakeholder views on any monitoring and evaluation activities that might have been undertaken were also captured, as well as whether / how lessons learnt are implemented at various levels. Finally, workshop participants were also asked to suggest examples of potential case studies.

All these suggestions were compiled by the study team into a long list of potential case studies (see next section), with eight case studies selected in consultation with OPSS to ensure that they covered a range of supply chain characteristics, tier and company types, and processes.

2.4.3 Case study outline

All evidence gathered under the case studies was summarised according to a case study reporting template covering the following aspects:

- short overview of the case study;
- brief description of the contextual information;
- unit of analysis – the type of product/organisation/tier;
- description of the relevant upstream/midstream/downstream supply chain characteristics;
- evidence base – existing assessments and evaluation reports and other data and documents showing effectiveness of case study example (how and why it is working); and

- lessons learnt from the case study and implications for policy and practice.

2.4.4 Agreed list of case studies

Upon receiving feedback from OPSS, the study team reduced the list to eight case studies to be included in this report. The selected case studies represent a balanced approach across all five construction products and specific topic areas, as outlined below:

- Case study 1 - Similarities and differences in the pharmaceutical and construction industry supply chains; and
- Case study 2 - The influence of a project size on the procurement and supply chain practices;
- Case study 3 - Cable products as an example of a highly regulated construction product – the applicability and transferability of lessons learnt for other construction products;
- Case study 4 - Implications of different types of cladding 'compilations';
- Case study 5 - Challenges related to selecting and installing the correct firestopping product / system;
- Case study 6 - Challenges resulting from an extended application of testing results when applying the cascaded evidence of fire performance;
- Case study 7 - Remaining challenges in standards' development and implementation in newbuilds, and maintenance and refurbishment of existing buildings;
- Case study 8 - The roles of manufacturers, distributors and customers in the product information flows.

2.5 Analysis and reporting - definitions

This section defines the scope of the product for this study and how sub-products are defined for the purposes of the study's analysis.

2.6 Analysis and reporting - legislations and voluntary initiatives

Much of the relevant legislation and many of the voluntary initiatives apply to all products and these are outlined in section 11.1. Any legislation and voluntary initiatives that apply to the specific product are outlined in the product section. This is the study team's analysis of relevant legislation and initiatives.

2.7 Analysis and reporting - UK market size

2.7.1 Top down v bottom up approach

There are two main approaches to assessing the market size for a product or industry:

- Top-down; and
- Bottom-up

The top-down approach starts with publicly available data for the overall market. Sometimes this directly correlates to the market segment required, but usually the market is a subsection of the lowest level of data available. Sometimes the market is a

combination or two or more subsections. When a subsection of the lowest level is required, assumptions about the proportion that relates to the required segment are made. These assumptions are based upon conversations with industry stakeholders and other data that might be available.

The bottom-up approach starts by asking all the suppliers of the products in the market being analysed for their turnover relating to the market and uses this information to build market size.

The top-down approach was taken for the following reasons:

- Three products (cladding, fire barriers and fire doors) have large numbers of small manufacturers and it would have been difficult to contact a sufficient number of companies
- Whilst turnover data is publicly available for at least the larger companies, this is rarely available for the products as defined and/or for the UK market only. The study team would have needed to ask each company for this information, which was likely to be commercially sensitive in many cases.
- If the study team had relied on publicly available turnover data, it would have been difficult to make any realistic assumption about the percentages of turnover as provided by the company in its account for the turnover relating to products defined in the study going into the UK market. Further complicating factors are that some UK production is then exported, and some non-UK production imported.

2.7.2 Data requirements

To analyse the market for each of the five products, the study team collected data on the following indicators:

- Number of firms producing the products (BEIS, 2019);
- Size distribution (employees) of these firms (BEIS, 2019);
- Location distribution (England, Wales, Scotland and Northern Ireland) of these firms, (ONS, 2019);
- Imports and exports of the products (UK Trade Info, 2019); and
- Production levels of the product, in the form of both tonnages and values of that sector (ONS PRODCOM, 2019).

Size distribution of firms is defined by the number of people employed (Department of Trade, 2020).

2.7.3 Data sources not used

Several sources of market data are available for some of the products, in particular the study team is aware of:

- Mintel – thermal insulation;
- AMA Research– electrical accessories, building insulation, passive fire protection, and wall cladding;
- Construction Markets – insulation;
- Barbour ABI; and

- Glenigan.

The study team considered using data from these reports, but there are issues concerning the usefulness of these data sources for the purpose of this study. In general, the data collected concentrates on actuals such as how much insulation is installed, rather than the overall market size, and the data is collected from companies using a bottom-up approach, see section 2.7.1. The definition of the products and segmentation of the product market also tended to be different to that used by the study team, making it difficult to compare values. There are many different ways in which the products and sub-products are defined as can be seen in the sections on definitions for each product: there are also many different names used for the same products. The study team could have used the definitions and segmentation used in these reports, but this would have excluded large sections of the market that OPSS did not want to exclude. Barbour and Glenigan are also designed to help manufacturers work out their sales pipeline, which mean that the data is different to that required for this study. In addition, the reports are confidential making them difficult to use, as this report may be published. Therefore, the study team decided not to use data from these reports.

2.7.4 Identification of classification

The identification of relevant data follows a process starting with identification of the most specific data and moving onto identification of more general data, should specific data not be available.

2.7.4.1 Identify relevant SIC, NACE, PRODCOM, HS codes etc. for each product type.

Initially, the search for SIC and HS codes considers the most specific codes possible. For example, in cabling the most specific code may be “low voltage insulated electrical cables, made of copper, for use in construction”. Should a highly specific code not be available, more general codes are considered such as “insulated electric cables”. If codes for each specific product are not available, data for materials were collected instead. For example, in the case of cabling, if there are no data available on insulated electric cables, data are collected for materials such as copper and the polymers used within the insulation instead.

2.7.4.2 Identify the proportion of the data that is relevant for each product

These more general classifications include a wider range of products and companies than is relevant to the study. In these circumstances, the most relevant classifications were selected, and further research conducted to identify the proportion of each classification that is relevant. Trade associations and companies operating in the relevant area were consulted to identify an approximate proportion of relevant enterprises/ products within the classification. This information was collected and validated during the survey and interviews.

2.7.4.3 Development of scenario estimates

If the estimates were still felt to be uncertain, multiple scenarios were analysed. These scenarios are RPA estimations informed by information gathered from consultation with trade associations, opinions of experts and relevant literature. All assumptions made are documented including the rationale behind each assumption; this also fed into the description of the levels of uncertainty for each scenario.

Figure 2-2 below provides a step-by-step graphical representation of the methodology followed by the study team to collect data on and analyse the different markets for the different products within the scope of this study.

2.7.4.4 Uncertainty

To account for uncertainty, ranges may be required in estimating the proportion of relevant data within the categories. Ranges are only used if specific data cannot be found.

2.7.4.5 Double counting

Another potential issue is the chance of double counting. As an example, insulation and fire barriers are often made of the same materials, such as stone wool: cladding also often contains insulation. Some companies may install an insulation product to act as a fire barrier, which may then be counted as both a fire barrier and insulation. Due to the generality of available data and potential for double counting, the market analysis may provide an overestimation of the market size. The study team have endeavoured to indicate if they believe this is likely to have occurred.

2.7.5 Regional split

The market data on company numbers is disaggregated by the four home nations. The data are limited in that they provide information where the manufacturer is based rather than where the building is constructed.

2.7.6 Converting from 2019 values to 2022

Many of the data sources are from 2019 as this is both the latest robust data source, and not affected by Covid or the recent supply chain issues. Since 2019, there has been a significant increase in the price of many building products due to Covid, the recent supply chain issues, the Ukraine war and increased energy costs.

The values in this report are a mix of 2019, 2020 and 2021 values and they should theoretically be adjusted to 2022 values. The BEIS building materials and components statistics: April 2022 provides indices to adjust prices. However, although there is data for some individual products, there is no comparable data for cables, cladding, or fire barriers, therefore the only indices available are for all building work and these are shown in Table 2-4. Many stakeholders have indicated significant price rises over the last three years, but they range considerably from 10% to 50%, depending upon the product type. As the calculations are complex and would only result in approximate figures, the study team believes it is more sensible to assume that all values for market size are approximately one third higher than those calculated (the 2019 to 2022 multiplier in Table 2-4 is 1.32 or approximately one third).

Table 2-4 SIC codes identified for cables

Item	March 2019 index	March 2022 index	2019 to 2022 multiplier
All work	113.1	149.8	1.32 (32% increase)

Source: (BEIS, 2022)
Note: 2015=100

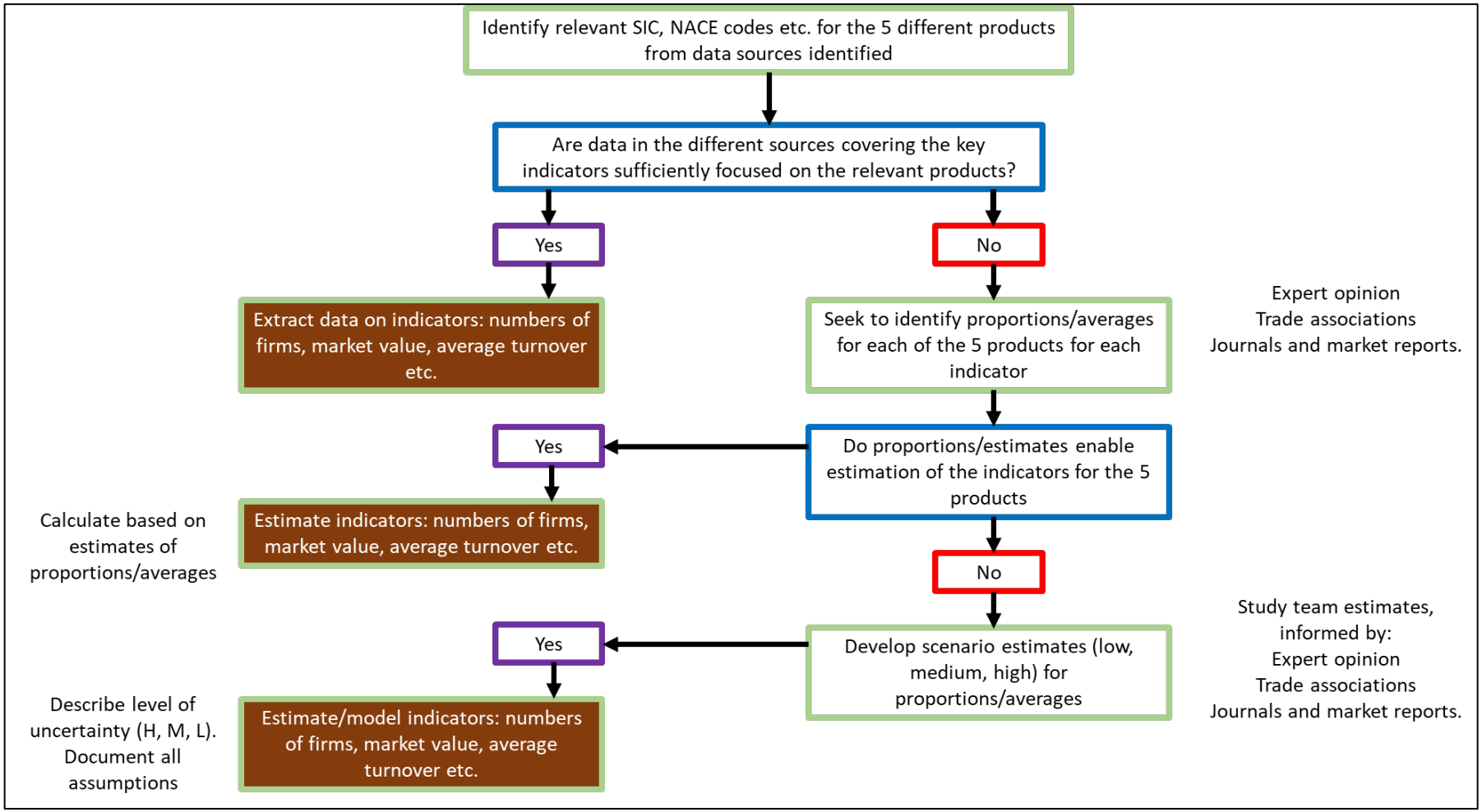

Figure 2-2 Approach to analysing markets
Source: RPA

2.8 Analysis and reporting - supply chain system mapping

'Supply chain mapping' is also known as 'value chain mapping'. Supply chain mapping tends to be used to refer to the demand side from manufacturer to end-user, and value chain mapping tends to refer to the tiers between raw materials and product manufacturer, where value is added at each tier. The distinction is complex, as one could argue that the installation process adds another level of value to all of the products, particularly cladding. For the purposes of this study, the study team agreed with OPSS to use the term supply chain mapping for the whole chain from raw materials to client (the owner of the finished building). The stakeholders attending interviews and workshops did not communicate any concerns on the use of this terminology.

2.8.1 Cradle to gate

The study covers the supply chain from "cradle to gate+" from raw materials, manufacturing production, marketing, distribution, sales and application/installation of products. The in-use performance, end-of-life and waste disposal of the products is not in the study's scope.

The gate to grave element would be a major potential study in its own right. The two parts are separate in many ways, however moving to a sustainable world, understanding the different 'graves' (recycle, re-use, reclaim and dispose), the routes to them and how these could be affected by the actions taken between cradle and gate is important. This would also be a major potential study in its own right.

2.8.2 Background

This task involves the mapping of the supply chains and the information flows within the supply chains for the five products. Information was sourced through interviews with stakeholders and case studies were also used to ensure that the research questions were addressed. The case studies were picked in accordance with criteria agreed with OPSS, such as market share, and potential areas of interest to OPSS.

As supply chains have expanded, they have become increasingly complex. This complexity in the supply chains and the global supply chain pressures is not specific to the construction industry, as other sectors also had to respond to similar challenges (see Case study 1).

This makes mapping them even more important to understanding their complexity. (Gardner and Cooper, 2003) lay out the attributes that make a good map, which are that it is 'interpretable, recognisable, and in an easy-to-disseminate format' (Gardner and Cooper, 2003). Furthermore, it should have standardised icons for added clarity. There are currently no universal symbols for a supply chain map. There are many ways of mapping supply chains but to date there is no single comprehensive accepted method according to (Mubarik *et al.*, 2021).

The most suitable supply chain mapping covered by Gardner and Cooper, 2003 is shown in Figure 2-3. It is capable of showing a supply chain in its entirety, capturing the required complexity and the different tiers involved.

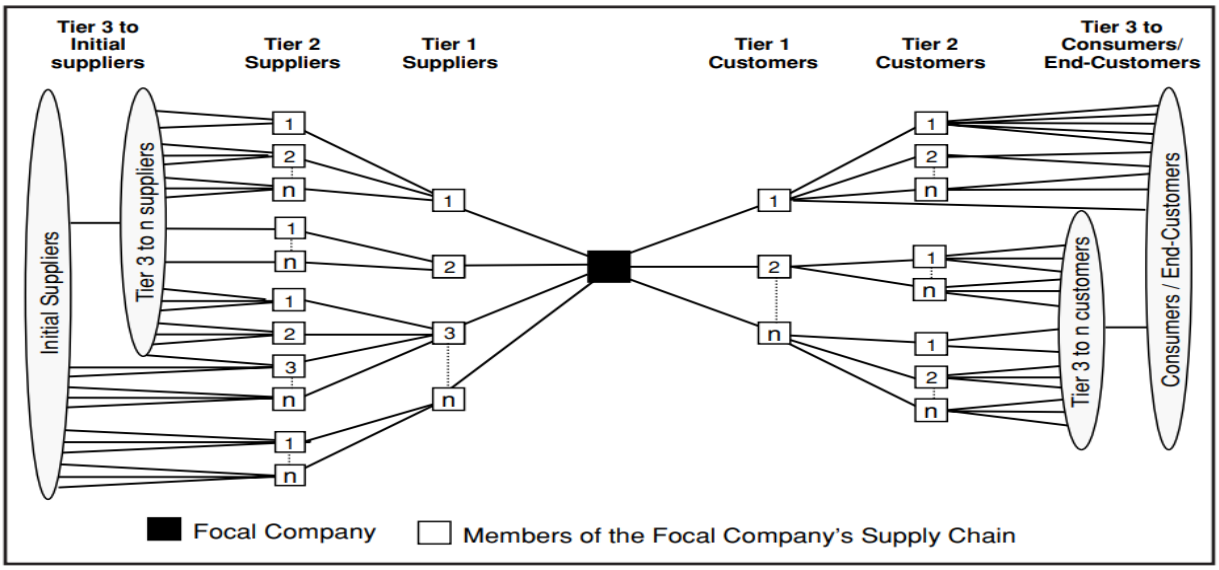

Figure 2-3 Supply chain network structure
Source: (Gardner and Cooper, 2003)

Case study 1: Similarities and differences in the pharmaceutical and construction industry supply chains

This case study provides a brief comparison of the construction industry with the pharmaceutical industry outlining similarities and differences between the supply chains in these two sectors and drawing on best practice examples from which lessons can be drawn. The pharmaceutical sector was selected for comparison due to the importance of products' safety which is also an important factor for construction products.

In the pharmaceutical sector, the process of new product development and putting them on the market is highly regulated. There are multiple control measures applied during the regulatory approval process and several monitoring and regulatory loops once products are commercialised (Pedroso and Nakano, 2009). The evidence collected during the project suggests that regulatory standards also play an important role in the construction sector. Construction products operate at multiple scales and degrees of integration, and certified construction products can be integrated into assemblies in a number of ways. When there is an absence of testing of the whole system to a dedicated standard, there will always be a gap. However, several loopholes that were identified as related to the application and compliance with the standards could be potentially addressed with additional regulatory and/or policy action, e.g. developing standards for 'system products', application of the cascaded test evidence (see Case study 6), clear delineation of responsibilities and liabilities for product installations, final check and warranties.

In addition, the supply chain in the pharmaceutical sector is an example of rich information flows to many stakeholders via multiple information channels. The knowledge flows consist of structured and unstructured, and controlled and uncontrolled patterns to disseminate technical information to the market. In many instances, the industry proactively disseminates medical information to individuals and organisations. The rationale for this rich flow of technical

information to the market is twofold: (1) to create demand by making users aware of products, (2) to ensure that users fully understand products' applications and limits as otherwise products may be improperly utilised or consumed and this could have a negative impact on users' health and safety (Pedroso and Nakano, 2009).

Similar concerns and safety implications were identified in relation to the construction products. As indicated by stakeholders, insufficient flow of information about products' application and installation, as well as timing of this information flow, can lead to incorrect products being selected for the specific project requirements and / or products being installed in a suboptimal way. Findings and conclusions drawn from evidence collected during this study provide suggestions for concrete actions that could be undertaken to improve the information flows in the construction sector, for instance manufacturers providing more targeted information about applicability of their products, distributors having technically-skilled representatives advising clients, and a circular route of inspections for product selection and installation (Case study 8).

For the list of all case studies, see section 2.4.4.

2.8.3 Tiers and streams

The study team considered the tier structure used in the BEIS Research paper No. 145, (Department for Business Innovation & Skills, 2013) which describes the chain between client and installer as three tiers. The study team also drew upon (Mubarik *et al.*, 2021), and (Gardner and Cooper, 2003) and considered basing the mapping on a tiered system of one to three or more tiers each for suppliers and customers. This revolves around the focal point of the manufacturer, see Figure 2-3. However, the construction supply chains appear to have two focal points: the product manufacturer and the installer. The tiers between the product manufacturer and installer are particularly important for this study and this arrangement does not allow for these tiers.

The study team believed that dividing the supply chain into three sets of tiers, each with three more levels, would be difficult to understand. Instead, the supply chain has been divided into three streams. This is similar to a methodology developed by (Mubarik *et al.*, 2021). The three streams are:

- Upstream – Covering raw materials to product manufacturer;
- Midstream – Covering product manufacturer to installer; and
- Downstream – Covering installer to client.

Within these three streams, the tiers are defined in section 2.8.4. Using three streams allows the study team to comprehensively cover the entire supply chain and guides the remainder of the supply chain methodology.

2.8.4 Definition of supply chain tiers

Many of the terms in Table 2-5 are defined in the Definitions section. These definitions were created to enable this research into supply chain mapping.

Table 2-5 Definition of tiers

Key concepts	Definitions	Stream
Raw materials	The raw materials from which the product is made	Up
Processing/refining	Mechanical or chemical processes to refine or process a product for use by other manufacturers	Up
Component manufacturer	Manufacturer of individual components of a product	Up
Distributor	Any intermediary between tiers from raw materials to product manufacturer, that enables the next purchaser in the supply chain to choose from a range of suppliers	Up
Product manufacturer	Manufacturer of the end product	Up/mid
Distributor	Any intermediary that makes a construction product available on the market	Mid
Fulfilment service provider	See Definitions, for example, Amazon or Alibaba	Mid
Installer	Someone paid to install the product, they often pay for the product, but not always	Mid/Down
Sub-contractor	Sub-contracted construction, including design, components and materials, labour and supervision	Down
Main contractor	Has general oversight and runs day-to-day operations	Down
Client	Ultimate decision-maker buying the building that contains the product. The level of design input may be detailed or high level depending upon the procurement strategy.	Down
Consumer	Private individual buying the product	Down

Source: RPA

Note: (1) The designer can be involved in various stages of the project across the tiers of the supply chain. (2) The table follows the goods chain rather than the money chain. If the table was to present the money chain, the order in the downstream would be as follows: main contractor, sub-contractor, installer, client. This re-ordering would allow the midstream importers and distributors to supply construction products to any members of the downstream.

2.8.5 Large and small projects

The study team can see indications of different behaviour for the supply chains for some products for projects with lower values and has taken £5 million as the division between a small and a large project. Reviewed sources suggest that various values are taken as the division between large, medium, and small projects, the most common in studies and reports appear to be £5 million and £50 million. However, the views expressed during the study were not linked to specific project values. The terms were generally used by stakeholders as they made a distinction between large and small projects. When the study team questioned stakeholders about this, no specific value was given, but it was found that they generally meant domestic and small, rather than medium-sized, projects. Therefore, the study team believes that £5 million is the best approximate division between small and large projects.

Case study 2: The influence of a project size on the procurement and supply chain practices

Multiple interviewees representing different products observed that **the project size has an influence on the procurement and supply chain practices**.

Typically, **for large projects and/or higher-value projects**, products (including cables, cladding, firestoppers, and insulation) are sometimes procured by the main contractor or a specialist subcontractor and delivered to the installer. This gives reassurance to contractors about the products' warranty and compatibility. Products are typically purchased directly from manufacturers and/or from a distributor.

In **smaller projects**, products are either being bought directly by the installer, or by a specialist subcontractor from a distributor and then delivered to the installer. The 'pick and mix' approach to product selection is more prevalent in smaller projects (such as for cladding products). Products are typically purchased from the distributors and fulfilment service providers (e.g. firestopping products).

For the list of all case studies, see section 2.4.4.

2.8.6 Supply chain mapping template

As the study team analysed the supply chains, it became clear that there could be differences in the mapping depending upon whether one considers the supply chain for the goods or the money (ownership/order/contract). Most of the time, the two are linked together. However, there are some scenarios where the two are separated. The most common is where the main contractor (or subcontractor) purchases the product directly from the manufacturer or distributor, while the product is delivered directly to the installer, who is employed on a labour-only contract. This occurs for two main reasons:

- The main contractor buys the product across many projects and can buy at a much better price than the installer; and
- The installer cannot obtain liability insurance for the product either at all, or at a reasonable cost, therefore the main contractor purchases the product and takes the liability.

Throughout the product supply chain mappings, the mapping is for the goods, not the money. In the example given above, the route for the goods would be:

- Manufacturer
- Distributor
- Main contractor
- Installer
- Subcontractor (optional)
- Main contractor
- Client

whereas the route for the money (ownership/order/contract) would be:

- Manufacturer

- Distributor
- Main contractor or subcontractor
- Client

The distinction is key as the installer's work is critical to the successful use of the product and it is important that they receive the correct information.

A further issue is the chain of responsibility and liability for the product, not only for the correct operation of the product, but also for the correct operation within the context of the building. This is controlled by whoever undertakes the detailed specification of the product and is related to whoever "pays for the product" or "is paid for the product". The detailed specification is usually done by a specialist design consultant (whether employed by contractor or client). The detailed design may be done either by, or with the heavy involvement of, a distributor or manufacturer.

Using the example above again, the responsibility for the specifying, supplying, and installing is as follows for a traditional procurement contract:

- Client – defines outline specification (written by their designers)
- Main contractor – defines detailed specification or, more commonly, delegates detailed design responsibility to a sub-contracting installer, who works with the specialist sub-contracted suppliers (distributor / manufacturer) to develop the detailed specification which are then reviewed by the contractor's and / or the client designers.
- Subcontractor (optional)
- Installer – installs to the detailed specification
- Distributor – supplies to the detailed specification
- Manufacturer – supplies to the detailed specification

There are many variations possible, particularly that the detailed specification could be done by the subcontractor.

The liability for a serious failure varies greatly too. There are many variations in the procurement routes, the example below is based upon a hypothetical design and build arrangement only - many other models apply and almost all projects differ due to different contractual arrangements at each tier creating many different potential combinations and permutations. The study team has not analysed the potential variations any further because this would have been an exercise beyond the scope of the study and because it believes that they would all be relatively small variations on the broad design and build model. In this hypothetical design and build, the liability for a serious failure might be as follows:

- Client – are liable if the overall broad design is inappropriate
- Main contractor – are liable if the detailed specification is inappropriate
- Subcontractor (optional)
- Installer – are liable if the product is not installed according to the detailed specification
- Distributor – are liable if the product is not supplied according to the detailed specification

- Manufacturer – are liable if the product is not supplied according to the detailed specification

The roles above relate to the actual design and specification. In addition, the CDM regulations define designers which relates to health and safety: these are specific appointed roles to be such as Principal Designer (PD). A PD does not need to design or specify anything as such, but is responsible for making sure that the design does consider health and safety practicalities etc. The PD could be an architect, engineer, surveyor, contractor or quite likely a specific professional who specialises in the role of PD.

The template of a supply chain mapping for this study is shown in Figure 2-4. The diagram is divided into upstream, midstream, and downstream. For each product, the study team assessed the similarities and differences. Where there are differences which have led to the removal of a tier or a connection, these have been removed from the product specific mappings, but the other parts of the mapping are not moved: this is to help delineate the differences.

There are potentially many variations:

- Raw materials' companies are often combined with processing and refining; this is particularly relevant to cabling where large companies like Glencore both mine and process copper.
- There are often distributors operating at many stages of the upstream. The mapping will only include them if a significant percentage (approximately 10% or more) of the value of the materials for the product go through a distributor.
- There could be many tiers of component manufacturer.
- Some product manufacturers are secondary processors, buying in components to create a system, and testing them. This affects fire doors and cladding systems.
- The installer may buy the product for installation, but often a sub-contractor, or the main contractor purchases the product, and the installer is only responsible for the installation.
- There is a growing trend over recent years for manufacturers to sell direct to contractors. This cuts out the distributors.
- There could be many tiers of sub-contractors.
- The design element lies with the client for a traditional contract, where the client employs architects and engineers to specify the product. In practice, contractors do take responsibility for product selection. The mechanisms for passing this responsibility for final product selection to the contractor are known as Contractor Design Portions (CDPs). Where clients have specified a product, there are competition rules which enable contractors to propose alternative products. Under other contract types, such as design and build, the main contractor could be responsible for the detailed specification, but this responsibility is often passed down to sub-contractors or the installer.

Consumers are shown buying direct from distributors: this happens if they are installing themselves or providing the product free of charge for an installer to install. If the installer is buying on behalf of a consumer, this is effectively the same as the route through the installer – subcontractor – main contractor, even if these three roles all belong to one person and the project is small.

Each product will have at least one high-level mapping based upon Figure 2-4. Additional supply chain mappings are provided in circumstances where the supply chain for a significant amount of the product is different. The reasons for the difference vary greatly between the products.

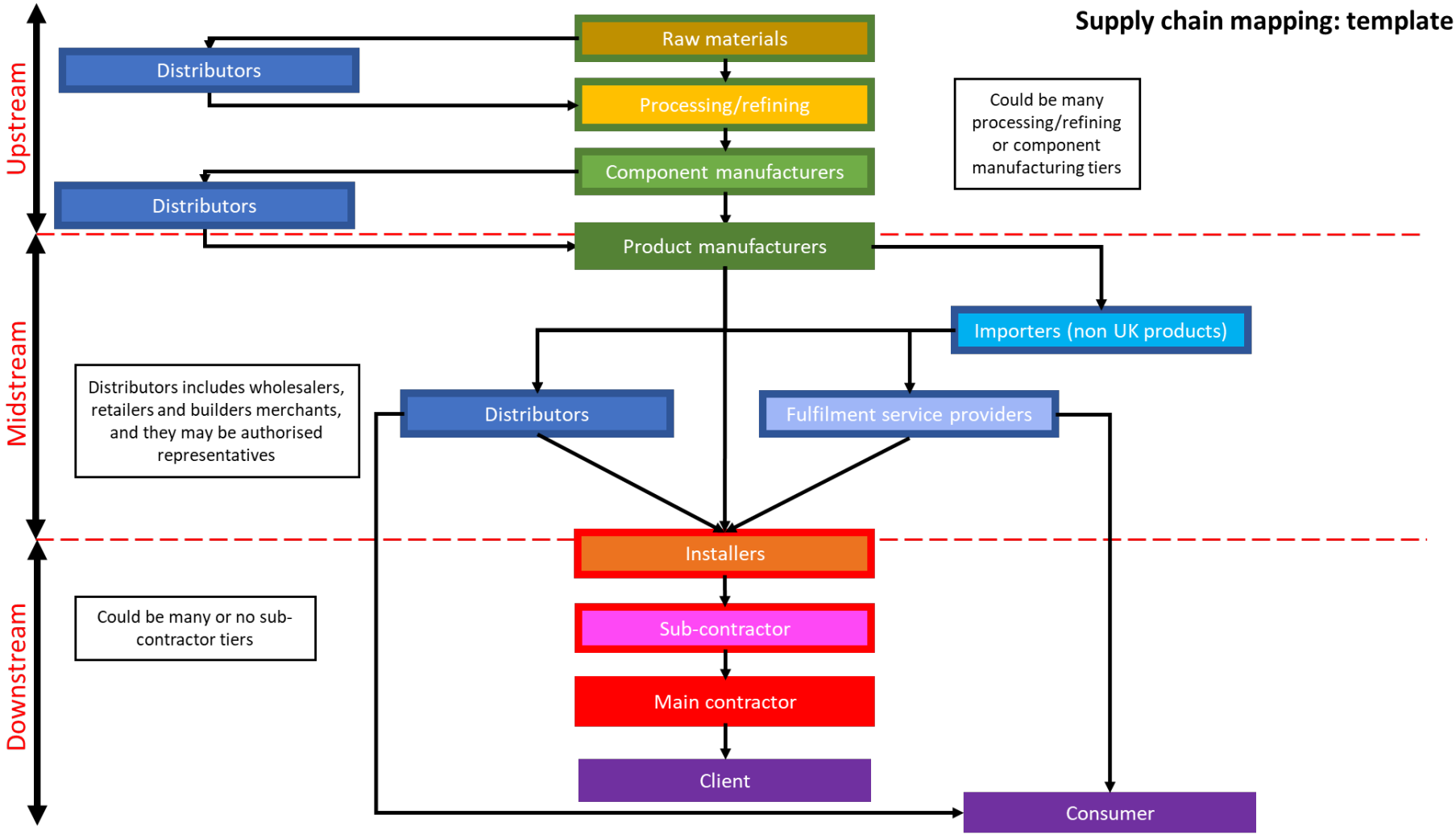

Figure 2-4 Supply chain mapping – template

2.9 Analysis and reporting – information flows between tiers

2.9.1 Information flows

The literature search focusing on the information flows was performed as explained in section 2. There was little published literature on this subject and most of the information was gathered from company websites and supplemented by information from the survey, workshop, and interviews.

The investigation identifies the flow of information accompanying movement of goods relating to the product between each tier in the supply chain identified in Table 2-6 and Figure 2-4. The information focused upon the following types of information moving between tiers:

- Building Information Modelling (BIM) – a system of exchanging digital information about product that can be viewed in certain software packages as a 3D model.
- Brochures or leaflets –component manufacturers and product manufacturers may provide brochure/leaflets either in paper form or online
- BSI Kitemark –certification confirms that a product or service's claim has been independently and repeatedly tested by experts
- Company data sheets
- COSHH risk assessments may be provided throughout the supply chain providing details of the appropriate health surveillance and procedures for working with hazardous substances.
- Declaration of performance - required from the component manufacturer and the product manufacturer if the materials used are covered by a designated standard or a UK technical assessment under the CPR
- Information on packaging
- Information on product
- Installation guides are provided by product manufacturers and contain instructions for installation. Product manufacturers may also provide installation videos available on websites such as YouTube.
- Manufacturer's logo
- Manufacturing training may be provided in the form of paper instructions or as a training video for installation.
- Operation and maintenance manual
- QR code/barcode may be placed on a product by the product manufacturer to give access to information.
- Safety data sheet (SDS) provided by a raw material supplier, component manufacturer or product manufacturer. This safety data sheet is required by the REACH regulation when a hazardous substance is used, it does not need to be supplied with articles.

- Technical information provides details of the general functional requirements of a product, such as instructions for installation, use, maintenance, and steps for effective deployment of equipment.
- Third-party certification (voluntary) – can be provided by an independent expert who has assessed the product and found it meets certain standards and is made available on the manufacturer's website
- UKCA/CE mark – on product and/or packaging
- Unique ID on product
- Warranty

Survey responses indicate that distributors supply little information with the products that they sell (although data sheets are made available online). Subcontractors and installers need to revert to the product/component manufacturer for the declaration of performance, technical information and other information.

The information is provided using several methods:

- Online
- Paper
- Face to face

For each of the five products, a table similar to Table 2-6 is produced. Additional information flow tables are provided in circumstances where the information flows for a significant amount of the product is different. The reasons for the difference vary greatly between the products.

Regulation (EU) No 305/2011 lays down harmonised conditions for the marketing of construction products. Where bespoke or custom-made products are possible, articles 5 and 38 allow derogations and simplified procedures, which mean that the product manufacturer may use Specific Technical Documentation demonstrating compliance of that product. The study team investigated whether manufacturers are using these forms of documentation.

The study did not collect information about the flow of information from product manufacturers to fulfilment service providers (FSPs) because the importance of FSPs in the supply chains for firestoppers and cables was not understood until late in the study.

The Restriction of Hazardous Substances (RoHS), Electrical Equipment (Safety) Regulations EE(s)R, RED (Radio Equipment Directive) and Waste Electrical and Electronic Equipment recycling (WEEE) were not included for cables because they primarily relate to products containing cables. They could have been included for fire doors which may have sensors or wireless communication to fire alarms, but this possibility was not understood until late in the study and, therefore, this information was not collected.

The information flow analysis is based upon following the goods, similar to that for the supply chain. However, an alternative information flow could be the flow of the specification data as outlined in section 2.8.6. This was not considered any further in this study.

Table 2-6 Information flows between tiers – template

Information flow type	**From**	Raw	CompM	ProdM	FSP	DistP	Inst	SubC	MainC
	To	CompM	ProdM	DistP	Cons	Inst	SubC	MainC	Client
Building Information Modelling (BIM)									
Brochure/leaflet									
BSI Kitemark (on product and/or packaging)									
Company datasheet									
COSHH									
Declaration of performance (DOP)									
Info on packaging									
Info on product									
Installation guide									
Manufacturer's logo									
Manufacturer's training*									
Operation & maintenance manual									
QR/bar code									
Safety data sheets									
Technical info									
Third party certification (voluntary)									
UKCA/CE mark on product and/or packaging									
Unique ID on product									
Warranty									

Source: RPA

*Note: * Media for information is via paper/online, or on products or packaging, where indicated*
A tick means this is believed to exist: No tick could mean that it does not exist, sometimes exists or it was not found. Not all options were covered in surveys and interviews

Key to tiers:											
Raw	Proc	CompM	DistRM	ProdM	DistP	FSP	Inst	SubC	MainC	Client	Cons
Raw materials	Processing/ refining	Component manufacturer	Distributor of raw materials	Product manufacturer	Distributor	Fulfilment service provider	Installer	Sub-contractor	Main contractor	Client	Consumer

2.9.2 Circular information flows and supply chain movements

There are several situations where the product may return back up the supply chain, or information about the product might be transferred back up the supply chain.

Two types of information flow that return are:

- Information about products rejected prior to installation, for any reason; and
- Information about products that have been installed such as feedback, reviews, opinions or factors to consider in the future.

Two situations when goods may return up the supply chain are:

- End of line products;
- Seconds; and
- Damaged products.

The issue is how to ensure that seconds and damaged products are not relabelled and returned to the supply chain, as disposing of these products can be costly, and they could potentially be sold to other industries.

These products which are returned back up the supply chain should not be sold to the construction industry buyers as they do not meet the building regulation standards. However, this raises questions about the potential return of these 'seconds' to the construction market, such as if someone is not aware of the 'second' class of the product and installs this sub-quality product into a building.

Information also flows back up the supply chain from designers to contractors and manufacturers as the product is specified.

None of these situations were considered further by the study team.

2.10 Evidence mapping

2.10.1 Methodology

Our initial assessment of evidence collected and analysed during this research project indicated a low availability of secondary data and a high reliance on primary data collection methods. This resulted in a large variation in data availability, quality and reliability, which has had an impact on the level of certainty when drawing conclusions and recommendations. To mitigate this risk and to provide clarity on the availability and strength of evidence, and to inform the conclusions and lessons learnt, the study team used an adapted approach of an evidence gap map.

The methodology of the evidence gap map is a systematic visual overview of evidence to identify knowledge gaps and/or redundancy, and to evaluate the quality of available evidence (Saran and White, 2018; Mubarik *et al.*, 2021). An evidence gap map draws and builds on the systematic literature reviews that synthesise identified and collected evidence into new knowledge and provide answers to the research questions. In addition, an evidence gap map provides an organised and visualised overview of knowledge, outlining the strength and reliability of data, and pinpointing the remaining evidence gaps across research areas. It is a robust and transparent methodology that supports the design of a research project as well as the process of evidence gathering and assessment, and the identification of the themes and wider aspects requiring further investigation in the follow-up studies.

In this project, the study team applied an adapted evidence gap map methodology to:

- Assess the availability and quality of evidence across three main thematic areas (market size, supply chain mapping, and information flows) and five construction products (cables, cladding, fire barriers, fire doors, and insulation);
- Identify remaining evidence gaps; and
- Outline the strength and robustness of conclusions that could be drawn on the basis of the available evidence.

The evidence gap map was conducted through the following steps:

- **Step 1 – Literature review**: defining research scope and specific search words (see section 2.2), running searches, and identifying and assessing written sources;
- **Step 2 – Market data review**: identifying and reviewing quantitative sources (see section 2.7);
- **Step 3 – Identifying evidence gaps** to be filled by primary data collection **and collecting evidence** via an online survey, interviews and workshops with stakeholders; and
- **Step 4 –** Constructing the evidence gap map visualising evidence availability and relevant sources.

During steps 1 and 2, the process of reviewing, appraising and evaluating gathered sources focused on assessing relevance and quality of evidence (O'Leary et al. 2017)[2]. The aim of this process was to ensure that included sources present the best evidence available, and findings and conclusions are based on a rigorous and robust foundation. Upon identifying remaining evidence gaps, as part of step 3, the research team consulted stakeholders on a set of targeted research questions to plug the remaining gaps in knowledge and understanding. Finally, during step 4, a map visualisation was created to graphically display evidence availability and data sources (Saran and White, 2018). The visualisation process can follow a range of graphical strategies, e.g. a traffic light system, bubbles of different shape, colour and/or size, numbers, or tick boxes. Based on the type of data to be displayed, the study team adopted a traffic light system and descriptive notes.

2.10.2 Evidence gap maps – sources and their quality

In the evidence gap maps, the quality of the sources is presented as follows:

- Green: relevant sources identified; robust analysis feasible;
- Amber: relevant sources identified, some analysis feasible; and
- Red: no relevant sources identified; no analysis feasible.

However, the quality of the sources varies greatly. A broad description of the type of sources required for each quality level is shown in Table 2-7. Often, several sources of data are required to achieve a level of "Green" quality rating, but there are situations where there is only one possible source and if it is sufficiently robust and relevant, this might lead

[2] Typically, a hierarchy of evidence is applied when assessing evidence for scientific and technical reports. Hierarchy of evidence is a research evaluation aid that allows ranking research in accordance with different parameters that contribute to the strength of evidence such as effectiveness, appropriateness and feasibility (Evans, 2003). The basic principles of the hierarchy of evidence were applied in this research, however, due to scarcity of relevant scientific sources, only a simplified evidence assessment was feasible as part of this project.

to a “Green” quality. Similarly, there could be many seemingly robust and relevant sources, but if they all contradict each other, the quality is lowered.

Table 2-7 Evidence gap map – quality of data and sources required

Quality	Source
Market size	
Secondary data sources - Green	Data from ONS, BEIS, HMRC Trade data, Eurostat where the SIC code matches the product exactly or closely. Company turnover data where the company is a major actor and a known proportion of their turnover is related to the product. Independent or commercial reports and analysis of the product, where the definition and scope of the product is clearly stated and appropriate.
Secondary data sources - Amber	Data from ONS, BEIS, HMRC Trade data, Eurostat where the SIC code can be identified for the product, and the proportion relating to the product can be estimated
Secondary data sources - Red	Data from ONS, BEIS, HMRC Trade data, Eurostat where either the SIC code cannot be identified for the product, or the proportion relating to the product cannot be estimated
Primary data sources - Green	Data from the survey, interviews and workshop that is based on company data, relevant confidential reports or extensive industry knowledge and which is directly relevant to the product.
Primary data sources - Amber	Data from the survey, interviews and workshop which has some relevance to the product and/or is the subjective view of the stakeholder
Primary data sources - Red	Data from the survey, interviews and workshop that stakeholders admit is only their opinion and highly subjective, or they have no opinion.
Supply chain mapping and information flows	
Secondary data sources - Green	Independent or commercial reports and analysis AND/OR manufacturers’ websites, literature and data sheets, where the definition and scope of the product is clearly stated and directly relevant.
Secondary data sources - Amber	Independent or commercial reports and analysis AND/OR manufacturers’ websites, literature and data sheets, where the product is defined, and some relevant information relating to the product is available.
Secondary data sources - Red	Independent or commercial reports and analysis AND/OR manufacturers’ websites, literature and data sheets cannot be identified for the product.
Primary data sources - Green	Data from the survey, interviews and workshop that is based on company data, relevant confidential reports or extensive

Quality	Source
	industry knowledge and which is directly relevant to the product.
Primary data sources - Amber	Data from the survey, interviews and workshop which has some relevance to the product and/or is the subjective view of the stakeholder
Primary data sources - Red	Data from the survey, interviews and workshop that stakeholders admit is only their opinion and highly subjective, or they have no opinion.

Source: RPA

3 Cabling

3.1 Definitions

For the purposes of this study, a cable is defined as a 'conductor of electricity usually made from copper and sheathed with insulation' (Gorse, 2012).

Electrical cables can consist of one or more cores (a conductor usually made of copper or aluminium, most commonly insulated in PVC) which are contained within a cable jacket. The diagram below shows a cable with a single core.

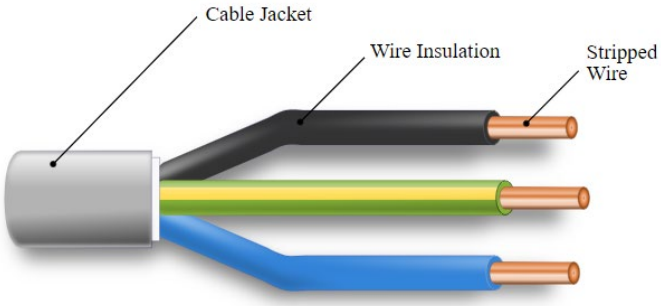

Figure 3-1 Diagram of a three core electrical cable
Source: (Uwe Schwöbel adapted by Marekich, 2012)

This study covers cables used within the construction sector, which can be categorised as follows:

- High voltage and power utility cables;
- Low voltage;
- Extra-low voltage;
- Fire resistant cables;
- Data and network cables (including fibre optic cables);
- Telecommunications cables; and
- Cables used for transport networks.

The table below defines the cables and their voltage ratings.

Table 3-1 Cables and their ratings

	Volts (AC)	**Volts (DC)**
Extra low voltage	≤ 50	≤ 120
Low voltage	>50 and ≤1,000	>75 and ≤1,500
High voltage*	> 1,000	> 1,500

Note: this study has taken anything higher that 'low voltage' to be 'high voltage'.
Source: (The Building Regulations 2010, 2010)

Construction cables used within dwellings typically include low-voltage power cables feeding into buildings and some communication and data cables.

High-voltage cables are primarily used by power utilities, although they can be used for the supply of electricity in some larger industrial buildings.

This study does not cover load bearing 'mechanical' cables. A different set of rules and regulations would apply to mechanical cables, and these would therefore need to be considered as a separate construction product.

Furthermore, this study does not cover cables used in devices such as radios, televisions and bedside lamps (such as the flexible cables between the wall socket and a device or appliance powered from the socket) which do not form a permanent part of a construction work/dwelling (as required by the definitions under the UK Construction Products Regulations (*The Construction Products Regulations 2020*, 2020) and the Building Regulations (*The Building Regulations 2010*, 2010).

3.1.1 Cable product types

The following subsections provide descriptions of the most common types of cable products available on the UK market that are used in the construction sector.

3.1.1.1 High voltage and power utility cables

High voltage cables can be used for the supply of electricity in larger developments, they are also used to supply electricity to substations in the form of overhead power lines and underground cables (BASEC, no date; NKT Cables, no date).

3.1.1.2 Low-voltage electrical cables

Low-voltage cables are the most frequently used in construction. The most common types of low-voltage cable and their uses within a building are summarised in the table below.

Table 3-2 Low-voltage cables and their uses in buildings

Low-voltage cable type	Uses in a building
Building wire/ general-purpose single insulated cables	Used in domestic and commercial premises for final circuit wiring.
Twin-core and earth cabling	All the general internal power cables within a home generally use twin-core and earth cabling. They are, for example, used for sockets and switches, as well as smoke alarms and central heating thermostats. This cable type consists of two PVC-insulated cores, with an earth core between the two, all insulated in a PVC outer sleeve.
Three-core and earth cabling	Domestic light fittings that are controlled by two light switches use three-core and earth (EC4U, no date).
Flexible cable or 'flex'	Light pendants
Arctic flexible cable	Arctic flexible cable is designed for outside use and can withstand temperatures of -20°C. It remains flexible in cold environments.
Armoured cables/steel wired armoured (SWA) cables	Armoured cable is chiefly used to transfer power underground or

Low-voltage cable type	Uses in a building
	overhead. These cables are not flexible and are intended for fixed applications.

Sources: (BASEC, no date; Electrician Courses 4U, no date; Diydata, 2022)

3.1.1.3 Extra-low voltage

Extra-low-voltage cables (according to the Building Regulations) are cables that carry a voltage ≤ 50 V (AC) or ≤ 120 V (DC). Extra-low-voltage cable systems are used mainly for telecommunications, security and surveillance systems such as closed-circuit television (CCTV), access control systems, and alarm systems (Supermec, 2019).

3.1.1.4 Fire-resistant cables

Fire-resistant cables are coated with a protective sheath designed to prevent the spread of flames while limiting the amount of smoke and toxic fumes given off in the event of combustion. Fire-resistant cables are therefore used in areas that require circuit integrity for a stated fire survival time: these minimum fire survival times are categorized 1-3 depending on their application, for example for fire alarm, evacuation systems and emergency lighting (BS 8519, 2020).

3.1.1.5 Low-smoke and fume (including zero-halogen) cables

Low-smoke zero-halogen cable (abbreviated either 'LSZH' or 'LS0H') is intended for use in applications where smoke emissions and toxic fumes could pose a risk. Unlike PVC, LSZH cables only produce low levels of smoke and toxic fumes (Clynder Cables Ltd., no date).

There is currently movement away from PVC as an insulator towards more fire-performing materials such as low smoke halogen free (LSHF) cables that provide better fire performance.

According to Part B of The Building Regulations, smoke and noxious gases produced by a fire present more of a danger than flame (*The Building Regulations 2010*, 2010).

3.1.1.6 Data/network cables

There are three classes of data/network cables (ACCL, 2018)

- Coaxial cable or 'coax': generally used for satellite television connection and radio aerial (for FM, DAB, etc.) (AA Electrical Services, no date);
- Twisted-pair cable: used for ethernet connection; and
- Optic cable: primarily used for internet connection.

3.1.1.7 Telecommunications cables

Telecommunication cables are used for voice, data and signal transmission. Telecommunication cables include the following types of cable:

- Telephone cables (including CW1128, CW1128/1198, CW1308, and CW1308B)
- Local area network cables (e.g. Cat6 and Cat7)
- Fibre optic cables
- Coaxial cables (Eland Cables, no date)

3.1.1.8 Cables used for transport networks

Cables used for transport networks include cables used for electrification and power supply, as well as signalling, control and communication. Common cables used for railway networks are summarised in the table below.

Table 3-3 Cables used in transport networks

Use in transport networks	Examples of cables used
Railway power cables	BS6724, BS6622, Trackfeeder cable, and the Network Rail specification NR/PS/ELP/00008 25kV Feeder Cable
Railway overhead line cables	Catenary wire, contact wire, Cockroach, Hornet and Centipede cables
Railway signalling cables	Network Rail approved signalling cable NR/PS/SIG/00005 Types A to E
Railway telecoms cables	Telecommunications cabling including Copper and Fibre trackside cables, Twin Datalink cables (PVC and LSZH) and Screening Conductors for Rail applications

Source: (Eland Cables, no date)

3.2 Legislation and voluntary initiatives

3.2.1 Legislation

3.2.1.1 Overview

The following subsections describe the legislation governing cables as construction products, based on analysis carried out by the study team. Legislation governing cables includes:

- The Building Regulations
- The Construction Products Regulation.

3.2.1.2 UK Building Regulations

For a broad overview of the UK Building Regulations, see section 11.1.10.

Specifically with regard to cabling, Part P of the Building Regulations covers electrical safety in dwellings. See the subsection below for further details.

Part P (electrical safety) of the Building Regulations

Part P of the Building Regulations states that electrical installations should be designed in a way that protects those who operate, maintain or alter the installation from fire or injury. This Part of the regulation applies to low- and extra-low-voltage installations associated with dwellings (*The Building Regulations 2010*, 2010).

Part B (fire safety) of the Building Regulations

Part B paragraph 3.46 of the Building Regulations states that to 'limit potential damage to cables in protected circuits', cables 'should be sufficiently robust', cable 'routes should be carefully selected and/or physically protected in areas where cables may be exposed to damage', and methods of cable support should 'offer at least the same integrity as the cable'. According to paragraph 3.47, a cable 'should only pass through parts of the building in which fire risk is negligible' and 'should be separate from any circuit provided for

another purpose'. This paragraph also stipulates that cables should achieve 'PH 30 classification' in accordance with BS EN 50200. Paragraph 3.48 indicates that guidance on cables for large and complex buildings is provided in BS 5839-1, BS 5266-1 and BS 8519.

3.2.1.3 UK Construction Products Regulation

For an introduction to the UK's Construction Products Regulation (CPR), see Section 11.1.2. A summary of the designated standards relevant to cables under the UK's CPR is provided in the subsection below.

Designated standards

There is one single designated standard under the CPR for cables:

- EN 50575:2014/A1:2016 – Power, control and communication cables — Cables for general applications in construction works subject to reaction to fire requirements

This standard specifies reaction to fire performance requirements and sets out test and assessment method for electric cables used for the supply of electricity and for control and communication purposes, which are intended for use in construction works. This standard covers:

- Power cables
- Control and communication cables
- Optical fibre cables (Eland Cables, no date)

Under the CPR, cables having an intended use for permanent installation in buildings and constructions works are therefore classified according to their reaction to fire[3] and require a declaration of performance (DoP) in addition to the CE/UKCA mark. Other performance properties, such as resistance to fire[4], are not covered by the requirements.

The DoP provides the class of reaction to fire performance. These classes, as set out in BS 50575:2014/A1:2016 are summarised in the table below.

Table 3-4 Declaration of performance - class of reaction to fire performance

Class	Fire performance	Test
A	Practically impossible to burn	BS EN ISO 1716
B1	Combustible but very little, if any, flame spread or heat release	BS EN 60332 1-2 and BS EN 50399
B2	Low flame spread, fire growth & heat release	BS EN 60332-1-2 and BS EN 50399
C	Reduced flame spread, limited fire growth/heat release rate	BS EN 60332-1-2 and BS EN 50399
D	Moderate fire spread and high levels of heat generated	BS EN 60332-1-2 and BS EN 50399
E	Limited fire spread under test and burns less than 425mm	BS EN 60332-1-2
F	High level of flammability under test and burns over 425mm	BS EN 60332-1-2

[3] 'Reaction to fire' concerns how a cable performs when exposed to fire, and tests are used to measure the effect on the spread of flame, burning droplets and toxic emissions.
[4] If a cable is 'fire-resistant', it means that it can continue to function in the event of a fire.

As set out in the table above, these classes have fire performance assessment processes based on the following standards:

- BS EN 60332-1-2;
- BS EN 50399; and
- BS EN ISO 1716.

In the UK (unlike many EU countries) the regulations do not specify which class of reaction to fire performance is applicable for a given installation. Specifiers and designers of cables can therefore choose any class, so long as the cable complies with other applicable legislation (BCA, 2018). Furthermore, BS EN 50575 does not prevent the use of cables that emit toxic fumes and smoke in the event of a fire, it is again up to the designer, specifier or installer to ensure that the products chosen are appropriate and meet contractual requirements (FS Cables, 2022). It was recommended by one consultee during the workshop carried out as part of this study that **class CCA or above** be specified, as this ensures that there is an independent check of the cable under the CPR. Anything less than this class means that a manufacturer is self-declaring the fire performance of the cable.

British standards

For an introduction to British Standards and the BSI Kitemark, see Section 11.1.9. The table below lists some of the most common British Standards relevant to cables.

Table 3-5 British Standards most relevant to cables

British Standard/specification created by the BSI	Title of the British Standard/specification
BS 7671:2018	Requirements for Electrical Installations. IET Wiring Regulations
BS 6701:2016+A1:2017	Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance
BS 5266-1:2016	Emergency lighting. Code of practice for the emergency lighting of premises
BS 5467:2016	Electric cables. Thermosetting insulated, armoured cables of rated voltages of 600/1 000 V and 1 900/3 300 V for fixed installations. Specification.
BS 5839-8:2013	Fire detection and alarm systems for buildings. Code of practice for the design, installation, commissioning and maintenance of voice alarm systems
BS 6004:2012	Electric cables – PVC-insulated and PVC-sheathed cables for voltages up to and including 300/500 V, for electric power and lighting (+A1:2020)

British Standard/specification created by the BSI	Title of the British Standard/specification
BS 6195:2006	Electric cables. Rubber or silicone rubber insulated flexible cables and cords for coil end leads
BS 6231:2006	Electric cables. Single-core PVC-insulated flexible cables of rated voltage 600/1000 V for switchgear and controlgear wiring
BS 6500:2000	Electric cables. Flexible cords rated up to 300/500 V, for use with appliances and equipment intended for domestic, office and similar environments
BS 6724:2016	Electric cables. Thermosetting insulated, armoured cables of rated voltages of 600/1 000 V and 1 900/3 300 V for fixed installations, having low emission of smoke and corrosive gases when affected by fire. Specification
BS EN 60794-1-21:2015+A1:2020	Optical fibre cables – Generic specification. Basic optical cable test procedures. Mechanical tests methods
BS EN 61034-1:2005+A1:2014	Measurement of smoke density of cables burning under defined conditions – Test apparatus
BS EN 61034-2:2005+A1:2013	Measurement of smoke density of cables burning under defined conditions – Test procedure and requirements
BS 6883	Elastomer-insulated cables for fixed wiring in ships and on mobile and fixed offshore units. Requirements and test methods
BS 7629	Electric cables. Specification for 300/500 V fire-resistant, screened, fixed installation cables having low emission of smoke and corrosive gases when affected by fire. Multicore cables
BS 7846	Electric cables. Specification for Thermosetting insulated, armoured, fire-resistant cables of rated voltage 600/1 000 V for fixed installations, having low emission of smoke and corrosive gases when affected by fire.
BS 7870	LV and MV polymeric insulated cables for use by distribution and generation utilities.
BS 8491	Method for assessment of fire integrity of large-diameter power cables for use as components

British Standard/specification created by the BSI	Title of the British Standard/specification
	for smoke and heat control systems and certain other active fire safety systems.
BS 6231	Electric cables. Single-core PVC-insulated flexible cables of rated voltage 600/1000 V for switchgear and controlgear wiring
BS 7917	Elastomer-insulated fire resistant (limited circuit integrity) cables for fixed wiring in ships and on mobile and fixed offshore units. Requirements and test methods.
BS 7211	Electric cables. Thermosetting-insulated and thermoplastic-sheathed cables for voltages up to and including 450/750 V for electric power and lighting and having low emission of smoke and corrosive gases when affected by fire.
BS 8573	Electric cables. Thermosetting-insulated, non-armoured cables with a voltage of 600/1,000V, for fixed installations, having low emissions of smoke and corrosive gases when affected by fire.

3.2.2 Voluntary initiatives

3.2.2.1 Independent third-party approvals

Independent third-party approvals are provided by the British Approvals Service for Cables (BASEC) and the Loss Prevention Certification Board (LPCB). See subsection below for further details.

3.2.2.2 BASEC

The British Approvals Service for Cables (BASEC) is an independent third-party approvals body for the cable industry. Certification from BASEC covers power cables, control cables, signalling cables and datacom cables for all types of construction and developments.

The BASEC approval scheme is designed to meet the requirements of UK wiring regulations, including the Construction Products Regulation (CPR), and relevant cable standards.

BASEC's scheme also includes ongoing quality assurance and surveillance activities that help to reduce the risk of sub-standard and counterfeit cables. Through their surveillance activities they engage with the whole cable supply chain (i.e. manufacturers, compound suppliers, stockists, distributors, contractors, clients, etc.) and this helps them to identify potential issues early and to carry out corrective and preventative actions, so as to minimise the risk of potential future problems and sub-standard cables entering the UK market.

BASEC uses accredited independent laboratories to test cables in line with specifications and standards. Certification can then be provided attesting to a product's compliance with a given standard.

BASEC conducts tests for cables that cover fire performance, electrical, physical and chemical properties for industrial, construction, OEM and other applications.

A cable that has been approved by BASEC will carry the registered certification trademark 'BASEC' on the cable itself, together with a manufacturer's traceability mark (manufacturer's name, brand name or unique code). The BASEC logo may also be provided on packaging but this is not a requirement (BASEC, no date).

Pan-European HAR scheme

In addition to providing third-party approval, BASEC are also part of the pan-European HAR scheme. This scheme ensures that cables that are made to harmonised European standards (or designated standards that align with harmonised European standards) are certified by an approval body. This ensures that the cables can be accepted as approved in participating European countries. Any cables certified in this way will be marked 'BASEC <HAR>' (BASEC, no date; HAR-Cert.com, no date).

3.2.2.3 LPCB

The Loss Prevention Certification Board (LPCB) is a globally recognised third-party certification body. They provide third-party confirmation which demonstrates that cables (among other products) meet and continue to meet a given standard. As part of the certification process, the LPCB undertakes an audit of the factory production control system. All certified products are listed on their 'RedBookLive', which acts as a reference for specifiers, designers and end users for products that have been checked by independent experts (BRE Group, no date).

3.2.2.4 Voluntary industry initiatives

Case study 3: Cables – stakeholder views on sector

According to consulted stakeholders involved within the sector, cables are a stable product with few major technical changes implemented over recent years. Cables are also considered by consulted stakeholders to be a highly regulated construction product. The first testing and certification regimes covering cable products were established in the 1960-1970s and aimed initially at cable manufacturers: over time they expanded to cover other stakeholders in the supply chain. As a result, cables have been operating within a high-level testing and certification regime for over 50 years. Trade associations are involved in discussions about standards and regulations on cable products, and in self-regulatory activities. This length of experience and the active involvement of stakeholders, according to consulted stakeholders, enable cable products to serve as an example of an established well-regulated product, with lessons applicable to other construction products.[5]

At present, cables in the UK are **governed by the Building Regulations and the Construction Products Regulation**. The British, EU and international standards tightly define construction cable characteristics, such as size ranges, design, testing, intended use, and performance and material requirements. All cable manufacturers are required to include the UKCA/CE mark and the declaration of performance mark, and label products as defined by standards' minimum marking regime. In addition to this, manufacturers often decide to put additional information on cables. Moreover, the amount of

[5] However, it has to be noted that cables are also a relatively simple product, rarely needing to be integrated physically with other products, with little change in the technology and the associated regulations over time.

information that goes into the cable marking has been expanded over recent years.

In addition to government regulations, the cables industry is self-regulating via well-established voluntary initiatives, such as independent third-party approvals, and market surveillance. Most cable products are certified from third party testing due to pressure from distributors, installers and sub-contractors. The independent testing and certification schemes involve regular factory inspections and regular re-testing of products, and these processes are considered to aid compliance. According to trade association interviewees, most stakeholders comply with these voluntary third-party approval routes and have their products tested and approved.

In addition, according to consulted stakeholders, the electrical sector has well-established **installation design rules** (BS7671) and organised **technical competency schemes for designers and contractors**.

As attested by the cable trade association interviewees, the cable sector has consistently pushed for higher standards of scrutiny rather than lower. For example, in many cases cables currently already apply the assessment and verification of constancy of performance systems (AVCP) System 1+, the highest level under the Construction Products Regulation. In addition, the sector is currently undertaking a large digitalisation activity to ensure an improved flow of good quality information to members and users. Using the ETIM data model[6], one of the trade organisations is currently developing a database and qualification system for all electrical products (wider than cables). The trade association is also encouraging ETIM to introduce a new standard for the technical attributes of cable products. This would act as a standard for information provision and would include information on what the conductor and insulation is made of, the diameter of the cable, colour, fire performance, maintenance of circuit integrity, low smoke performance and other attributes depending on the type of cable.

Trade association interviewees observed that every participant in the electrical system contributes to the regulation, certification and testing schemes to **ensure the correct credentials for cable products and their safe installation**. This enables the information flows to actors throughout the supply chain and also results in formalised information for end-users.

For the list of all case studies, see section 2.4.4.

3.2.2.4.1 Approved Cables Initiative

The Approved Cables Initiative (ACI) was established in 2010 to highlight the prevalence of non-compliant, sub-standard, and unsafe cables in the UK electrical supply chain. The ACI aims to ensure the following:

- All cable sold and bought for UK installation to conform to British (or relevant European/international) standards;

[6] ETIM (European Technical Information Model) is the international classification standard for technical products. ETIM is currently voluntary, however, market forces and industry best practice are pushing towards this standard. For instance, the CPA's Code for Construction Information Project is also based on the ETIM data model. (https://www.etim-international.com/)

- All cable sold and bought for UK installation to be independently third-party approved;
- Wholesalers and distributors to supply certification/approval for all cable they supply and this information to be available upon request;
- Provenance and traceability to be key purchasing requirements for all imported, distributed, sold or installed cable in the UK;
- A greater number of standards-led installations to be championed in the UK
- Acceptance, enforcement and monitoring at all levels of the supply chain (Approved Cables Initiative, no date)(Approved Cables Initiative, no date).

The ACI provides guidance documents, and acts as a point of contact for reporting faulty cables. Guidance is for example provided on checking cable safety, as shown in Figure 3-2 and Figure 3-3.

3.2.2.4.2 Electrical Distributors Association (EDA)

The Electrical Distributors Association (EDA), with the support of some of the British Cables Association's (BCA) members, is making efforts to digitise processes to ensure a flow of good-quality product information to members. The EDA developed their database and qualification system for all electrical products (wider than cables) based on the ETIM data model. See case study 4 for further details.

Figure 3-2 shows a list of criteria to determine the safety of a cable. Third-party approval is considered important for ensuring cable safety, along with identification of key pieces of information about the cable such as voltage, information identifying the manufacturer, as well as the British Standard number, among others.

Figure 3-3 sets out how cables should be marked. It shows that each cable type has its own requirements for marking.

Figure 3-2 Cable Safety Checklist provided by the ACI
Source: (Approved Cables Initiative, 2019)

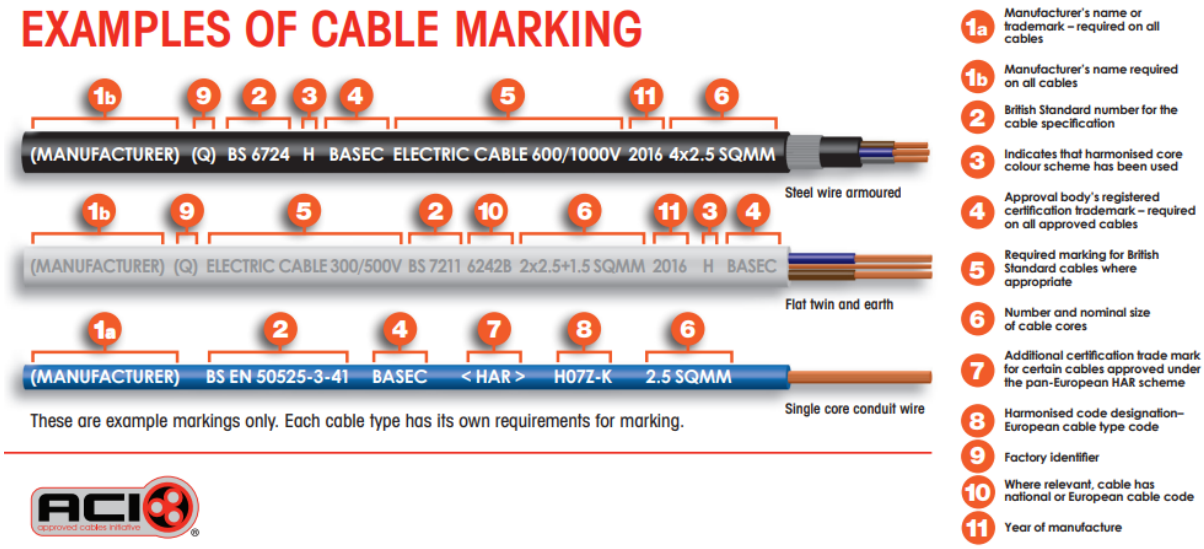

Figure 3-3 Example of Cable Marking provided by the ACI
Source: (Approved Cables Initiative, 2019)

3.3 UK market size

3.3.1 Product types and their SIC codes

Table 3-6 and Table 3-7 provide the identified SIC and PRODCOM codes that are relevant to cables.

Cables used in both construction and infrastructure are within the scope of the study. The data will include "device" cables that are used to connect to radios, televisions and bedside lamps (such as the flexible cables between the wall socket and a device or appliance powered from the socket). These do not form a permanent part of a construction workplace/dwelling. The study team has found no data indicating the amount of "device cables or the proportion of all cables that these "device" cables comprise.

Table 3-6 SIC codes identified for cables

Code	Description
C27.31	Manufacture of fibre-optic cables
C27.32	Manufacture of other electronic and electric wire and cables

Table 3-7 PRODCOM codes identified for cables

Code	Description
27311100	Optical fibre cables made up of individually sheathed fibres, whether or not assembled with electric conductors or fitted with connectors
27321200	Insulated coaxial cables and other coaxial electric conductors for data and control purposes, whether or not fitted with connectors
27321380	Other electric conductors, for a voltage not exceeding 1000V, not fitted with connectors EXCLUDING winding wire, coaxial cable and other coaxial electric conductors

Code	Description
27321400	Insulated electric conductors for a voltage exceeding 1,000V EXCLUDING winding wire, coaxial cable and other coaxial electric conductors, ignition and other wiring sets used in vehicles, aircraft or ships

3.3.2 Size of the market and characteristics

Market size data has been collected from the Annual Business Survey (ABS), published by the Office for National Statistics (ONS). In 2019, **229 companies** were registered under SIC code 27.32 as manufacturing other electronic and electric wires and cables, an additional **31 companies** were registered under code 27.31 as manufacturing fibre-optic cables. Code 27.32 includes insulated wire and cable, made of steel, copper and aluminium. Fibre-optic cable manufacture has a total turnover of **£301 million per annum**, other cables have a turnover of **£2,223 million per annum**.

Table 3-8 Number of enterprises manufacturing cabling (2019)

Description	Number of enterprises UK 2019	Turnover UK 2019
Manufacture of fibre-optic cables	31	£301 million
Manufacture of other electronic and electric wire and cables	229	£2,223 million
Total	**260**	**£2,524 million**

Source: (ONS, 2019)

3.3.3 Market segmented by product type

Table 3-9 shows the total market size of cable products from PRODCOM. The data displayed does not account for products produced and retained for reuse by the producer. The total market size is calculated as the UK production, plus imports, minus exports, thus accounting for only the cables used for construction within the UK. The total market value of all cable products is estimated at approximately £2 billion, equating to 370,000 tonnes of cable. As this is likely to be an overestimate for various reasons, the study team believe that there is a medium level of certainty that the value is in the region of £1.75–2 billion, representing approximately 350,000 tonnes of cable.

The data in the table below indicates that approximately 70% of cables are imported into the UK.

Table 3-9 Market size of cable products (2019)

Classification	UK Market size 2019	Quantity Sold
High voltage		
UK Production	£184 million	1,026 tonnes
UK Imports	£308 million	55,807 tonnes
UK Exports	£71 million	4,912 tonnes
UK Total market size	£421 million	51,921 tonnes

Classification	UK Market size 2019	Quantity Sold
Low voltage		
UK Production	£441 million	99,469 tonnes
UK Imports	£905 million	232,394 tonnes
UK Exports	£435 million	64,145 tonnes
UK Total market size	£911 million	267,718 tonnes
Fibre optic		
UK Production	£331 million	21,792 tonnes
UK Imports	£203 million	12,031 tonnes
UK Exports	£105 million	8,098 tonnes
UK Total market size	£429 million	25,725 tonnes
Coaxial cables		
UK Production	£129 million	10,112 tonnes
UK Imports	£122 million	13,435 tonnes
UK Exports	£58 million	2,101 tonnes
UK Total market size	£193 million	21,446 tonnes
Total for all cables	**£1,954 million**	**366,810 tonnes**

Sources: (ONS PRODCOM, 2019; UK Trade Info, 2019)

3.3.4 Market distribution

According to the Business Population Estimates from BEIS, based on number of employees, 96% of companies manufacturing wire and wiring devices are SMEs. Only 4% of businesses are classified as large businesses. BEIS data was published in October 2021 and reports estimates for 2021 whereas the Annual Business Survey reports data from 2019. Table 3-10 demonstrates the size distribution of businesses within the SIC code 27.3. It is important to note that this figure will be an overestimation of the proportion of the cabling construction products market comprised of SMEs, as this classification also includes products such as lamp holders and electrical outlets.

Table 3-10 Market distribution of companies manufacturing cables

273 Manufacture of wiring and wiring devices	Number of enterprises	Turnover
Micro	38%	2%
Small	38%	18%
Medium	20%	33%
Large	4%	47%

Source: (ONS, 2019)

The ONS UK business: activity, size and location dataset has been used to demonstrate the distribution of businesses across regions. Table 3-11 shows the regional distribution of the manufacture of fibre-optic cables and manufacture of other cables.

Table 3-11 Regional distribution of cables manufacturers' businesses

	England	Wales	Scotland	Northern Ireland
Manufacture of fibre optic cables	35	0	5	0
Manufacture of other electronic and electric wires and cables	200	15	15	5
Total	**235**	**15**	**20**	**5**

Source: (ONS, 2019)

3.3.5 Exports versus Imports

The exports minus the imports provide the balance of trade. Therefore, when a figure is presented as a negative, it demonstrates a trade deficit (or net import), and the UK has a higher value of imports than exports of that product. In comparison, a surplus demonstrates a larger export value than import value (or net export). Overall, the UK has trade with 187 countries for insulated wire and cable products. This data has been collected from UK Trade Info, provided by HMRC. Data presented will be an overestimation, as the data cannot be further segmented into the proportion relevant to the construction products supply chain.

Overall, the UK are a net importer of all insulated wire and cable products. The trade balance is -£869,699,550. Ireland has the largest positive trade balance, compared to the large quantity of imports received from Turkey. This data is presented in Annex 15.[7]

3.3.6 Summary of market size for cables

The market data for cables is summarised in Table 3-12. These are values based primarily on 2019 values and the values in 2022 are likely to be approximately a third higher, see 2.7.6.

Table 3-12 Summary of the cables market analysis

Variable	Value
Estimated total annual market value for cables	£1.75 - 2 billion
Study team's confidence in estimated market value	Medium
Estimated number of enterprises manufacturing cables	350,000 tonnes
Trade balance for cables	-£869,699,550

Sources: (ONS ABS, 2019; ONS PRODCOM, 2019; UK Trade Info, 2019), RPA consultation

[7] Despite well-established means of third-party testing and certifying of cable via approval schemes, it should be noted that these schemes are not mandatory. There is, for example, no requirement for a distributor to stock approved cables. Cables can therefore be easily sourced from elsewhere (e.g. Turkey) and supplied without any third-party approval or testing. A client may or may not specify that they want an approved (third-party-tested) cable.

3.4 Major players

The following table provides examples of companies associated with cable production, at the different levels of the supply chain.

Table 3-13 Companies associated with cable production

Stakeholder type	Examples of companies	Turnover (UK level, 2021 unless otherwise stated)
Product manufacturers	Prysmian Group	€927 million (EU-wide)
	Batt Cables PLC	£152 million
	Doncaster Cables	£40 million (2013)
	British Cables Company	£38 million
	Tratos UK Ltd.	£22.9 million
	AEI Cables Ltd.	£17.3 million (2019)
	Permanoid Ltd.	£8.9 million
	Nexans UK	£2 million (2020)
	Levition Network Solutions Europe	N/A
	TE Connectivity	N/
	Wrexham Mineral Cables (a trading name of Saldon Products Ltd.)	£37.8 million (for Saldon Products Ltd.)
Distributors	Travis Perkins	£4.6 billion
	Screwfix	£2 billion
	Jewson	£2 billion (2019)
	Wolseley UK Limited	£1.7 billion
	Edmundson Electrical	£1.2 billion (2020)
	City Electrical Factors (CEF)	£711 million
	Rexel UK	£624.3 million
	Selco	£471 million (2020)
	YESSS	£114 million (2020)
Trade associations	The British Cables Association (BCA); Electrical Contractor's Association (ECA); Electrical Distributors Association (EDA); Fibreoptic Industry Association (FIA); BEAMA – the UK trade association for manufacturers and providers of energy infrastructure technologies and systems.	N/A

Sources: Association member lists

3.5 Supply chain mapping and information flows

3.5.1 Supply chain maps for cables for small and large projects

The procurement supply chain for cables depends on the size of the project.

For **large projects** (refer to section 2.8.5 for a definition of large and small projects), most cables are centrally procured by a subcontractor or main contractor from a distributor, before being delivered to the installer.

For many **small projects**, cables are bought by the installer or possibly the subcontractor (i.e. the mechanical and electrical (M&E) contractor) from a distributor, before being delivered to the installer.

Manufacturers may also act as importers and sell to wholesalers and distributors in the UK. They may sell directly to contractors and consumers, or to specialist cable distributors. Some manufacturers provide technical assistance services. According to one industry association, SME manufacturers usually make specialist types of cable.

Some distributors only deal with cables, some are wholesalers dealing with all types of electrical products. There are some specialist wholesalers (much of the imports go through this route).

Approximately 70% of cables are imported into the UK (based on data in Table 3-9 Market size of cable products (2019)).

Figure 3-4 provides a supply chain map for cables procured for small projects.

Figure 3-5 provides a supply chain map for cables procured for large projects.

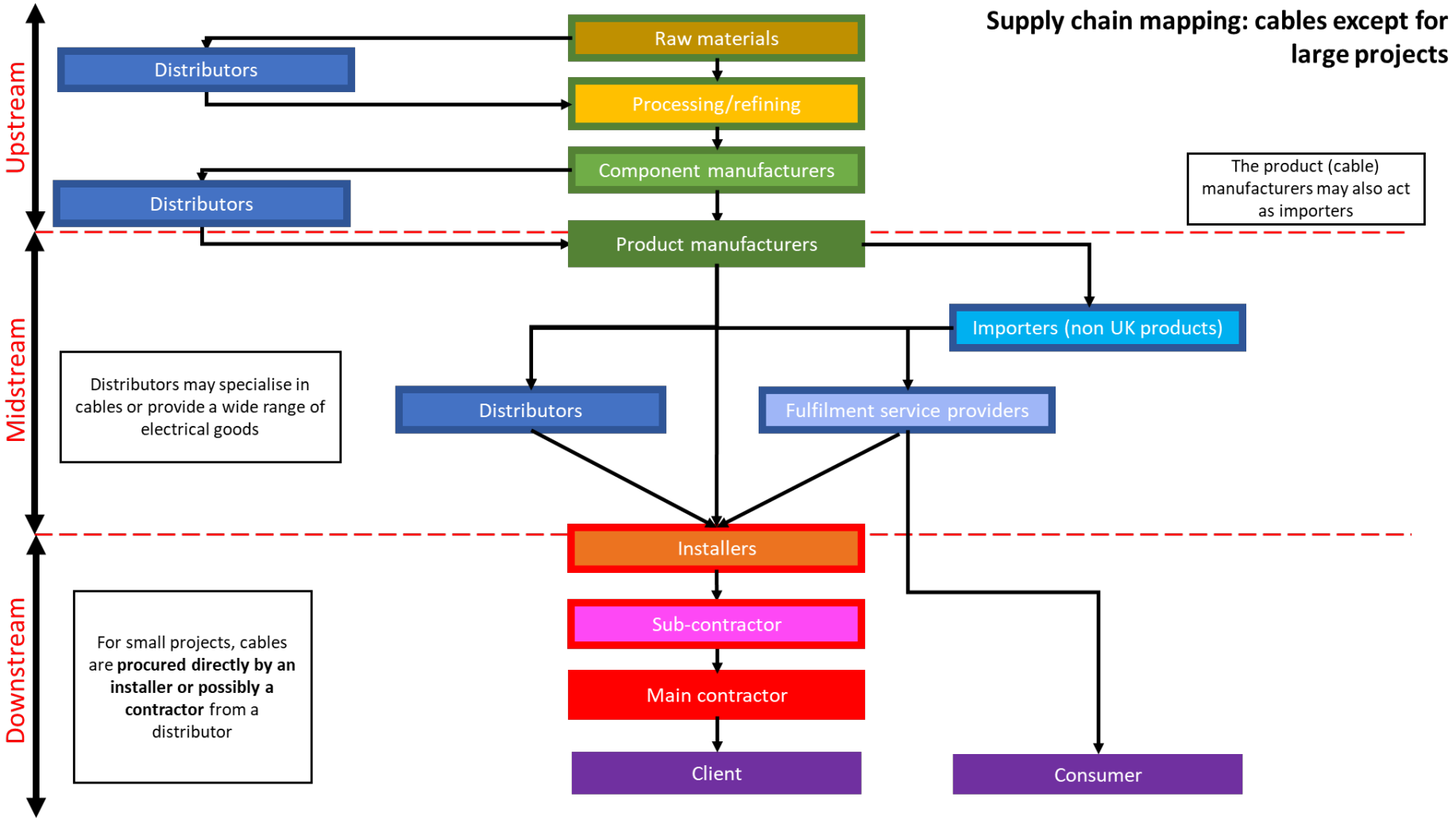

Figure 3-4 Supply chain map for cables, except for large projects
Source: RPA

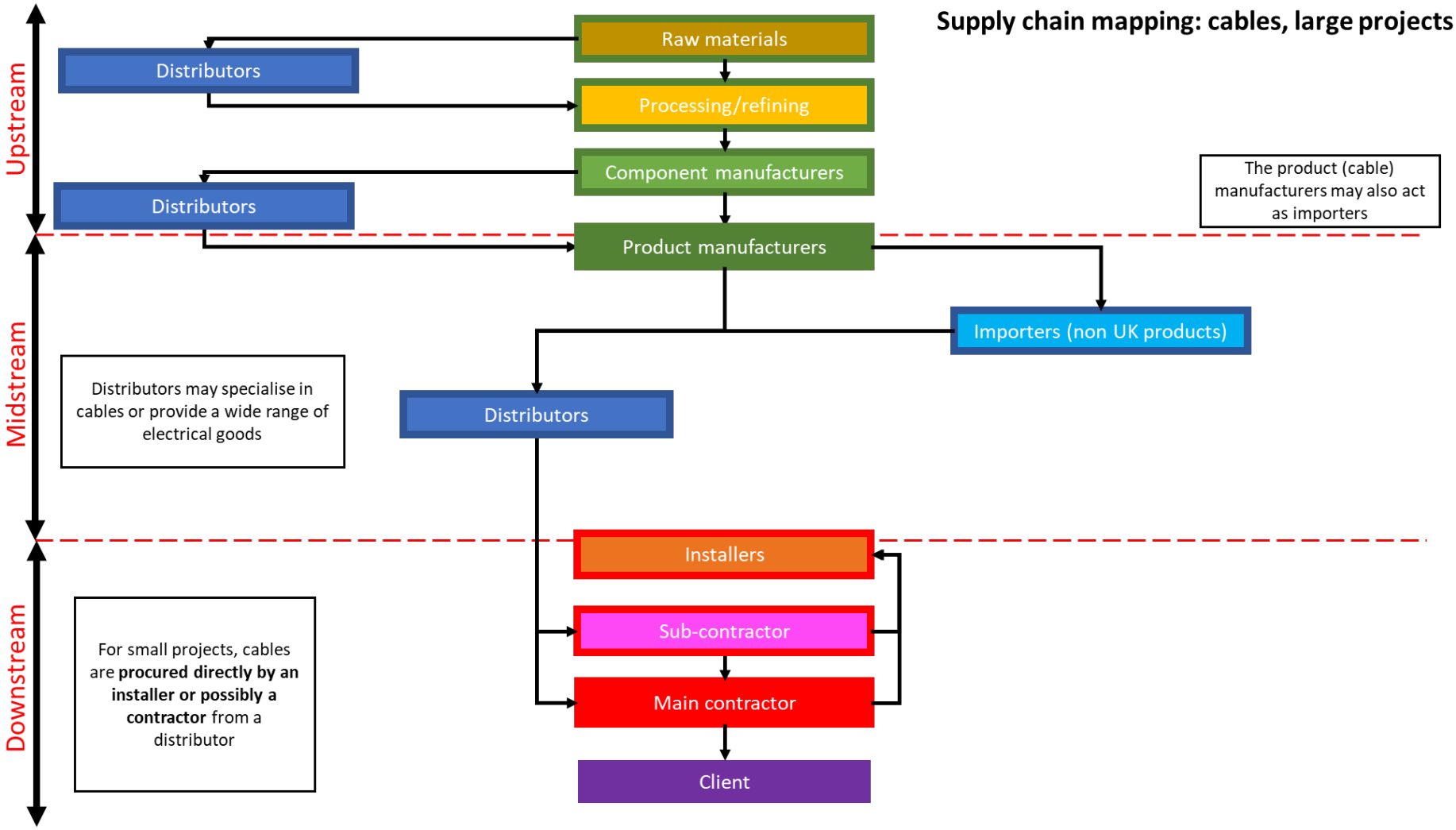

Figure 3-5 Supply chain map for cables for large projects
Source: RPA

3.5.2 Information flow

Table 3-14 describes the information flows between the actors in the supply chain for cables. Descriptions of these flows through the supply chain are given in section 2.9.1.

A declaration of performance is also required from the product manufacturer due to the designated standard covering the fire performance of cables. See section 3.2.1.3 for further details on which products are covered by a designated standard.

An industry association stated that most cable products are also certificated from third party testing due to pressure from installers and sub-contractors. BASEC and LPCB third-party certification may be provided from the level of the product manufacturer and downstream.

An industry association indicated that its members hold data sheets that contain information on their cable products, including information on intended and/or recommended uses. It was furthermore highlighted that British Standards require information on how cables can and cannot be used, limitations for use such as whether a cable is suitable or not for use in water, and the temperature ranges for which it is suitable. All manufacturers stamp the cable as required by the standards.

Table 3-14 Information flows between tiers in the cable supply chain

Information flow type	From	Raw	CompM	ProdM	FSP	DistP	Inst	SubC	MainC
	To	CompM	ProdM	DistP	Cons	Inst	SubC	MainC	Client
Building Information Modelling (BIM)			√	√					
Brochure/leaflet									
BSI Kitemark (on product and/or packaging)			√	√	√	√	√	√	√
Company datasheet									
COSHH		√	√	√	√	√	√	√	√
Declaration of performance (DOP)				√					
Info on packaging				√	√	√	√		
Info on product				√	√	√	√	√	√
Installation guide									
Manufacturer's logo				√	√	√	√	√	√
Manufacturer's training*									
Operation & maintenance manual									√
QR/bar code									
Safety data sheets		√							
Technical info			√	√					
Third party certification (voluntary)				√	√	√	√	√	√
UKCA/CE mark on product and/or packaging			√	√	√	√	√	√	√
Unique ID on product									
Warranty				√					

Source: RPA

*Note: * Media for information is via paper/online, or on products or packaging, where indicated*
A tick means this is believed to exist: No tick could mean that it does not exist, sometimes exists or it was not found. Not all options were covered in surveys and interviews

Key to tiers:											
Raw	Proc	CompM	DistRM	ProdM	DistP	FSP	Inst	SubC	MainC	Client	Cons
Raw materials	Processing/ refining	Component manufacturer	Distributor of raw materials	Product manufacturer	Distributor	Fulfilment service provider	Installer	Sub-contractor	Main contractor	Client	Consumer

4 Cladding

4.1 Definitions

According to the Oxford Dictionary of Construction, Surveying & Civil Engineering (Gorse, 2012), cladding is:

> *…the non-load bearing external envelope or skin of a building that provides shelter from the elements. It is designed to carry its own weight plus the loads imposed on it by snow, wind, and during maintenance. It is most commonly used in conjunction with a structural framework.*

According to this definition, cladding is *not* integral to the structural framework of the building itself, but instead provides the building with additional properties, such as:

- Durability (protection against adverse weather conditions);
- Aesthetic value;
- Thermal insulation; and
- Acoustic insulation.

The definition provided in the Oxford Dictionary of Construction, Surveying & Civil Engineering (Gorse, 2012) however falls short for at least the following reason:

> *The cladding industry has undergone significant changes in recent decades. Some cladding can now, in some cases, be considered load bearing.*

The Cambridge Dictionary (Cambridge Dictionary, no date) provides a much broader definition of cladding as 'material that covers the surface of something and protects it'.

However, in this case the definition is considered too broad for the purposes of regulation, for the following reasons:

- Firstly, this definition would include materials applied to both external *and* internal walls, and would not therefore be coherent with current legislation (i.e. the Building Regulations) which treats external and internal walls separately;
- Secondly, this definition would also include purely 'aesthetic finishes' (e.g., decorative stone, timber or tiles adhered to an internal or external outer wall) which may incidentally provide some element of protection and can be applied in a wide variety of ways.

An 'aesthetic finish' may of course be included as part of a cladding system, e.g. rainscreen may include decorative brick slips, but this study considers a cladding system's main function to be to protect against the elements, while also incidentally capable of accommodating an aesthetically pleasing finish. This study does not therefore include either internal or external 'aesthetic finishes' within the definition of 'cladding'.

In conclusion, based on recent changes within the industry, to ensure that the definition is coherent with current legislation and sufficiently narrow for regulatory purposes while covering a broad range of the most common types of cladding system, this study defines 'cladding' as follows:

> *Cladding is an external skin of a building that provides shelter from the elements and/or thermal insulation, and/or an aesthetic finish, and is used in conjunction with a structural framework.*

Cladding product types

Due to its complexity as a construction product, there is disagreement within the industry as to what constitutes a cladding product. Some consider cladding to be only the more traditional types of cladding (e.g., twin-skin metal construction and composite/sandwich panels), while they believe rainscreen to be a 'façade' and curtain walling to be 'glazing'. Others disagree and believe rainscreen should indeed be considered cladding, albeit a more complex form.

Cladding has developed significantly in recent years, and for this reason the updated definition used in this study attempts to cover the broad range of cladding systems that currently exist in the UK.

The following subsections describe the most common types of cladding product available on the UK market that fall within the definition of cladding used in this study: these are as follows:

- Single-skin cladding
- Built-up assembly/twin-skin
- Sandwich panels or insulated panels
- Rainscreen
- Curtain walling
- External rendered wall insulation

It should be noted that structural insulated panels (SIPs) have been precluded from the definition of 'cladding' used in this study because they are not typically external to a building and often provide a frame-like structure behind a cladding system.

Furthermore, although cladding in its broadest sense would encompass traditional masonry/brickwork, for the purposes of this study, the study team focused on proprietary cladding systems.

4.1.1 'Single-skin'

'Single-skin' cladding consists of a single piece of material (typically steel, but also materials such as glass-reinforced plastic and polycarbonate) that is shaped (e.g. corrugated, trapezoidal, sinusoidal or half-round) and used as external cladding, typically in agricultural, industrial, retail and leisure buildings. This 'skin' can then be coated with preservatives to improve its durability and painted in a range of colours and textures. Single-skin can be subjected to external imposed loads (i.e. wind) and provides a degree of weather resistance (MCRMA, no date b). It was traditionally made from steel, aluminium, zinc, and copper.

Single-skin metal profile cladding can be used on its own, or as part of a 'built-up assembly' (see 'built-up assembly' below for further details). However, it is rarely used on its own as it provides minimal thermal or acoustic separation. It is therefore usually combined with other materials to create a built-up assembly.

An image of single skin metal profile cladding can be found on the 'Designing Buildings' website (Designing Buildings, no date).

4.1.2 'Twin-skin' or built-up assembly

Twin-skin is an assembly consisting of multiple elements. This assembly generally includes self-supporting metal inner and outer profiles which are held apart by a structural

support system. The space between the inner and outer profiles is usually filled with an insulation product, such as mineral fibre.

The assembly can be subjected to external imposed loads i.e. wind, it also provides a degree of weather resistance and offers a level of thermal performance. The inner and outer profiles can be supplied with a pre-coated finish to provide durability and added aesthetics (MCRMA, no date b).

Twin-skin is generally assembled on-site and is considered one of the cheapest ways to install a roof or wall system.

An image of twin-skin (also called 'built-up assembly') can be found on page 3 of the MCRMA's 'The Definition of Cladding within the Construction Sector' (MCRMA, no date b).

4.1.3 'Sandwich panel' or 'insulated panel'

A sandwich panel comprises three layers of material; most typically, inner and outer sheets of profile metal adhesively or cohesively bonded either side to an expanded foam or fibrous core material (MCRMA, no date b). Sandwich panels can act as a wall or roof (i.e. a 'skin') on simple buildings such as commercial retail buildings, airports and train stations. Sandwich panels also form part of rainscreen (see section 4.1.4. for further details on rainscreen).

Sandwich panels have inherent structural strength, can be subjected to external imposed loads i.e. wind, provide a degree of weather resistance and offer a level of thermal performance. The inner and outer profiles can be supplied with a pre-coated finish to provide durability and aesthetics (MCRMA, no date b).

This product is generally factory-assembled and brought on site as a complete product, enabling efficient implementation.

4.1.4 Rainscreen

According to the Centre for Window and Cladding Technology (CWCT), a rainscreen system is 'a wall comprising an outer skin of panels and an airtight insulated backing wall separated by a ventilated cavity. Some water may penetrate into the cavity but the rainscreen is intended to provide protection from direct rain'. A rainscreen system is designed to keep the structural frame and thermal insulation dry, by the rainscreen system itself, but also due to the airspace between the cladding and the insulation, and it can be considered an outer protective layer that sits over a structural wall (SAGE BEC, no date).

Drained and ventilated rainscreen systems work by allowing air to enter at the base of the system and escape at the top of the system. The ventilated cavity allows water penetrating the panel joints to be partly removed by the 'stack effect' and partly removed by running down the rear face of the panels and out of the base of the system (Knauf Insulation, no date).

In addition to providing a range of aesthetic finishes, rainscreen is also lightweight and is therefore increasingly used for tall buildings such as student housing, offices, hotels and high-rise residential buildings. Because rainscreen is intended to be lightweight, any materials attached also need to be lightweight; brick slips are used instead of bricks, for example, to provide a more traditional-looking brickwork finish.

According to two industry associations, rainscreen is considered to be far more complex than traditional cladding such as single-skin and twin-skin, and due to its relatively recent development, training in the sector is not sufficient. Furthermore, one industry association

did not consider rainscreen to be cladding, the main difference being that rainscreen facades contain a cavity (although it was agreed that other systems that do not traditionally have a cavity, do have a cavity in some circumstances).

Under this study, rainscreen is considered to be cladding for the following reasons:

- It is an external skin of a building that provides shelter;
- It provides an aesthetic finish; and
- It is used in conjunction with a structural framework.

An image/diagram of rainscreen is available on the Proteus website (Proteus, no date).

4.1.5 Curtain walling

Curtain wall systems are non-structural cladding systems for the external walls of buildings. Although they act as an external wall, they are not an integral part of the structural framework and only support loads imposed on them (such as wind, seismic loads, etc.). Typically, they consist of a lightweight aluminium frame onto which glazed panels are fixed. Curtain walling often features a spandrel zone, usually between floors, where insulation is fitted.

Curtain walling is used in prestigious commercial buildings and is also increasingly used in high-value inner-city residential buildings where the view is a major selling factor.

Figure 4-1 Example of curtain walling
Source: Photo by (von Werder, 2022)

There is some debate within the industry regarding whether curtain walling should be considered as cladding or glazing. For the purposes of this study, curtain walling is considered cladding for the following reasons:

- It is an external skin of a building that provides shelter;
- It provides an aesthetic finish; and
- It is used in conjunction with a structural framework.

4.1.6 External rendered wall insulation

External rendered wall insulation consists of a layer of insulation that is fixed to the outside of an existing wall using brackets. This layer is covered with a coat of render.

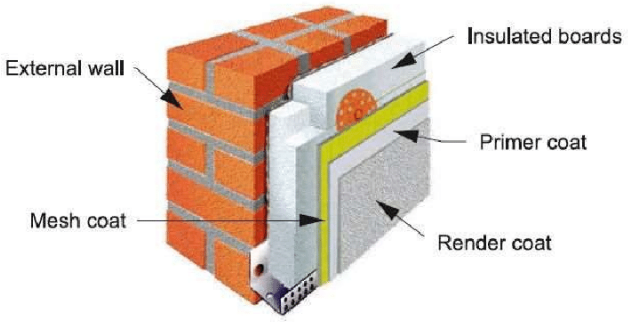

Figure 4-2 External wall insulation

Source: (Yu, Chen and Liu, 2020)

There is also debate regarding whether external rendered wall insulation should be considered cladding. Based on the definition used in this report, external rendered wall insulation would be classified as cladding for the following reasons:

- it is an external skin of a building that provides shelter;
- it can provide an aesthetic finish; and
- it is used in conjunction with a structural framework.

Summary of materials used in and uses of cladding

The table below provides a summary of the cladding system product categories, their uses and the materials used in these products.

Table 4-1 Summary of the cladding system product categories

Cladding product type	Uses	Materials commonly used
Single-skin metal profile cladding	Agricultural, industrial, retail and leisure buildings	Typically steel panels and framework, but also glass-reinforced plastic and polycarbonate panels
Twin-skin/built-up assembly	Agricultural, industrial, retail and leisure buildings	Predominantly steel panels and framework, also some copper or zinc panels; insulation
Sandwich panels/insulated/composite panels	Used more commonly in commercial settings (where aesthetics are not high-priority and cost is a key factor)	Steel (most common), copper or zinc panels; and insulation
Rainscreen	Student housing, offices, hotels and high-rise buildings more likely to use rainscreen for pleasing aesthetics and lightweight properties	Steel, aluminium, fibre cement boards, mineral fibre boards, timber, glass and brick slips; and insulation
Curtain walling	Shopping centres, office buildings, commercial and residential buildings	Glass, aluminium
External wall insulation	Housing, offices, hotels	Insulation; glass fibre mesh; primer; silicone silicate render

4.1.7 Choice of cladding product

Cladding products are complex; each product type can take various forms and be made from a variety of materials depending on building requirements, and a single building may contain multiple types of cladding. The choice of cladding product may depend on one or several of the following factors:

- Budget
- Aesthetic preferences
- Thermal insulation requirements
- Level of weatherability required
- Resilience, strength, durability
- Requirements with regard to spread of fire
- Carbon footprint
- Ease of installation.

Although there are many factors that can influence the choice of cladding, two of the associations interviewed emphasised that the choice of cladding product is predominantly cost-driven (so long as the product appears to meet legal requirements), particularly under design and build contracts, where main contractors try to make cost savings where possible.

Single-skin and twin-skin are the two cheapest cladding options, but the least aesthetically pleasing. Rainscreen is generally used where a more aesthetically pleasing finish is required (e.g., student housing, offices, hotels, schools, reception areas, etc.). Industrial buildings are more likely to use built-up assembly and composite due to cost and labour availability. Composite/sandwich panels are often used in commercial settings as they have more decorative coatings.

According to one association, sandwich panels are becoming increasingly popular in industrial settings; they are assembled at the factory and are much more efficient to install, which is becoming particularly desirable due to labour shortages within the industry.

As shared by interviewees and workshop participants, cladding is not commonly found on residential houses in the UK, which most commonly feature traditional brickwork.

4.2 Legislation and voluntary initiatives

4.2.1 Legislation

4.2.1.1 UK Building Regulations

Regulation 7 of the Building Regulations covers materials and workmanship. According to Regulation 7 of the Building Regulations:

> Building work shall be carried out—
>
> (a) with adequate and proper materials which—
>
> (i) are appropriate for the circumstances in which they are used,
>
> (ii) are adequately mixed or prepared, and

(iii) are applied, used or fixed so as adequately to perform the functions for which they are designed; and

(b) in a workmanlike manner.

Following the review of the Building Regulations and fire safety conducted in 2017–2018, the Building Regulations were amended via Building (Amendment) Regulations 2018 (SI 2018/1230)). This amendment came into force on 21 December 2018.

With regards to cladding, this amendment restricted the use of combustible materials in the external wall of certain buildings over 18 metres in height. According to the amended regulation 7(2) of the Building Regulations (The Building (Amendment) Regulations 2018, 2018):

> building work shall be carried out so that materials which become part of an external wall, or specified attachment, of a relevant building are of European Classification A2-s1, d0 or A1, classified in accordance with BS EN 13501-1:2007+A1:2009 entitled "Fire classification of construction products and building elements. Classification using test data from reaction to fire tests" (ISBN 978 0 580 59861 6) published by the British Standards Institution on 30th March 2007 and amended in November 2009.

Table 4-2 Fire classification

Fire classification according to BS EN 13501-1:2007 +A1:2009	**Description**
A1	Non-combustible
A2-s1, d0	A2-s1,d0 is non-combustible in Scotland and of limited combustibility in England and Wales. The 's' part of the classification refers to the total smoke emitted during the first 10 minutes of exposure to fire. S1 = little or no smoke S2 = quite a lot of smoke S3 = substantial/heavy smoke The 'd' part of the classification concerns the number of flaming droplets and particles that are produced within the first 10 minutes of fire exposure. D0 = no droplets D1 = some droplets D2 = quite a lot

Source: (Cedral, no date)

Materials used in an external wall do not however need to meet these classification requirements in the following cases: (according to Regulation 7 (3)):

- cavity trays when used between two leaves of masonry;
- any part of a roof (other than any part of a roof which falls within paragraph (iv) of regulation 2(6)) if that part is connected to an external wall;
- door frames and doors;

- electrical installations;
- insulation and waterproofing materials used below ground level;
- certain intumescent and firestopping materials;
- membranes;
- seals, gaskets, fixings, sealants and backer rods;
- thermal break materials where the inclusion of the materials is necessary to meet thermal bridging requirements; or
- window frames and glass.

A 'relevant building' is considered to be a building with a storey (not including roof-top plant areas or any storey consisting exclusively of plant rooms) at least 18 metres above ground level and which:

- contains one or more dwellings;
- contains an institution; or
- contains a room for residential purposes (excluding any room in a hostel, hotel or boarding house).

Regulation 6 (requirements relating to material change of use) confirms that these requirements also apply 'where there is a material change of use' of a property, i.e. if a building is used as a dwelling/hotel, etc. where it was not previously.

4.2.1.2 Approved Document B (Fire Safety) of the UK Building Regulations

According to Volume 2, Requirement B4 (External fire spread) of Approved Document B (Fire Safety) under the Building Regulations:

> 1 The external walls of the building shall adequately resist the spread of fire over the walls and from one building to another, having regard to the height, use and position of the building;
>
> 2 The roof of the building shall adequately resist the spread of fire over the roof and from one building to another, having regard to the use and position of the building.

4.2.2 UK Construction Products Regulation

For an introduction to the UK's Construction Products Regulation (CPR), see Section 11.1.2. A summary of the designated standards relevant to cladding products under the UK's CPR is provided in the subsection below.

4.2.2.1 Designated standards under the CPR

"A designated standard is a standard, developed by consensus, which is recognised by government in part or in full by publishing its reference on GOV.UK in a formal notice of publication."

Those affected by a given standard are given the opportunity to contribute to its development in the following ways:

- Viewing and commenting on proposals for new standards
- Viewing and commenting on draft standards
- Applying as a BSI committee member and providing input on the standards-making process.

It is important to note that there are no designated standards under the CPR that are applicable to cladding systems. Instead, the designated standards under the CPR cover some of the materials and components used in cladding systems. Some examples of the designated standards relevant to cladding are summarised in the table below.

Table 4-3 Examples of designated standards relevant to cladding

Designated standard relevant to cladding	Description
EN 14309:2009+A1:2013	Thermal insulation products for building equipment and industrial installations — Factory made products of expanded polystyrene (EPS) — Specification
EN 14509:2013	Self-supporting double-skin metal-faced insulating panels — Factory made products — Specifications
EN 14782:2006	Self-supporting metal sheet for roofing, external cladding and internal lining — Product specification and requirements
EN 14783:2013	Fully supported metal sheet and strip for roofing, external cladding and internal lining — Product specification and requirements
EN 490:2011	Concrete roofing tiles and fittings for roof covering and wall cladding — Product specifications
EN 1090-1:2009+A1:2011	Execution of steel structures and aluminium structures — Part 1: Requirements for conformity assessment of structural components

Source: (Designated standards: construction products, 2020)

4.2.3 British Standards

For an introduction to British Standards and the BSI Kitemark, see section 11.1.9. The table below lists some of the most common British Standards relevant to cladding.

Table 4-4 Common British Standards relevant to cladding

British Standard/specification created by the BSI	Description
BS 5427:2016 +A1:2017 Code of practice for the use of profiled sheet for roof and wall cladding on buildings	This British Standard contains recommendations on the design and construction of external cladding assemblies for roofs and walls of buildings in the UK, using 'longitudinally profiled sheeting as the external surface, including standing seam'. Materials covered by this British Standard: 'steel, aluminium, fibre cement, bitumen fibre and plastics, including insulated sandwich panel assemblies of profiled sheeting, thermal insulation and linings'.

British Standard/specification created by the BSI	Description
BS 8414-1:2020 Fire performance of external cladding systems - Test method for non-loadbearing external cladding systems fixed to, and supported by, a masonry substrate	This standard is the first part of a multiple series. It contains 'a test method for determining the fire performance characteristics of non-loadbearing external cladding systems, rainscreen over-cladding systems, and external wall insulation systems when fixed to, and supported by, a masonry substrate and exposed to an external fire under controlled conditions.' Falls under 'BR 135 - Fire performance of external thermal insulation for walls of multi-storey buildings'
BS 8414-2:2020 Fire performance of external cladding systems - Test method for non-loadbearing external cladding systems fixed to, and supported by, a structural steel frame	BS 8414-2 is part two of the multi-series standard that provides a test method for determining the fire performance characteristics of non-loadbearing external cladding systems when fixed to, and supported by, a structural steel frame and exposed to an external fire under controlled conditions. BS 8414-2 helps you evaluate and improve the fire performance of non-loadbearing external cladding systems fixed to, and supported by, a structural steel frame.
BS 476-7:1997 Fire tests on building materials and structures - Method of test to determine the classification of the surface spread of flame of products	This standard sets out tests for verifying the extent to which a 'flame spreads over the surface of the product'

The British Standard for metal roofing and cladding (BS 5427) acts as a set of guidance, while BS 8414 is used to test the fire performance of all types of cladding system.

Industry associations provide their members with guidance on standards to follow. For example, the CWCT provides guidance on the specification of built-up walls (CWCT, 2017). The NFRC also provides a 'Blue Book', a guide to the design and best practice of profiled sheet roofing and cladding (NFRC, 2022). The MCRMA provides a list of British Standards relevant to cladding on its website (MCRMA, no date a).

4.2.4 Voluntary initiatives

4.2.4.1 Independent third-party approvals

There are several organisations that provides a voluntary third-party certification for cladding systems. The aim of the certification is to confirm that the manufacturers' claims have been independently tested and verified.

One organisation is the British Board of Agrément (BBA) and BBA certification assesses the following key factors of a cladding system:

- Structural performance — if the structure will remain stable under normal conditions
- Weathertightness — if the system will resist the passage of rain and wind-driven snow
- Thermal insulation — if insulation is adequate and in line with national building regulations
- Condensation risk — if the risk of condensation forming under normal service conditions is negligible
- Performance in relation to fire — the national reaction to fire class
- Durability — the level of durability and the factors on which the durability depends.

A BBA certificate details whether the cladding system is in line with each of the building regulations covering the devolved nations (i.e. if the product is in line with The Building Regulations 2010; The Building (Scotland) Regulations 2004; The Building Regulations (Northern Ireland) 2012). It also specifies whether the product meets requirements for the Construction (Design and Management) Regulations 2015 and the Construction (Design and Management) Regulations (Northern Ireland) 2016.

A BBA certificate also specifies any designated standards that the certificate holder has met, as well as any technical approvals under the CPR. Finally, BBA certificates provide detailed descriptions of the cladding system (including measurements) and indicate how the product should be delivered and then handled on site (this information was provided during consultation with a cladding manufacturing trade association).

The reliability of the information contained in some third party certificates has however been called into question in recent years (The Construction Index, 2021).

4.2.4.2 Safety data sheets

Suppliers of raw materials will supply safety data sheets in some cases. The format and content of safety data sheets are specified in the REACH Regulation. According to the Regulation, a safety data sheet should be provided for *substances and mixtures* that have been classified as hazardous. It is not mandatory for safety data sheets to be provided with articles.

4.3 UK market size

4.3.1 Size of the market and characteristics

Initially, the study team considered a top-down approach to assess this, similar to the approach taken for the other products in this study. There were some considerable complications when selecting the most relevant approach, but the methodology is as follows:

- Identify materials used in each cladding product, see Table 4-5 (based on Table 4-1);
- Identify SIC codes for these materials, see Table 4-6;
- Make an assumption about the proportion of the material that is used in cladding; and

- Make an assumption about the multiplying factor that represents the added value of transforming the material into the cladding product

The study team had difficulty arriving at assumptions for the first draft of the calculations which were presented at the workshop: it was hoped that the attendees could provide further input to help identify the correct SIC codes and improve the assumptions for the last two steps in the process.

The workshop however highlighted that the materials identified by the study team did not cover the entirety of the cladding market. The data collected by the study team did not consider the steel framework or the intumescent strips. For some materials, data is either not clear or not publicly available. Due to these complications, it was not possible to arrive at a market size using a top-down approach.

Any information provided is highly uncertain, and the study team have low confidence in data presented.

Table 4-5 Materials used for product types

Type of cladding	**Primary materials used**
Sandwich panels	Steel, copper or zinc panels, and insulation
Rainscreen facades	Steel, brick slip, wood, fibre cement boards, glass, mineral fibre boards, aluminium, and insulation
Curtain walling	Glass, aluminium
Single-skin	Steel, glass reinforced plastic and polycarbonate panels, and insulation
Twin skin	Steel, copper and zinc panels, and insulation
External wall insulation	Insulation, glass fibre mesh, primer, silicone, silicate render

Table 4-6 PRODCOM codes identified for cladding

Code	**Discussion**
Steel	
25112350 (CN 73089059) - Structures solely or principally of iron or steel sheet (whether profiled or not), for the interior or exterior of buildings, ships and the like INCLUDING: - ductwork, frames, walls, roofs and cladding, lintels, metal profiles EXCLUDING: - sandwich panels; elements for prefab buildings, bridges, towers, lattice masts; doors, windows and their frames	This code covers the steel used in in the facing panels of twin-skin and single-skin cladding, as well as rainscreen facades. This code will also cover the steel frames used in cladding systems
24333000 (CN 73089051) - Structures solely or principally of iron or steel sheet comprising two walls of flat or profiled sheet with an insulating core, often referred to as sandwich panels EXCLUDING: - prefabricated buildings	This code will cover only sandwich panels made of steel. This is the most accurate code for composite cladding; however, this will only cover steel sandwich panels and not the fastenings or any framework used within the system

Code	Discussion
Steel	
Glass	
23121230 (CN 700719) - Other toughened safety glass INCLUDING: - for architectural use - for safety goggles - for eyepieces in diving helmets EXCLUDING: - of a size and shape suitable for use in vehicles, aircraft, spacecraft or vessels	These codes may cover the types of glass used in cladding. In the workshop, a trade association suggested that the glass used in curtain walling is of a specific type and size
23121270 (CN 700729) - Other laminated safety glass INCLUDING: - for architectural use EXCLUDING: - of a size and shape suitable for incorporation in vehicles, aircraft or vessels	

Note: This does not cover all potential codes for data on cladding. Other materials have been identified which the codes are not granular enough to properly identify.

The workshop did provide information on average cost per m^2 for the product types. No data was provided for external rendered wall insulation EWI, and the only information gained for curtain walling is that it is less than £500/m^2.

Table 4-7 Cost per m^2 of cladding product types

Product type	Cost
Single-skin	£30/m^2
Twin-skin	£70/m^2
Composite (Sandwich panels) with a U value of 0.18	£80/m^2
Rainscreen	£150/m^2 to £500/m^2 depending on the outer skin
Curtain walling	Less than £500/m^2
EWI	No data found

Source: Workshop with trade association representatives.

4.3.2 Market segmented by product type

It was not feasible to provide the market size because the appropriate SIC codes could not be defined and therefore the production of cladding cannot be extracted and analysed.

The most accurate data available is for sandwich panels/composite cladding, as shown in Table 4-8. This data does not account for any added value that may arise from integration into a cladding system and is only the cost of the facing sandwich panel.

Table 4-8 Market size for sandwich panels

Measure	UK market value	Quantity (m^2)
UK Production	£406 million	27,692,000 m^2
UK Imports	£57 million	35,491,000 m^2

Measure	UK market value	Quantity (m^2)
UK Exports	£100 million	4,441,000 m^2
Total UK market size	£363 million	58,742,000 m^2

Sources: (ONS ABS, 2019; ONS PRODCOM, 2019; UK Trade Info, 2019)

4.3.3 Exports versus Imports

It was not feasible to provide the imports, exports, and trade balances because the appropriate SIC codes cannot be defined and therefore the imports and exports of cladding cannot be extracted and analysed.

During an interview with a trade association, the study team was informed that there is only one UK manufacturer of curtain walling, and 95% of product is imported.

4.3.4 Summary of market size information for cladding

The market data for cladding is summarised in Table 4-9. These are values based primarily on 2019 values and the values in 2022 are likely to be approximately a third higher, see 2.7.6.

Table 4-9 Summary of the cladding market analysis

Variable	Value
Estimated total annual market value for cladding (sandwich panels only)	Composite - £363 million
Study team's confidence in estimated market value	Low
Estimated number of enterprises manufacturing cladding	Composite - 58,742,000 m^2
Trade balance for cladding	95% of curtain walling is imported

Sources: (ONS ABS, 2019; ONS PRODCOM, 2019; UK Trade Info, 2019), RPA consultation

4.4 Major players

The following table provides examples of companies involved in cladding production, at the different levels of the supply chain.

Table 4-10 Companies associated with cladding production

Stakeholder type	Examples of companies
Component manufacturers	A. Proctor Group Ltd, ALPOLIC™, EJOT UK Limited, Euramax Coated Products Ltd, Filon Products Limited, Fixing Point Limited, Guttercrest Limited, HS Butyl Limited, Hydro Aluminium Rolled Products Limited, Knauf Insulation Limited, Latchways plc, Premier Sealant Systems Limited, Rockwool Limited, SFS Group Fastening Technology Limited, Siderise Insulation Limited, Ibstock Brick, Celotex, Kingspan Insulation, Xtratherm, Recticel Insulation, Thermafleece
Product manufacturers	Kingspan, A Steadman & Son, Architectural Profiles Limited, BTS Facades & Fabrications Ltd, Elval

Stakeholder type	Examples of companies
	Colour, Euroclad Group Ltd, Firth Steels Limited, Kalzip Limited, Benx Holdings, Shackerley (Holdings), James & Taylor, CGL Facades, SIG, Proteus, Taylor Maxwell Group, Eurobrick Systems Ltd., Aliva UK, RHEINZINK, Cupa Pizarras
Distributors	SIG, Euroclad, Vivalda Group Plc, Pura Facades, Monolith, BBS Facades
Installers	KR Cladding Systems Ltd, SPV Group
Certifiers	British Board of Agrement
Trade associations	Centre for Window & Cladding Technology (CWCT), Insulated Render and Cladding Association (INCA), Metal Cladding and Roofing Manufacturers (MCRMA), National Federation of Roofing Contractors (NFRC)

Sources: Association member lists

4.5 Supply chain mapping and information flows

Broadly speaking, the route of the supply chain varies depending on the type of cladding sought. Based on findings from desk-based research and consultation, the supply chain can be broken down into the following three maps:

- Approved cladding systems;
- 'Pick and mix' cladding systems; and
- Curtain walling.

The three supply chain maps and the corresponding explanations are set out in the subsections that follow.

4.5.1 Supply chain map for an approved cladding system

Approved cladding systems are systems where all components have been tested as part of a system by a main product manufacturer. The main product manufacturer tests each component in conjunction with its main product (all components may have been manufactured by the main product manufacturer or some/all provided by other manufacturers). Approved cladding systems typically come with a 25-year warranty. In these cases, components are likely to originate from multiple sources, with most components sourced directly from a component manufacturer, except for insulation, which is predominantly sourced from a distributor.

The map set out in Figure 4-3 provides an overview of the route most commonly taken for acquiring approved cladding systems. It illustrates that a cladding system is most often purchased by a sub-contractor before being passed on to the installer[8].

A main product manufacturer will specify the components that have been tested with their product and that meet the requirements for the warrantied system. Most components will be sourced directly from the component manufacturers, with the exception of insulation, which is predominantly sourced via a distributor.

[8] Distributors include wholesalers, retailers, and builders' merchants.

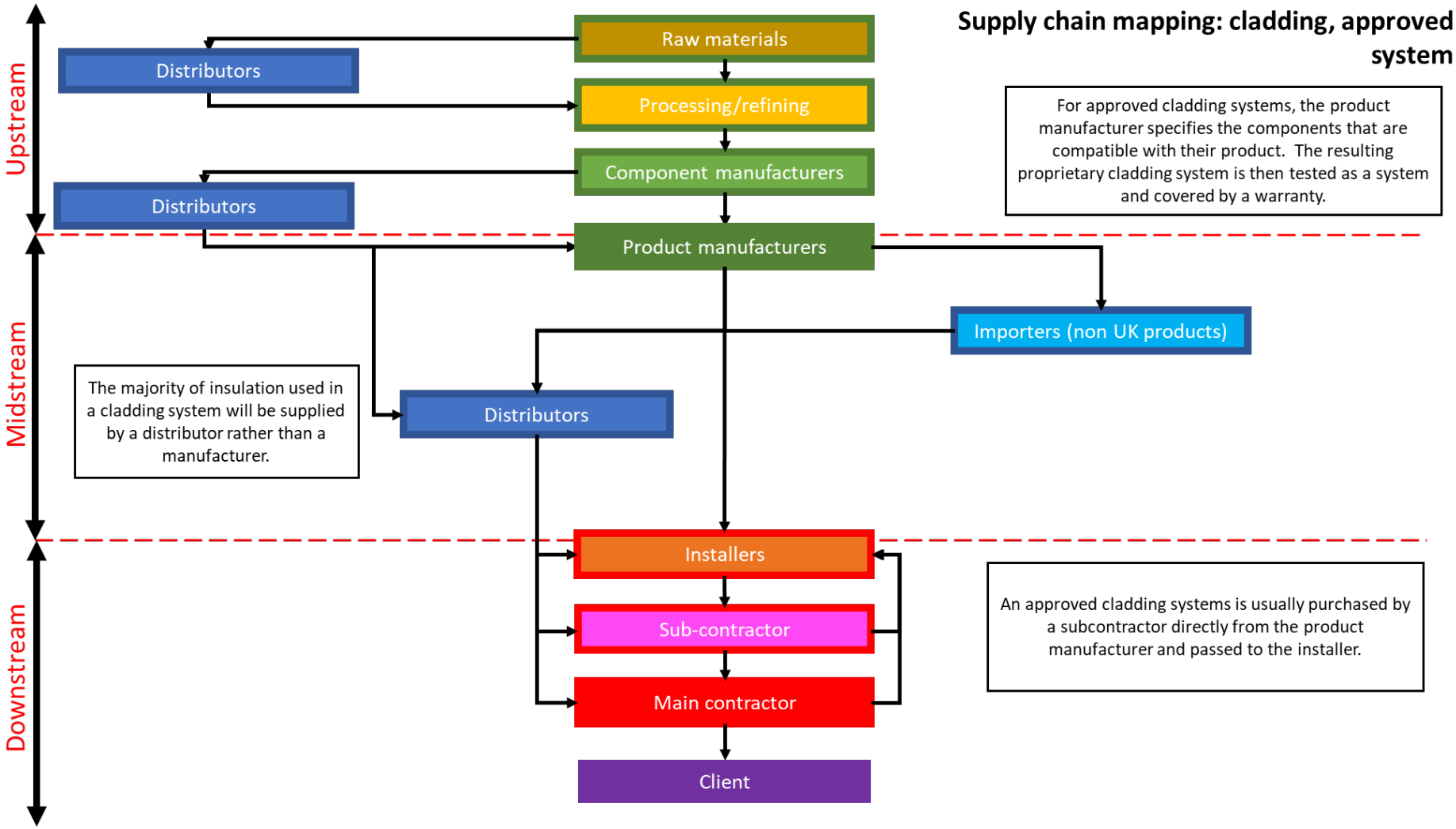

Figure 4-3 Supply chain map for an approved cladding system
Source: RPA

4.5.2 Supply chain map for 'Pick and mix' cladding

'Pick and mix' cladding, like the approved cladding system**,** is assembled using numerous components acquired separately, but in this case the components have not been tested by a main product manufacturer as part of a system, and the resulting cladding assembly therefore does not come with a warranty.

The third map, provided in Figure 4-4, sets out the supply chains for downstream users to acquire components for **'pick and mix' cladding**. It shows that the components are predominantly obtained via distributors (these can be either large or smaller regional distributors).

Little is sourced through fulfilment service providers (Alibaba, Amazon, Ebay, etc.), but distributors (e.g. Screwfix) have a comprehensive online presence and a large proportion of purchases are made through their websites.

It was highlighted by one industry association that 'boxing and badging', where products are bought online in bulk and then a logo is simply affixed to the packaging and/or components, may disguise the origin of some products being purchased.

Product manufacturers may also be component manufacturers.

Case study 4: Implications of different types of cladding 'compilations'

Cladding products often comprise multiple elements. These elements can either be provided as an approved system or as a 'pick and mix' system to be constructed and assembled on-site using a range of products or systems (e.g. metal profiles, glass, brick slips, insulation material).

The Construction Products Regulation does not currently include designated standards applicable to cladding systems but defines the designated standards for some of the materials and components used in cladding systems such as cover finishes/facing materials (for example, concrete, natural stone, solid wood, metal sheets, and slate stones).

Similarly, the industry associations provide members with some advice and guidance, yet this is again in relation to individual products rather than the whole cladding system.

Applying Regulation 7 of the Building Regulations, two types of risks can be identified in relation to various types of cladding compilations:

- **cladding product selection and preparation** to ensure that adequate and proper materials are used: and
- **cladding installation** to ensure that products are applied, used, and fixed to adequately perform functions for which they are designed.

Regulation 7 also states that the quality and safety of the building work also depends on the **skills of the workforce** involved in the building work.

According to trade association interviewees, the level of technical knowledge and training of the workforce in the sector is sometimes not sufficient to select and install complex cladding systems (e.g. rainscreen). In addition, the choice of particular cladding systems is predominantly cost-driven, and this can also influence the selection of products. As a result, even though the selected individual products meet the requirements of standards, when used in combination with other selected products, they may be incompatible, may not fully meet the intended function, and / or deliver suboptimal quality. The

risks are higher when cladding companies compile different materials as a 'pick and mix'. Furthermore, approved cladding systems typically come with a warranty, whereas 'the pick and mix' installations have no warranty. The evidence collected for this study during interviews[9] suggests that 'pick and mix' cladding systems are typically used under smaller contracts, whereas larger projects predominantly use approved cladding systems.

As observed by one trade association interviewee, due to technical requirements and workforce shortages some cladding products (e.g. sandwich panels) are increasingly being assembled in factories into approved systems. This method ensures quality, is more efficient to install and is often the preferred option for cladding companies due to labour shortages within the sector. It is too early to assess whether other cladding products will follow suit and increasingly be offered as assembled systems. Still, a move in this direction could potentially eliminate some of the risks by providing more control over the design, selection and installation processes.

For the list of all case studies, see section 2.4.4.

[9] However, a relatively small sample size has to be noted as a caveat for this finding.

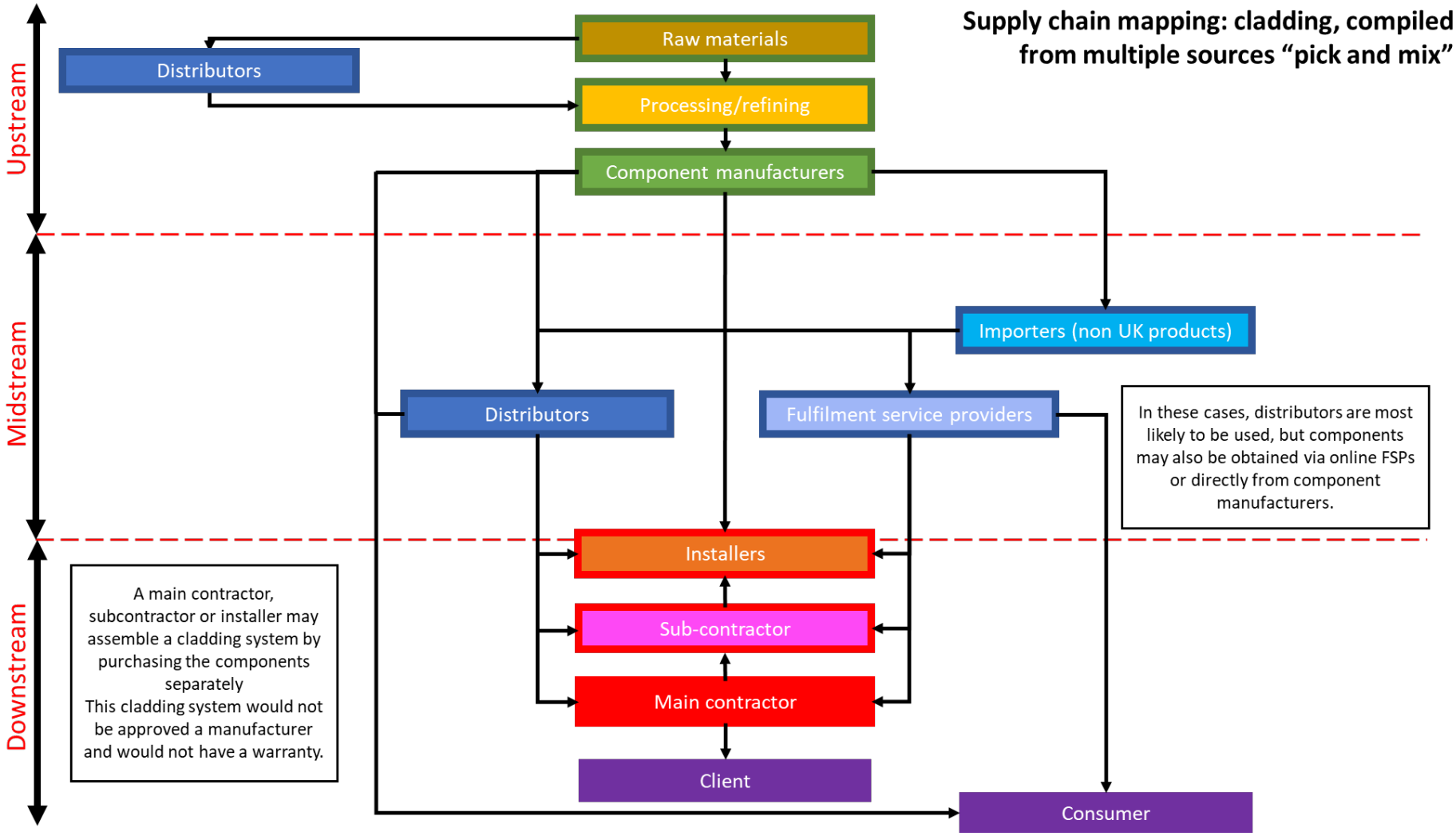

Figure 4-4 Supply chain map for cladding complied from multiple sources (“pick and mix”)
Source: RPA

4.5.3 Supply chain map for curtain walling

Due to its specialist nature, curtain walling is supplied by a specialist manufacturer as complete panels. The manufacturer will also likely install the product onsite on behalf of their client.

Figure 4-5 sets out the supply chain map for **curtain walling**. It shows that typically the subcontractor will acquire curtain walling directly from a product manufacturer. The product will be passed to an installer. Due to the specialist nature of curtain walling, the manufacturer may in many cases act as the installer and install their product on behalf of their client.

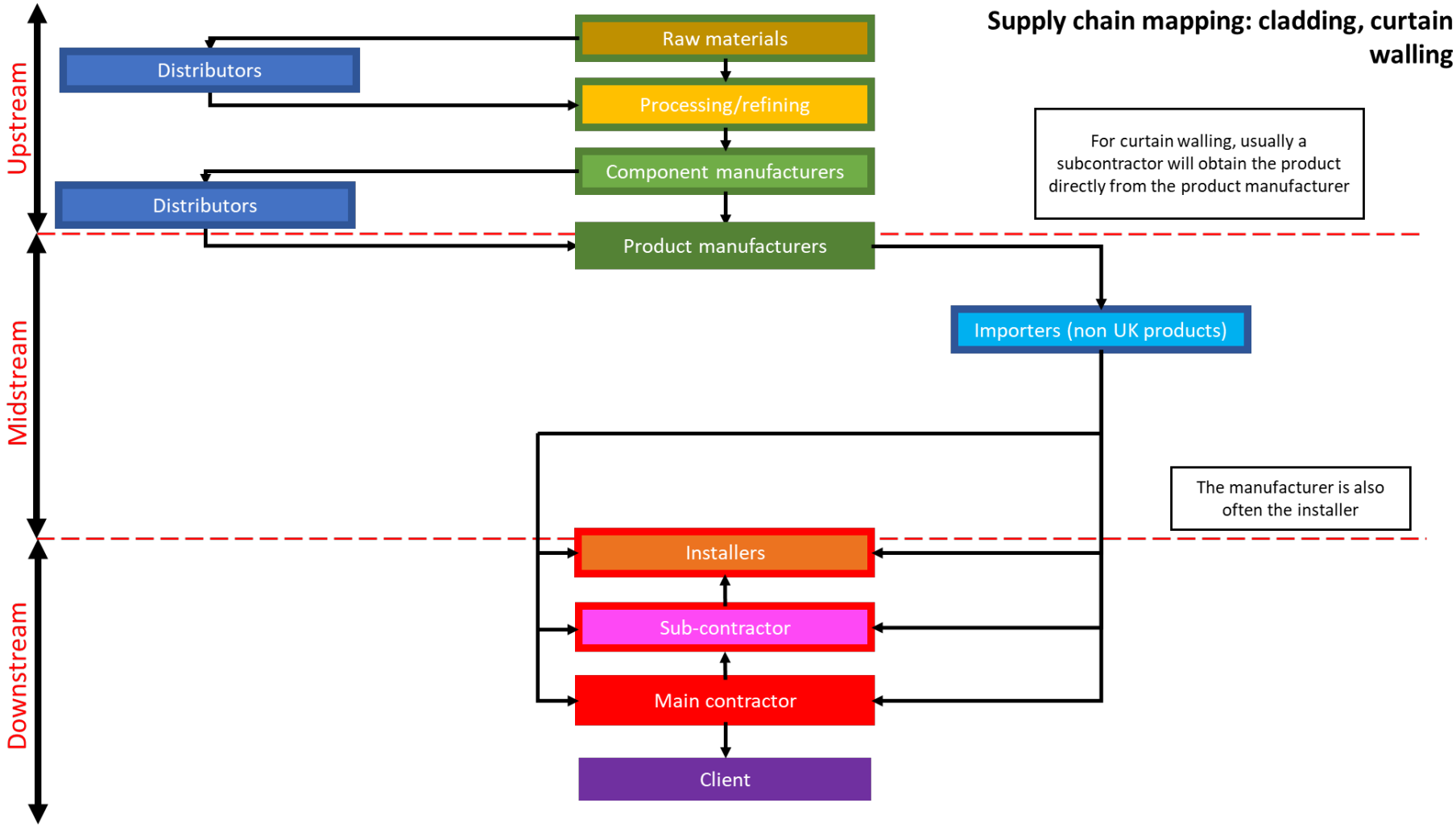

Figure 4-5 Supply chain map for cladding, curtain walling
Source: RPA

4.5.4 Information flow

Table 4-11 describes the information flows between the actors in the supply chain for cables. Descriptions of these flows through the supply chain are given in section 2.9.1.

A declaration of performance will also be required at the level of the component manufacturer and the product manufacturer if the materials used are covered by a designated standard or a UK technical assessment under the CPR. See section 4.2.2 for further details on which products are covered by a designated standard.

In addition, when an approved product has been supplied, cladding manufacturers have roving inspectors and advisors, who will come to site if there is an installation issue, or to investigate if a cladding system has failed. They also provide advice on product choice, installation, and training. These inspectors are however sales-focused rather than providing impartial technical advice. Furthermore, these inspectors do not generally inspect cladding systems of the ‘pick and mix’ variety.

Table 4-11 Information flows between tiers in the cladding supply chain

Information flow type	From	Raw	CompM	ProdM	FSP	DistP	Inst	SubC	MainC
	To	CompM	ProdM	DistP	Inst	Inst	SubC	MainC	Client
Building Information Modelling (BIM)			√	√					
Brochure/leaflet									
BSI Kitemark (on product and/or packaging)			√	√	√	√	√	√	√
Company datasheet									
COSHH		√	√	√	√	√	√	√	√
Declaration of performance (DOP)			√	√					
Info on packaging				√	√	√	√		
Info on product				√	√	√	√	√	√
Installation guide									
Manufacturer's logo			√	√	√	√	√	√	√
Manufacturer's training*									
Operation & maintenance manual									√
QR/bar code									
Safety data sheets		√							
Technical info			√	√					
Third party certification (voluntary)			√	√					
UKCA/CE mark on product and/or packaging			√	√	√	√	√	√	√
Unique ID on product									
Warranty			√	√					

Source: RPA

*Note: * Media for information is via paper/online, or on products or packaging, where indicated*
A tick means this is believed to exist: No tick could mean that it does not exist, sometimes exists or it was not found. Not all options were covered in surveys and interviews

Key to tiers:											
Raw	Proc	CompM	DistRM	ProdM	DistP	FSP	Inst	SubC	MainC	Client	Cons
Raw materials	Processing/ refining	Component manufacturer	Distributor of raw materials	Product manufacturer	Distributor	Fulfilment service provider	Installer	Sub-contractor	Main contractor	Client	Consumer

4.5.5 Impact of end use

No information received via primary or secondary sources suggested that end use influences the supply chain for the procurement of cladding products. The choice of cladding product is driven by the end use (e.g., if a client requires a more aesthetically pleasing finish for a building such as a school reception, or if the choice of product is cost-driven — see section 4.1.7), but it was not indicated that this impacted the route taken through the supply chain.

4.5.6 Impact of contract type

Those creating ‘pick and mix’ style cladding are thought to be smaller DIY projects. It is thought unlikely that contractors working on large projects would risk using products that have not been approved, especially as this may risk return on the investment made in a building (based on information collected by the study team from a cladding manufacturer association).

5 Fire barriers

5.1 Definition

Fire barriers are defined as 'a strip of non-combustible material that is inserted into a construction to restrict the movement of smoke and flames' (Gorse, 2012). This definition focuses on the property of the product rather than the specific construction or material it is made from. As such, fire barriers can encompass a broad range of proprietary products.

As the definition is broad, there is a risk that the term is understood differently by a variety of industry stakeholders. For example, a fire barrier to a builder will be the overall property of a wall used to compartmentalise a room in a building whereas for a specialist contractor, the fire barrier might be a product that simply fits around a pipe that passes through a wall to prevent fire spreading through the hole in the wall.

For the purposes of this study, fire barriers are taken to be a specific subset of the whole fire barrier product, which are known as firestops or firestopping. These are proprietary products/systems used in apertures in walls and floors to restrict the spread of fire and according to (HM Government, 2013) are defined as:

Firestops*: 'A seal provided to close an imperfection of fit or design tolerance between elements or components, to restrict the passage of fire and smoke'*.

Throughout this report, the fire barriers under consideration are firestops. Several types of fire barrier that are part of a bigger system such as HVAC systems are also excluded, some of which would be firestops and some not. Fire dampers in HVAC systems are excluded, as are fire barriers used to compartmentalise buildings into areas of manageable risk to provide means of escape and to provide fire separation for adjoining building using fire curtains, fire partitions (walls and floors) and large-scale intumescent coating systems and loadbearing support systems. More detail is given about the many types of firestop below: some types of firestops are also excluded because they are part of a bigger system, see section 5.1.3.

5.1.1 Firestopping product types

Many types of fire-stopping products are available on the UK market. As a guide, the *ASFP - Red Book - Linear joint seals, penetration seals (fire-stopping) and cavity barriers* (ASFP, 2016) is used to define the types of fire-stopping systems available.

There are fundamentally two different types of firestopping (ASFP, 2016):

- **Penetration seals:** A seal for an aperture through a separating element designed to maintain the integrity and insulation performance of the separating element
- **Linear joint seals:** Designed to maintain the required fire resistance across separating elements of a building and to accommodate a defined degree of movement e.g. the junction between a wall and ceiling.

ASFP - Red Book - Linear joint seals, penetration seals (fire-stopping) and cavity barriers (ASFP, 2016) provide detailed pictures showing the difference between penetration seals and linear joint seals.

5.1.2 Fire-stopping definitions

Fire-stopping products that are included in the study are:

- **Coated stone wool batts/boards:** Firestopping batts or boards to support penetrated services through compartment walls and floor while allowing additional services to be readily installed as required.
- **Sealants/mastic coatings:** Composed of silicone or intumescent acrylics and applied by a mastic gun or trowel around openings and/or between and around penetrating services.
- **Mortars (compound)**: Gypsum or cementitious based powder blended with inorganic lightweight fillers, composite reinforcement, and chemical modifier. Mortars are used to firestop penetrations through concrete and masonry compartment walls and floors.
- **Preformed elastomeric seals:** Elastomeric foam, sometimes with reinforcing sheets on either side which may be intumescent. Generally used to seal the gap at a movement joint between two building elements.
- **Bags/pillows/cushions:** Available in various sizes and shapes to be used in temporary or permanent fire-stopping situations where services such as cables pass through walls and floors. Made from special fabrics and often incorporate an intumescent material.
- **Pipe closures:** Available in two methods (pipe collars and pipe wraps) and designed to preserve the integrity of a fire-rated compartment where various plastic pipes or plastic trunking pass through floors or walls. Both systems confine an intumescent compound which expands on exposure to fire, rapidly exerting pressure upon the pipe.
- **Plugs/blocks:** Formed from materials such as bonded vermiculite, mineral wool, gypsum or cementitious materials, polyurethane, modified rubber. They are useful where services require occasional re-routing.
- **Cavity barriers:** Designed to conceal spaces between a cavity wall or ceiling void to restrict the movement of smoke or flames. Cavity barriers are known as specialist designed systems due to their installation and life within a building.
- **Curtain wall seals – fire-stopping at junctions of floor slabs:** Composed of stone wool used in conjunction with metal support systems and/or mastics/self-levelling compounds to seal the gap between a floor slab and a curtain walling system.
- **Stone wool mineral fibre slabs and strips:** Stone wool products are those that are manufactured for a specific purpose such as blank seals and penetration seals.
- **Foams (silicone, polyurethane):** Suitable for the fire-stopping of service openings through compartment walls and floors, particularly where access is difficult and where there are complex spaces between groups of services. Provided in two components, which when mixed will foam and increase the volume.
- **Cable transits and sleeves:** Located in walls or floors where cables have to be moved, changed or replaced on a regular basis without disturbing or damaging the fire-resistant properties of the fire-stop seal.
- **Partial penetration fire-stopping devices/systems:** Used to prevent the passage of fire through part of a separating element. Generally comprising electrical socket box inserts, putty pads, intumescent pads, downlighter covers, fire protection hoods / boxes, conduit fillers, etc.

- **Pattressing:** Used for the application of a penetration sealing systems such as for cables and pipes onto the face of a separating element. Generally pattressing is used where it is impossible or impractical to install a penetration sealing system in the normal way.

ASFP - Red Book - Linear joint seals, penetration seals (fire-stopping) and cavity barriers (ASFP, 2016) provides detailed pictures of all firestopping products included within this study.

5.1.3 Excluded firestopping products

The study focuses on firestopping systems that are proprietary products/systems used in apertures in walls and floors. Products that are part of a different system are excluded because they are designed and installed by specialist contractors. An exception is cavity barriers within cladding systems, which are included because the stakeholders in the workshop specifically felt that they were closely related to the other firestopping products. Excluded firestops are:

- Open cavity barriers for example in rain-screen cladding
- Ductwork and damper penetration sealing systems in HVAC systems
- Service supports
- Loadbearing seals

ASFP - Red Book - Linear joint seals, penetration seals (fire-stopping) and cavity barriers (ASFP, 2016) provides detailed pictures of all firestopping products included within this study.

5.2 Legislation and voluntary initiatives

5.2.1 Legislation

Legislative requirements for fire-stopping can be found in section 11.1.2. Approved Document B (England) Volume 1 & 2 provides practical guidance to meet legislative requirements for fire safety within dwellings and non-dwellings.

Section 9 and 10 of Approved Document B Volume 2 provides guidance of performance for fire-separating elements, indicating that every joint, imperfect fit and opening for services should be sealed.

Methods for testing fire-stoppers, and their various applications, are provided within document *ASFP Red Book – Fire-stopping: Linear joint seals, penetration seals and cavity barrier – 4th Edition* (ASFP, 2016).

5.2.2 Designated standards

There are currently no designated standards for fire-stopping of penetration and linear joint seals.

5.2.3 British Standards

For an introduction to British Standards and the BSI Kitemark, see section 11.1.9. The table below lists some of the most common British Standards relevant to fire barriers:

Table 5-1 British Standards most relevant to fire barriers

British Standard/specification created by the BSI	Description
BS 476-20: 1987 - Fire testing on building materials and structures. Methods for determination of the fire resistance of elements of construction (general principles).	This standard sets out the general details of testing conditions, specimens, apparatus and criteria for fire resistance testing.
BS 476-22: 1987 – Fire tests on buildings materials and structures. Methods for determination of the fire resistance of non-loadbearing elements of construction.	This standard provides the procedures for determining fire resistance of non-loadbearing elements of a building when subjected to heat and pressure conditions.
BS EN 1366-3: 2009 – Fire resistance tests for service installation. Penetration seals	This standard sets out the method of test and evaluation of penetration seals to maintain fire resistance at the position at which it has been penetrated by a service
BS EN 1366-4: 2009 – Fire resistance tests for service installation. Linear joint seals	This standard sets out the method of test and evaluation of leaner joint seals to maintain fire resistance at the position at which it has been penetrated by a service.
BS EN 1364-1: 2014 – Fire resistance tests for non-loadbearing elements. Walls	This standard sets out the method for determining the fire resistance of non-loadbearing walls and covers equipment, test conditions, specimen and installation, test procedures and reports.
BS EN 1364-2: 2014 – Fire resistance tests for non-loadbearing elements. Ceilings	This standard sets out the method for determining the fire resistance of non-loadbearing ceilings, including self-supporting ceilings and suspended ceilings.
BS EN 1364-6: 2014 - Fire resistance tests for non-loadbearing elements. Cavity barriers	This standard sets out the method for determining the fire resistance of cavity barriers and is applicable to non-loadbearing vertically or horizontally oriented closed and open cavity barriers.
BS EN 13501-1: 2018 - Fire classification of construction products and building elements – Classification using data from reaction to fire test	This standard provides the procedures to obtain fire classification and applies to construction products, floorings and linear pipe thermal insulation products.
BS EN 13501-2: 2018 - Fire classification of construction product and building elements – Classification using data from	This standard provides the procedure to classify construction products and building elements with data resulting from fire resistance and smoke leakage tests.

British Standard/specification created by the BSI	Description
fire resistance tests, excluding ventilation services	
BS 7671: 2018 - Sealing of wiring installations	This standard sets out the methods of assessing wiring systems passing through elements of a building which should be sealed according to the degree of fire-resistance prescribed before penetration. It does not detail how testing should be carried out and who should perform the testing.

5.2.4 Voluntary initiatives

Section 11.1.6 provides a list of voluntary third-party schemes and code of practices that are relevant to fire-stopping.

5.2.4.1 International Fire Consultants Certification (IFCC)

International Fire Consultants Certification (IFCC) penetration and linear gap seal scheme provides voluntary third-party certification to indicate a product has successfully completed the requirements of UKAS standard SDI09 for installation of penetration sealing and firestopping in walls, floors, partitions and sandwich panels (UKAS, no date).

To achieve IFCC Certification for penetration seals and linear gap seals a product must meet the requirements laid out in the following standards:

Penetration seals:

- BS EN 476: 21 & 22, BS EN 1366-33 or BS ISO 10295-1

Linear joint seals:

- BS EN 1634-3, BS EN 1364-4 or BS EN 1366-4

IFCC also provide third-party certification for installation of fire-resistant cavity barriers under *UKAS standard SDI 10* (UKAS, no date).

5.2.4.2 FIRAS

FIRAS provides a voluntary third-party certification scheme under the Warrington Fire brand for the installation of passive and active fire protection products according to the *ASFP Red Book – Fire-stopping: Linear joint seals, penetration seals and cavity barrier – 4th Edition* (Warringtonfire, no date b).

5.2.4.3 Certifire

Certifire is a voluntary third-party certification scheme under the Warrington Fire brand. Certifire ensures the performance, quality, reliability and traceability of products and systems. It allows manufacturers to demonstrate that a passive fire product has passed relevant fire safety standards with addition of factory product control (FPC) audits according to ISO9001: Quality management systems – Requirements (Warringtonfire, no date a).

5.2.4.4 The Loss Prevention Certification (LPCB)

The Loss Prevention Certification Board (LPCB) offers a voluntary third-party approval certification scheme for penetration, cavity barriers and linear gap seals. To obtain certification, products must meet the requirements of *Loss Prevention Standard 1132* (Loss Prevention Certification Board (LCPB), 2014).

5.2.4.4.1 BM TRADA Q-MARK Firestopping

BM TRADA Q-MARK is a voluntary training scheme to ensure a responsible person can undertake installation of a firestopping product according to the manufacturer's instructions. A label that is registered with BM TRADA is placed on an installation to confirm it complies BM TRADA and relevant building regulations (BM TRADA, no date)

5.2.4.5 Blue Sky Certification

Blue Sky Certification offers a firestopping certification scheme. To obtain certification, an installer must obtain appropriate data sheets from the firestopping manufacturer and install the products in line with the manufacturer's instructions and test evidence. Installation is registered with Blue Sky so that a certificate can be emailed to the responsible person (Blue Sky Certification, 2020).

BS 7974: 2019 Application of fire safety engineering principles to the design and buildings. Code of Practice

Code of practice to provide a framework of recommendations and guidance on applying scientific and engineering principles to the protection of people, property and the environment from fire.

BS 9999:2017 Fire safety in the design, management and use of buildings. Code of practice

Code of practice giving recommendations and guidance on the design management and use of buildings for fire safety throughout a building's life cycle.

BS 9991:2015 Fire safety in the design, management and use of residential buildings. Code of practice

Code of practice giving recommendations and guidance on the design, management and use of residential buildings.

5.3 UK market size

5.3.1 Size of the market and characteristics

Initially, the study team considered trying a top-down approach, see 2.7.1, similar to the approach taken for the other products. However, there were some complications, due to the product categorisation, therefore the methodology employed was as follows:

- Identify materials used in each firestopping product, see Table 5-2;
- Identify SIC codes for these materials, see Table 5-3;
- Assume the proportion of the material that is used in firestopping; and
- Assume the multiplying factor that represents the added value of transforming the material into the firestopping product.

The study team had difficulty arriving at assumptions for the first draft of the calculations which were presented at the workshop; it was hoped that the attendees could provide

more input to help identify the correct SIC codes and improve the assumptions for the last two steps in the process.

However, it was not feasible to follow this approach as the participants could not provide estimations and verify assumptions. Whilst it is likely that the stone wool and mortar come from the SIC codes indicated in Table 5-3, the range of possible proportions is still large. For vermiculite, the workshop participants could not provide clarity on whether firestopping is a primary use of vermiculite or just one of the many benefits it provides. Another intractable issue is intumescent materials, foams and mastics: none of these appear to have anything in common with the many sealants and coatings related SIC codes available. Conversations with FEICA, the European Adhesives and Sealants Association, indicated that its members did not know which codes would include intumescent materials.

Finally, the workshop participants were not able to offer views on most of the value-added multipliers.

During the workshop discussion about market size, the attendees agreed that the total annual UK market size for firestopping could be worth approximately £800 million to £1 billion. These figures are highly uncertain, and the study team has low confidence in their accuracy.

Table 5-2 Types of firestopping and the primary material used in their manufacture

Barrier type – Firestopping	**Major component type**
Fire coated batts	Stone wool
Sealants or mastic coatings (silicone, intumescent acrylic)	Mastics, foams, intumescent material
Mortars	Mortar
Preformed elastomeric seals	Mastics, foams, intumescent material
Bags / pillows / cushions	Mastics, foams, intumescent material
Pipe closures	Mastics, foams, intumescent material
Plugs / blocks	Mortar
Cavity barriers	Stone wool, intumescent material
Curtain wall seals	Stone wool
Stone wool mineral fibre slabs and strips	Stone wool
Foams (silicone, polyurethane)	Mastics, foams, intumescent material
Cable transits and sleeves	Mastics, foams, intumescent material
Partial penetration fire-stopping devices/systems	Mastics, foams, intumescent material
Pattressing	Stone wool

Source: ASFP Red book (ASFP, 2016) and RPA analysis

Table 5-3 Possible SIC codes for the materials used in firestopping

Code	**Discussion**
Stone wool	

Code	Discussion
23991910 (CN 680610) - Slag wool, rock wool and similar mineral wools (EXCLUDING:- Glass wool) and mixtures thereof in bulk, sheets or rolls INCLUDING: - intermixtures - ceramic fibres	The primary code for stone wool. Although a sizeable amount of this production probably goes into firestopping, consulted stakeholders could not provide estimates of the proportion (e.g. 1% or 20%)
23991920 (CN 680620) - Exfoliated vermiculite, expanded clays, foamed slag and similar expanded mineral materials and mixtures thereof	Vermiculite is used in some bags, pillows and cushions. However, consulted stakeholders could not assess what proportion of this material is used in firestopping: it could be anything from fractions of one per cent to 10% or more. The overall value of this production under this SIC is relatively low at about £12 million
Mortar	
23641000 (CN 3824509) - Factory-made mortars	This is a large market worth £300–400 million. Consulted stakeholders could not estimate what proportion of this material is used in firestopping: it seems likely to be 1% or less but could be fractions of one per cent
Mastics, foams, intumescent material	
20302253 (CN 3214101) - Glaziers' putty, grafting putty, resin cements, caulking compounds and other mastics	Whilst intumescent materials are often described as a putty, it is unclear whether it is this specific type of putty
20302273 (CN 3814001) - Organic composite solvents and thinners used in conjunction with coatings and inks, based on butyl acetate EXCLUDING:- printing inks	These are only a few of the possible sealant and coatings codes available. Consulted stakeholders could not assess which might apply to intumescent materials used for firestopping, or any of the specific mastics and foams used
20165700 (CN 3910) - Silicones, in primary forms	
20301150 (CN 320910) - Paints and varnishes, based on acrylic or vinyl polymers dispersed or dissolved in an aqueous medium INCLUDING: - enamels and lacquers	
20301230 (CN 3208201) - Paints and varnishes, based on acrylic or vinyl polymers dispersed or dissolved in a non-aqueous medium and where the weight of the solvent exceeds 50% of the weight of the solution INCLUDING: - enamels and lacquers	

Code	Discussion
20301250 (CN 3208209) - Paints and varnishes, based on acrylic or vinyl polymers dispersed or dissolved in a non-aqueous medium INCLUDING: - enamels and lacquers EXCLUDING: - those where the weight of solvent exceeds 50% of the weight of the solution	
20595669 (CN 38151990 + 38159010 + 38159090) - Reaction initiators, reaction accelerators and catalytic preparations, n.e.s or included	

Source: (Office for National Statistics, 2020) and RPA analysis

5.3.2 Market segmented by product type

It was not feasible to provide this information because the overall market size cannot be determined.

The workshop attendees agreed that fire coated batts are the largest category of firestopper in terms of value, this is partly because they also come with many accessories.

5.3.3 Market distribution

It was not feasible to provide the market distribution (proportion of companies by size and location in the UK) because the appropriate SIC codes cannot be defined and therefore the numbers of companies making firestoppers cannot be extracted and the market distribution cannot be analysed.

5.3.4 Exports v imports

It was not feasible to provide the imports, exports, and trade balances because the appropriate SIC codes cannot be defined and therefore the imports and exports of firestoppers cannot be extracted and analysed.

5.3.5 Summary of the firestoppers market analysis

The market data for firestoppers are summarised in Table 5-4. These are values based primarily on 2019 values and the values in 2022 are likely to be approximately a third higher, see 2.7.6.

Table 5-4 Summary of the firestoppers market analysis

Variable	Value
Estimated total annual market value for firestoppers	£1 billion
Study team's confidence in estimated market value	Low
Estimated number of enterprises manufacturing firestoppers	N/A
Trade balance for firestoppers	N/A

Sources: (ONS ABS, 2019; ONS PRODCOM, 2019; UK Trade Info, 2019), RPA consultation

5.4 Major players

The following section provides examples of companies associated with fire-stopping production, distribution, and installation at different levels of the supply chain.

Stakeholder type	Examples of companies
Product manufacturers	Rockwool Ltd, Astroflame, Siderise, Insultation Limited, FSi Ltd, Saint-Gobain, Fire Stop Ltd, Coopers Fire Ltd, Firefly, Firetrace Ltd, Quelfire Ltd, LFS Ltd
Distributors	Encon insultation, SAIMAXX
Installers/subcontractors	East Anglia Fire Protection Ltd, LFS Ltd, Casu Consulto Ltd, Quest Solutions (UK) Ltd, TFA Interior Projects Ltd, Ldd Construction Ltd, Fireclad Ltd, Lockmetal Ltd, WRR0UK Ltd
Certifiers	International Fire Consultants Ltd (IFCC)
Trade associations	Association of Specialist Fire Protection (ASFP), Building Engineering Services Association (BESA), Building Services Research and Information Association (BSRIA), Finishes & Interiors Sector (FIS), Gypsum Product Development Association (GPDA)

Sources: Association member lists

5.5 Supply chain mapping and information flows

5.5.1 Supply chain

The following supply chain maps set out the main routes taken by stakeholders to acquire firestopping products and cavity barriers.

Figure 5-1 shows the supply chain for most firestopping products. The widespread use of distributors makes it difficult for manufacturers to track the end use of their products. Product manufacturers do not install firestopping systems.

Figure 5-2 shows the supply chain for cavity barriers which form part of a larger specialist contractual work package. For example, cavity barriers within suspended ceilings would be part of the suspended ceiling packages which may be subcontracted to a specialist subcontractor and/or specialist installer. Cavity barriers are generally purchased directly from the product manufacturer.

In the workshop, a trade association representing manufacturers and a contractor specialising in installation of firestopping products agreed that main contractors do not purchase firestopping or cavity barrier materials. They are subcontracted as part of the relevant subcontract. For example, cavity barriers will form part of the cladding package. Cavity barriers within suspended ceilings would be part of the suspended ceiling package. There would be a specialist package for firestopping. The subcontractor would normally purchase firestopping material from the product manufacturer or sometimes a distributor.

However, it may be purchased by the installer who is third party to the tier two or tier three contractor which has a contract with the tier one contractor. The only exception is where it is part of a specialist system (architecturally designed or specialist bespoke).

In an interview, a main contractor highlighted that design and build companies generally have their own in-house design team who will specify the goods themselves. While medium-sized design and build companies will employ an architect who is responsible for obtaining the relevant building regulations clearance and producing the overall design, the architect is not necessarily able to control what happens on site.

Case study 5: Challenges related to selecting and installing the correct firestopping product / system

The overall aim of firestopping products is to prevent the spread of smoke and fire by sealing any imperfections in the building or breaches to walls or floors (ASFP, 2016) that are part of the fire compartmentalisation of the building. Workshop participants agreed that the main challenges associated with firestoppers relate to selecting the wrong product for the specific job and/or incorrectly installing the product.

As there are many types of firestoppers, understanding the properties of the different types of products is essential to **correctly select the most appropriate product for a specific construction project**. As firestoppers are often made from a range of construction products, specialist technical knowledge alongside information about their compatibility and specific application is required to make informed product selections.

Feedback provided by workshop participants suggest that **the specific product selection and installation depends on:**

- the project **size**; and
- who is **responsible for designing and signing off** the design and/or installation of the firestopping system, which in turn partly depends on the type of contract.

Specialist firestopping contractors are typically appointed for **larger and more complex projects**. This provides the main contractor with a warranty for the products and their installation. Workshop participants also observed that main contractors often subcontract firestopping systems together with other relevant subcontracting activities. For instance, cavity barriers often form part of the cladding subcontracting package, whereas cavity barriers within suspended ceilings are part of the suspended ceiling package. The main contractors do not typically purchase the required firestopping products/systems, this is often the responsibility of the subcontractor(s) who normally purchase firestopping from the product manufacturer(s) or sometimes from a distributor.

There are some differences regarding the **responsibilities for designing and signing off** firestopping products/systems, **partly depending on the type of contract**. In the design and build contracts, which are becoming the most frequently used contract type, the 'build' part of the contract is increasingly subcontracted. (This is also true for large non-design-and-build projects as contractors have fewer workers.) In such instances, it is usually the specialist subcontractor who decides which products should be used and how they should be installed. According to workshop participants, this may

lead the subcontractor to consider cost optimisation strategies by selecting a cheaper product, and/or subcontracting this piece of work further.

In traditional contracts, the responsibility (i.e. liability) for the design of the firestopping product/system rests with the architect. Nevertheless, the concept designer (architect), spatial designer (e.g. structural engineer) and the technical designer (e.g. fire engineer and other specialists) typically work together and would seek input from the installer to make a product design choice and specify the installer. However, the architect will not take responsibility for the installation of the product as they are not signing it off.

Under both contract types, there seems to be a **disconnect between the designing and installation responsibilities** which become blurred as they are moved down the supply chain. This, in turn, can have an impact on the quality of products and/or installation, and the overall functionality and safety of the firestopping product/system. Workshop participants suggested that a circular route from design to installation and then inspection could alleviate this challenge. They suggested that the designer should be responsible for ensuring that the technical specification has been achieved.

This could be accomplished by, for instance, the main contractor employing an independent fire safety inspector to sign off the firestopping product/system installation.

For the list of all case studies, see section 2.4.4.

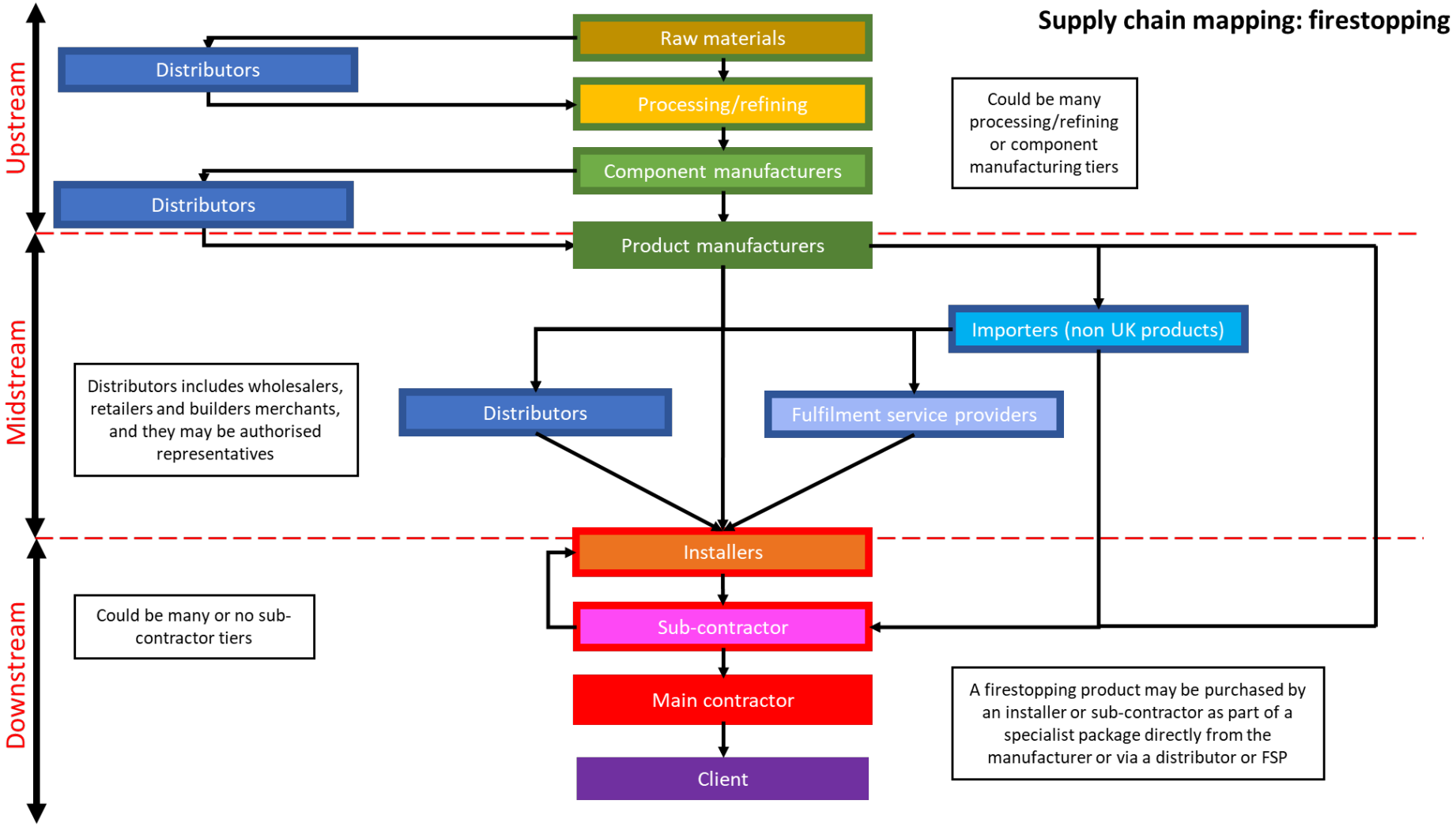

Figure 5-1 Supply chain map for firestopping

Source: RPA

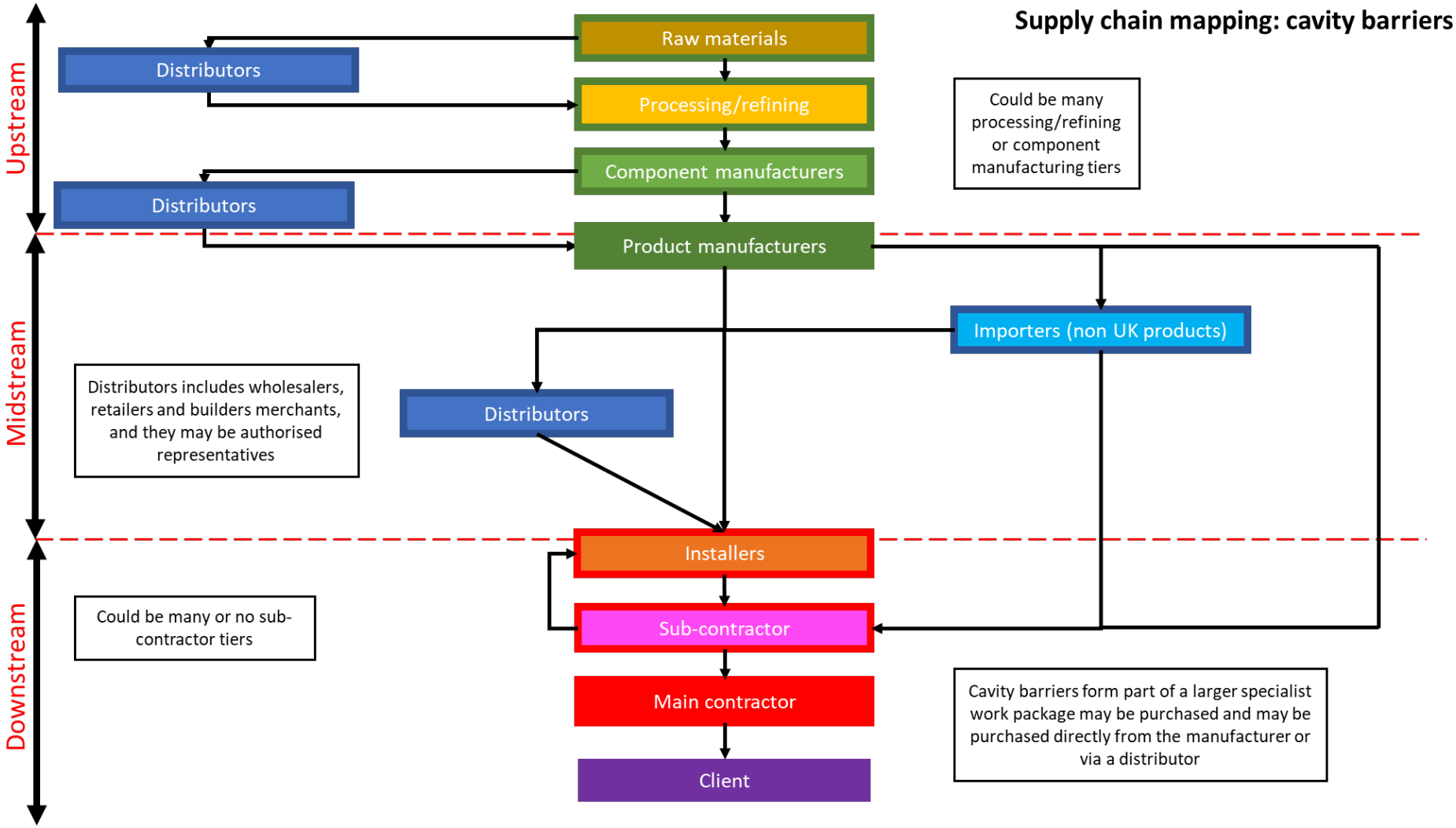

Figure 5-2 Supply chain map for cavity barriers

Source: RPA

5.5.2 Information flow

The information flows for fire-stopping systems and cavity barriers are broadly the same and are shown in Table 5-5. Descriptions of these flows through the supply chain are given in section 2.9.1.

Component manufacturer and product manufacturer may provide 3D BIM models containing product designs and information: these re only common for cavity barriers.

Once a designated British Standard has been introduced for fire-stopping products, a declaration of performance will be required at the level of the component manufacturer and the product manufacturer for the fire-stopping products covered by the new designated standard under the CPR.

The only difference in the supply of information between fire-stopping systems and cavity barriers is where there is involvement of a distributor. A manufacturer is responsible for supplying a declaration of performance under the CPR, and a customer would need to revert back to the manufacturer for this information.

In the workshop, a trade association representing manufacturers highlights that in a design and build contract, the specialist subcontractor usually selects which product is to be used. However, in a traditional build this decision may rest with the sub-contractor or the architect. In a traditional contract, the designers, fire engineers, architects would ask for the information to make a product design choice and specify the installer to install. However, in a design and build contract the product selection and technical appraisal is left to the specialist subcontractor. This may lead the subcontractor to select a cheaper product. Indeed, this may happen in any subcontracted situation in which a specification/design is not complete. There are challenges arising from the use of 'or equal approved' specification clauses, which are often used in specifications in order to ensure that a contractor will bid for the work.

It was further highlighted by manufacturers that whilst many systems are designed in BIM; it is still not common to design for firestopping products in BIM, except for cavity barriers. As noted in 6.5.5, contractors see BIM as a time consuming and difficult exercise, which they avoid if possible; which is one of the reasons that BIM is not yet widely used, despite the UK Government strategy on BIM.

One key issue is who has the competence to make the decision. An architect has design responsibility, they will specify a product because they have done due diligence. However, when the construction project gets awarded to a contractor, they have the option for looking for alternatives.

In traditional construction, you would have a responsibility chain and a supply chain and a Clerks of Works that would be looking at both areas making sure what has been specified is the correct product and installed correctly. However, Clerks of Works are expensive, and they can slow the construction process, they may even indicate that you must use a product that is 25% more expensive. Clerks of Works are still used in Scotland, but rare in England and Wales. This is mainly due to the Regulatory Reform (Fire Safety) Order which came into force in England and Wales but not Scotland.

All participants[10] within the workshop agreed that there are few bad products, the real problem is either poor installation or the wrong product. Participants said that traditional

[10] It should be noted that there were only four participants at the workshop, but between them they covered all tiers within the supply chain for firestopping products.

builds have a series of safety nets built in. However, with design and build the contractor is keen to pass the responsibility to the installer. Furthermore, there are currently no designated standards recognised by the UK government for firestopping systems. Instead, the UK building regulations are an outcomes-based series of regulations and firestopping is way to deliver that outcome.

In an interview, a trade association representing manufacturers highlights one of the key issues is upskilling the work force and knowing the processes that are in place. The trade association noted that there are currently no legal requirements for residential buildings for firestopping, except for large open-plan areas. One representative stated their opinion that firestopping is only driven by insurance requirements, however it should be noted that this statement was not verified at workshop discussions and/or with relevant or wider experts in the field.

Participants within the workshop were unaware of any well-established installation training for firestopping in the industry. The general feeling was that installers are reliant on installation guidance documents and installation videos from manufacturing websites and YouTube.

In the survey one respondent from a small enterprise highlighted:

> *'Regulation and compliance have driven our choice of product. We only have one supplier that we trust to meet all needs. However, the requirement to ensure that all subcontractors use the same products across a site, leaves us with an unworkable solution if we are not the largest supplier of firestopping on the project and cannot push through our product as the preferred site wide product. We can now only insist on having our products signed off as acceptable for use jointly with an alternative larger supplier's product. We can no longer comply with any and all products.'*

Table 5-5 Information flow between tiers for fire-stopping systems

Information flow type	**From**	Raw	CompM	ProdM	DistP	Inst	SubC	MainC
	To	CompM	ProdM	DistP	Inst	SubC	MainC	Client
Building Information Modelling (BIM)			√	√				
Brochure/leaflet			√		√	√	√	√
BSI Kitemark (on product and/or packaging)			√	√	√	√	√	√
Company datasheet				√				
COSHH		√	√			√	√	√
Declaration of performance (DOP)				√				
Info on packaging			√	√	√			
Info on product				√	√	√	√	√
Installation guide				√	√		√	√
Manufacturer's logo			√	√	√	√	√	√
Manufacturer's training*				√	√			
Operation & maintenance manual								√
QR/bar code				√	√	√	√	√
Safety data sheets		√						
Technical info			√		√	√	√	√
Third party certification (voluntary)			√	√				
UKCA/CE mark on product and/or packaging								
Unique ID on product				√	√			
Warranty								

Source: RPA

*Note: * Media for information is via paper/online, or on products or packaging, where indicated*
A tick means this is believed to exist: No tick could mean that it does not exist, sometimes exists or it was not found. Not all options were covered in surveys and interviews

Key to tiers:											
Raw	Proc	CompM	DistRM	ProdM	DistP	FSP	Inst	SubC	MainC	Client	Cons
Raw materials	Processing/ refining	Component manufacturer	Distributor of raw materials	Product manufacturer	Distributor	Fulfilment service provider	Installer	Sub-contractor	Main contractor	Client	Consumer

6 Fire doors

6.1 Definitions

The definition of a fire doorset is dependent on the standard used. Approved Document B 2022 edition provides the following definition (HM Government, 2022).

> *'A door or shutter which, together with its frame and furniture as installed in a building, is intended (when closed) to resist the spread of fire and/or gaseous products of combustion and meets specified performance criteria to those ends.*
>
> *NOTE: A fire doorset may have one or more leaves. The term includes a cover or other form of protection to an opening in a fire resisting wall or floor, or in a structure that surrounds a protected shaft. A fire doorset is a complete door assembly, assembled on site or delivered as a completed assembly, consisting of the door frame, leaf or leaves, essential hardware, edge seals and glazing, and any integral side panels or fanlight panels in an associated door screen'*

For the purposes of this study, the following definition was agreed with stakeholders:

> *A door which, when closed, forms a barrier to stop the spread of fire and when opened provides access.*

Fire shutters have been excluded from the scope of the study as they often form part of a larger system of fire curtains and fire compartmentalisation.

For a door to be classified as a fire door it must have a fire rating. Fire doors are not necessarily part of the means of escape. Fire doors can be subdivided in several ways:

- Whether the components for the doorset originate from one or many sources;
- How the fire door has been tested and certified;
- Whether the fire door is available off-the-shelf, customisable, or bespoke;
- What material makes up the fire door's core and skin; and
- Whether the fire door is internal or external.

6.1.1 Fire door types – number of sources

There are two ways in which fire doors can be sourced:

- **Fire doorset:** A fire door that is supplied by one supplier which is constructed offsite including all essential components such as ironmongery, glazing and intumescent sealants. As a subset a fire door may be supplied by a single supplier and assembled onsite, this is sometimes known as a fire door kit, although many fire doors are delivered in parts and assembled on site, but when there is one supplier of all the components, they are called doorsets. Doorsets and door kits have all been tested as a system by the manufacturer.

  A variation of the fire doorset occurs when a manufacturer supplies one element of the fire door, such as the door leaf (a single, independently moving panel), edge seals and ironmongery), together with a specified list of all the other components such as ironmongery, glass, which it has tested and had certified as a system. The certification is only valid if all the components are selected from this list (field of application reports).

- **Fire door assembly:** A fire door that is constructed on site from components supplied by multiple sources, including ironmongery. The complete fire door has not been tested as a system, even though the individual components may have been tested, and therefore, cannot be certified.

Workshop participants observed that the market is moving away from fire door assemblies to fire door sets, which they believe is being done to reduce their risk.

6.1.2 Fire door types – tested and certified

Fire doors can be divided into two main groups:

- Tested and certified as a system: fire doorsets in section 6.1.1; and
- Not tested and certified as a system: fire assemblies in section 6.1.1.

6.1.3 Fire door types – off-the-shelf, customisable, or bespoke

Fire doors can be divided into three main groups:

- Proprietary off-the-shelf, the fire door could be certified or uncertified;
- Customised when an already certified fire door is subject to minimal tweaks to client's specification, such as colour (this includes the variation under fire doorset outlined in 6.1.1); and
- Bespoke – fully designed to client's specification and requiring its own testing.

6.1.4 Fire door types – material

There are several materials from which fire doors can be made, often in combinations:

- **Wood fire doors:** A solid core made from a variety of components such as timber, flaxboard, magboard or particle board. The door leaf may be built in many ways as long as the fire rating is achieved. A few timber fire doors are hollow-core. Some timber doors have a solid timber core and a skin of uPVC, laminate or glass-reinforced plastic (GRP) surrounding the door leaf: sometimes these doors are called composite doors.
- **Metal fire doors:** The composition of metal fire doors may include an internal structure made from a variety of materials that include honeycomb, polyurethane, polystyrene, steel stiffened, timber or a mineral core. A steel or aluminium skin is laid over the core to form a door leaf.
- **Glass fire doors:** Fire rated glass that is proven during a fire resistance test to ensure protection against fire.
- **Plastic fire doors:** Plastic doors containing no timber core are usually defined as plastic doors: whilst most plastic doors are not fire doors, some do attain a 30-minute fire rating.

6.1.5 Fire door types – internal versus external

Fire doors can be either internal (within the building) or external (door for leaving the building).

- **Internal:** A fire door that is designed to separate a building into compartments. Testing is performed to indicate the amount of time it takes to withstand fire and to assign a fire door rating of 30, 60 or 120 minutes of protection as per BS 476: Part

22 guidelines. An internal fire door is required to meet the same fire rating as the corresponding compartment walls and floors (*Fire Doors : Firesafe.org.uk* (no date). However, there are no designated standards for internal fire doors (only for external fire doors.

- **External** A door at the end of an escape route at the boundary of the building is subjected to dual certification 'secured by design'. It does not need to be a fire door or kept closed. Non-domestic and commercial building fire doors are subjected to risk assessment under the Regulatory Reform (Fire Safety) Order 2005. The newly established Fire Safety Act 2021 also includes fire risk assessments to domestic premises and common areas ('Fire Safety Act 2021 CONTENTS', no date).

6.1.6 Further issues defining fire doors

In the workshop, a trade association representing fire testing and third-party certification indicated there is uncertainty in the overall definition of a fire door. Workshop participants explained that the definition of a fire doorset is dependent on the type of standard used.

There is a definition for timber fire doorsets in BS EN 1634-1:2014+A1:2018, which is the fire door testing standard. Stakeholders believed that BS EN 15269-1[11] has the clearest definition of a doorset as it does not differentiate between the frame material, indicating you can still have a timber doorset with a timber, steel, or PVC composite glass reinforced plastic (GRP) outer skin[12]. One definition for composite doorsets is available in BS 8529, but it only applies to "domestic external doorsets", in other words front doors of houses. BS 8529 strictly speaking does not apply to composite doors for flats and apartments as these are classed as internal doors because they separate one internal environment from another.

The workshop participants explained that plastic fire doors are one of the fastest growing fire door markets. Many timber door companies make doors with a plastic skin, these may also be called composite doors, as are timber doors set in a steel frame.

It was observed by several interviewees that the same product can be called different names. This is often due to a play of words or misuse of words. For instance, external doors may be called 'fire escape doors' but they are not usually 'fire doors'. Using the word 'fire escape' can imply that these doors are of a better quality/provide extra safety. However, these external fire escape doors do not have to meet the main function of a fire door, which is to provide fire compartmentation.

6.2 Legislation and voluntary initiatives

6.2.1 Legislation

Legislative requirements for fire doors can be found in section 11.1.2. Approved Document B (England) Volume 1 & 2 provides practical guidance to meet legislative requirements for fire safety within dwellings and non-dwellings providing guidance on the best practices to meet legislative requirements according to the Building Regulation 2010.

[11] Part 1 of the BS EN 15269 series of standards covers general principles.

[12] Specific door types are covered by the BS EN 15269 series of standards, for example:

- BS EN 15269-2 covers hinged and pivoted steel doorsets,
- BS EN 15269-3 covers hinged and pivoted timber doorsets and openable timber-framed windows.

However these are not test standards, rather they are extended applications of previous fire tests based on expert judgement.

6.2.2 Designated standards

There are currently three standards for internal and external fire doors, the first two of which listed below are designated.

Currently BS EN 14351-2: 2018 is not recognised as a designated standard**.**

Table 6-1 Designated standards for internal and external fire doors.

British Standard/specification created by the BSI	**Description**
BS EN 16034:2014 Pedestrian doorsets, industrial, commercial, garage doors and openable windows. Product standard, performance characteristics — Fire resisting and/or smoke control characteristics.	This standard provides performance characteristics, tests and assessment methods for all fire resisting and/or smoke control products. However, it excludes “door assemblies produced with components from several sources where there is no single identified manufacturer or legal entity who will take responsibility for them”.
BS EN 14351-1:2006+A2:2016 Window and doors – product standard, performance characteristics. External pedestrian door sets	This standard provides the performance characteristics except resistance to fire and smoke control characteristics, that are applicable to windows and external pedestrian doorsets (and their assemblies, including unframed glass doorsets, escape route doorsets) and screens.
pr EN 14351-2: 2018 Window and doors – product standard, performance characteristics. Internal pedestrian door set	This standard provides product characteristics, testing, assessment and sampling methods for internal pedestrian doorsets

6.2.3 British Standards

There are a number of British Standards (BSI) that have been created by industry experts relating to individual components that make up a fire doorset or assembly. Section 11.1.9. highlights if a product conforms to BSI standards a BSI Kitemark will be placed on a product.

6.2.4 Fire door testing

Fire doors are subjected to fire resistance tests which are determined under standards BS 476: Part 22 or BS EN 1634-1 (the European equivalent) at a certified body under a United Kingdom Accreditation Service (UKAS). Under BS 476: Part 22, fully insulated, partially insulated and uninsulated vertical doorsets (amongst other vertical partitions and non-loading bearing elements of construction) are tested for their fire resistance. BS EN 1634-1 requires exposing one face of a door to the heat conditions likely to be expected in a fire, while observing the door for stability and integrity to test the design, quality and performance of the fire door (*Fire Door Testing* | *Sentry*, no date)).

Case study 6: Challenges resulting from an extended application of testing results when applying the cascaded evidence of fire performance

The evidence collected during interviews suggest that fire doors can be made up of 60+ components and each component (such as glass, hardware and seals) can come from a range of separate manufacturers. Manufacturers placing fire doors on the UK market are legally required to provide evidence of performance to resist the spread of fire. This evidence can be provided by manufacturers undertaking fire tests for their specific products, or in a format of a 'cascaded test evidence'.

The **concept of a cascaded evidence of fire performance** refers to **a situation when a doorset supplier uses the fire test reports and/or assessments of another company** (with their permission) **as an alternative to their own fire test evidence** (FIA, 2019). The testing results are typically from a doorset or door blank manufacturer, which one interviewee also referred to as 'the systems' companies' or 'the systems' producers'. According to this interviewee, there are four or five such companies in the UK. These companies are important as they have 'the muscle' to gain the test evidence, thus they have the capacity and capability to design and draw technical specifications and undertake test evidence. Other individual manufacturers subsequently work to these companies' specifications and use their test evidence. This method is known as 'cascaded test evidence'. To ensure traceability, the door supplier's use of cascaded test evidence should be formally assessed by a third-party certification (FIA, 2019). The individual door manufacturer is a member of a third-party certification in their name, but the test report or assessment remains in the name of the system producer[13].

As noted by one interviewee, **the use of cascaded test evidence can create some challenges for the performance and safety of products**. This is because individual manufacturers may bring together parts that were individually tested (for instance as part of different systems) and assemble them together assuming they will work as a system. This assumption occurs at different levels in the context of construction, but it is a big assumption that could be flawed. Indeed, it was noted that **the product system relies on a combination of approved different components that have not been tested together as a whole system**. This aspect was also raised by another interviewee, an architect, when they noted that some construction products, such as fire doors and fire barriers, are tested only in standard settings and/or specific applications. However, these products are then being installed in a variety of settings as it is assumed that they will have the same technical performance regardless of settings where they are installed. According to this interviewee, this creates a gap in the accreditation / assessment system for products to be applied in certain building applications. A similar challenge was also identified by a cladding trade association interviewee in relation to cladding systems that are also often a combination of products which may have been tested in a different context to that in which they are being installed.

[13] As noted in the Fire Industry Association report (2019), 'Building Regulations currently permit evidence of performance to BS 476-22 to be used. This situation will change once CE marking of fire doors becomes a requirement; for CE marking only evidence of performance to EN 1634-1 can be used'.

As outlined by another interviewee, a further challenge, which is linked to the use of the cascaded test evidence, relates to the levels of responsibility. The interviewee suggested that the core door manufacturer should not be responsible for all individual components, such as specialist glass used for fire doors, and that the responsibility for individual products should go back down the chain to the component manufacturer. However, this creates challenges if manufacturers use cascaded test evidence and if they do not install the product, thus having no control over the installation process.

In addition, the rise in insurance premiums for whoever carries the liability (manufacturer, installer, design consultant, subcontractor, or main contractor) for several of the products was mentioned in many of the interviews and workshops. This particularly applies to cladding systems, and fire doors and fire barriers. Over the last 20 years, it has sometimes been difficult to define precisely who is responsible for the design of cladding systems. In addition, the potential liability costs if a cladding system fails are considerably greater than the cost of installing the system. This is due to the potential costs of both the failure, for example a fire, and/or the remediation, for example, scaffolding and possibly the vacation of the building by its occupants. The combination of the high liability costs and the relatively low installation costs have led to steep rises in insurance premiums for cladding installers. Stakeholders also reported that many installers and subcontractors could not obtain insurance and that the liability was being pushed back to the main contractor, as they can usually obtain the insurance due to their size.

In the workshop, a trade association representing manufacturers highlights that many specialist subcontractors may not have the appropriate professional indemnity (PI) insurance because of all the issues in the insurance industry. **Many insurers will provide PI but have a series of caveats in that it removes certain products, methods, and processes**.

For the list of all case studies, see section 2.4.4.

6.2.5 Voluntary initiatives

Section 11.1.6 provides a list of voluntary third-party schemes that are relevant to fire doors. There are a number of code of practice standards relating to fire doorsets and assemblies to which third-party schemes adhere as presented below.

6.2.5.1 International Fire Consultants Certification (IFCC)

The International Fire Consultants Certification (IFCC) installers of timber fire doors (non-metallic door installation) scheme provides voluntary third-party certification of fire resisting doorsets and door assemblies to indicate a product has successfully completed the requirements of UKAS standard SDI 14 in conjunction with SDI 00 (IFCC, 2021b). To achieve IFCC Certification for installation of timber fire resisting doorsets or assemblies' products must meet the requirements laid out in the following standards:

BS 476-22: 1987 or BS EN 1634-1:2014+A1:2018

Following satisfactory compliance, contractors are registered on the IFC Certification website as certificated installers. Labels are placed on the edge of a fire door providing traceable manufacturer information, a unique identification number and fire door (FD) rating, this enables on-site checks to be carried out against original standards (IFCC, 2021a).

6.2.5.2 Blue Sky Certification (BSC)

Blue Sky Certification (BSC) provides voluntary third-party certification for the manufacture, installation and maintenance of timber, PVCU and plastic doorsets. To achieve BSC certification a fire doorset manufacturer is required to provide test evidence in line with BS 476-22 or BS EN 1634-1. To obtain BSC fire door installation certification an installer is required to demonstrate that the product used to firestop the frame of a fire door to the surrounding structure is suitable for fire doorset application (BSC, no date).

BSC offers a fire door maintenance scheme for restoring a fire doorset back to the original manufacturer's specification. To achieve accreditation, maintenance must not deviate from manufacturer's original test evidence. To achieve BSC fire door inspection installers must comply with manufacturer's specification or ensure they have achieved industry recognised code of practice (BSC, no date).

6.2.5.3 The Loss Prevention Certification Board (LPCB)

The Loss Prevention Certification Board (LPCB) offers a voluntary third-party approval certification scheme for fire doorsets. To obtain certification, doorsets must meet the requirements of Loss Prevention Standard 1056 (LPCB, 2014).

6.2.5.4 BWF Fire Door Alliance

BWF Fire Door Alliance offers a voluntary third-party certificate of fire doors and fire doorsets for verifying a fire door's design, performance, manufacturing process and quality assurance of procedures (BWF, no date). To obtain certification BWF members need to ensure they meet the following criteria:

- Fire resistance testing to standards BS 476:22 or BS EN 1634-1.
- Auditing of the manufacturing processes
- Audit testing
- Traceability of fire doorset manufacturers and licensed processors by applying a unique labelling system defining member's name contact details, certification number, a unique serial number and fire door rating.

6.2.5.5 Licensed Fire Door Processor:

A joinery company who takes a BWF-CERTIFIRE certificated fire door or door blank and makes adjustments according to the manufacturer's fire test set that includes resizing, re-lipping fire door blanks, whilst maintaining the certification of the fire door (British Woodworking Federation, no date).

6.2.5.6 BM TRADA

BM TRADA Q-MARK fire door installation certification scheme is a voluntary training scheme to ensure a responsible person can undertake installation of a fire doorset according to the manufacturer's instructions. A label that is registered with BM TRADA is placed onto the installed fire doorset to confirm it complies to BM TRADA and relevant building regulations:

- **BS 9999:2017** Fire safety in the design, management and use of buildings. Code of practice

  Code of practice giving recommendations and guidance on the design management and use of buildings for fire safety throughout a building's life cycle.

- **BS 9991:2015** Fire safety in the design, management and use of residential buildings. Code of practice

  Code of practice providing recommendations and guidance on the design, management and use of residential buildings.

- **BS 8214:2016** Timber-based fire door assemblies – Code of Practice

  Code of practice providing recommendations for the specification, installation and maintenance of timber-based fire doors. Doors to have fire resistance rating up to and including 2 hours when tested in accordance with BS 476-22 or BS 1634-1.

- Door & Hardware Federation and Guild of Architectural Ironmongers: Code of Practice: Hardware for Fire and Escape Doors

  Industry code of practice providing advice on best practice in the selection of building hardware for use on fire-resisting doors and doorsets, and escape doors.

6.3 UK market size

6.3.1 Product types and their SIC codes

Table 6-2 summarises the harmonised system codes identified as of relevance to timber, plastic and steel doors, although the classifications do not specify whether the door is a fire door. The plastic door and steel door classifications include windows as well as doors. Glass doors are not included in this top-down approach, see section 2.7.1. A separate calculation is made for glass fire doors in section 6.3.4.

Table 6-2 NACE Codes identified for fire doors

Code	Description
16.23.11.50	Doors and their frames and thresholds (wood)
22.23.14.50	Plastic doors, windows and their frames and thresholds for doors
25.12.10.30	Doors, windows and their frames and thresholds for doors (iron or steel)

Source: (ONS PRODCOM, 2019)

6.3.2 Size of the market and characteristics – timber, plastic and steel

Market size data has been collected from the Annual Business Survey (ABS), published by the Office for National Statistics (ONS ABS, 2019). In 2019, **10,875 companies** were registered under the three SIC codes which could include fire doors (wood, plastic, and iron or steel), see Table 6-3. The combined turnover in the same three SIC codes which could include fire doors (wood, plastic, and iron or steel), was **£3,314,110,000**. For plastic and steel, these figures also include windows. Timber doors can also have a skin of other materials such as plastic, steel, and glass reinforced plastic (GRP).

Overall, the market for timber and plastic fire doors and the associated ironmongery is highly fragmented. The market for steel fire doors is less fragmented and for glass fire doors is highly concentrated with a few large companies supplying the market.

Table 6-3 Number of enterprises and annual turnover manufacturing timber, plastic, or steel doors (2019)

Description	Number of enterprises (2019)	Turnover (2019)
16.23 Doors and their frames and thresholds (wood)	7,460	£779,390,000
22.23 Plastic doors, windows and their frames and thresholds for doors	2,050	£2,070,991,000
25.12 Doors, windows and their frames and thresholds for doors (iron or steel)	1,365	£463,729,000
Total	**10,875**	**£3,314,110,000**

Sources: (ONS ABS, 2019; ONS PRODCOM, 2019)

The value and volume of all three types of doors produced, imported into and exported from the UK are shown in the table below (Table 10-3). The value per door of the imported and exported doors appears to be out of line with those produced in the UK. The study team believes this is too low for timber doors and steel doors in particular; stakeholders (business associations representing manufacturers, and consultants) agreed with this conclusion. It appears likely that the numbers of imported and exported "doors" includes parts of doors. Therefore, in the next section of analysis, the UK market size for fire doors is based upon the UK production value for timber, plastic and steel doors (and includes windows for plastic and steel doors).

Table 6-4 UK value and volume of production, imports and exports of timber, plastic and metal doors, some of which are fire doors, together with their corresponding SIC codes

Doors	UK Value	Quantity (doors)	Value/door
Timber: Doors, frames and thresholds (16.23.11.50)			
UK production	£779,390,000	11,103,523	£70
UK imports	£254,042,443	7,066,957	£36
UK exports	£23,478,122	2,406,350	£10
Total timber door UK market	£1,009,954,321	15,764,130	£64
Plastic: Doors, windows and their frames and thresholds for doors (22.23.14.50)			
UK production	£2,070,991,000	10,822,533	£191
UK imports	£88,544,447	9,021,146	£10
UK exports	£27,863,269	1,043,596	£27
Total plastic door UK market	£2,131,672,178	18,800,083	£113
Steel: Doors, windows and their frames and thresholds for doors (25.12.10.30)			
UK production	£463,729,000	634,016	£731
UK imports	£56,955,646	5,720,407	£10
UK exports	£25,548,611	605,277	£42

Doors	UK Value	Quantity (doors)	Value/door
Total metal (steel) door UK market	£495,136,035	5,749,146	£86
Estimated total timber and, metal door UK market	£1,505,090,356	21,513,276	NA

Sources: Eurostat (2019); (ONS PRODCOM, 2019; UK Trade Info, 2019)

6.3.3 Assumptions

It is clear to the study team that there is a disconnect between the average values of timber doors in Table 6-4 and the average values of timber fire doors provided by the stakeholders in the workshop, and those available through a search on Google. It seems likely that the values in Table 6-4 are often for the door leaf alone, and not the entire doorset. This does not apply to plastic and steel doors.

Following conversations with stakeholders (a consultant and a quantity surveyor), the average values of timber fire doors were estimated as[14]:

- Certificated fire doorsets: £500 - £1,000;
- Uncertificated fire doorsets: £200 - £500; and
- Uncertificated fire door assemblies: £150 - £200

From these figures, the study team has taken an approximate value for certificated timber fire doors of £500/doorset and £250/doorset for an uncertificated timber fire doorset. One stakeholder, who initially thought the average value of a certificated timber fire door was probably closer to £750/doorset, performed a separate set of calculations based on knowledge of the manufacturers of timber fire doors, using their turnover and his assumptions of the proportion of turnover likely to be for fire doors. These calculations also showed that £500/doorset was a reasonable assumption.

The estimated proportion of fire doors by number in each of the three types is shown in Table 6-5. This was developed following conversations with several stakeholders (trade associations and consultants). In addition, the British Woodworking Federation stated that their members supply approximately 2.5 million timber fire doors through their Fire Door Alliance: the stakeholders in the workshop believed that this probably represented about 50% of the timber fire door market.

Table 6-5 Estimated proportion of fire doors by type

Type	Proportion
Timber	85%
Plastic	10%
Steel/iron	5%

Source: RPA consultation with stakeholders

The stakeholders interviewed agreed that approximately a further 30% of timber fire door market would be certified under other schemes such as ASDMA, WarringtonFire or BM

[14] Note that the same fire door will cost much more if bought singly or in small quantities than if bought in large quantities.

Trada. This leaves approximately 20% of the fire door market uncertified: these fire doors are fire door assemblies of components, which might have been individually tested but have not been tested as a system and therefore cannot be certified.

If a fire door is bought as set of components that a manufacturer has specified, tested, and certified as a system, this is a fire doorset, see section 6.1.1.

The cost of a steel fire door is assumed to be the same as a steel door.

Stakeholders representing fire door manufacturers indicated that a rule of thumb for the cost of ironmongery was 20% of the cost of the door: although this may seem high, the stakeholders' debate was generally about whether this assumption was high enough rather than too high.

6.3.4 Size of the market and characteristics – glass

In contrast to the fragmented nature of the market for timber, plastic and steel doors, there are only a handful of manufacturers making glass fire doors. The glass used does not fit neatly into any of the flat glass SIC codes and there are several different methods used to make fire-resistant glass. Therefore, a different approach is used. A detailed conversation with a consultant specialising in fire doors and glass enabled the study team to develop the following estimates:

- There are likely to be approximately 8,500 glass fire doors installed annually: this does not include the glass screens that commonly surrounds the glass fire doors.
- The estimated value of the fire-resistant glass doors is approximately £7 million per year;
- The estimated value-added multiplier for the manufacturer framing the glass to delivery on site, but not including installation, is a factor of ten;
- The estimated value of the fire-resistant fire doors is approximately £70 million per year.

The study team has a medium level of confidence in these figures and believes that the order of magnitude is probably correct.

6.3.5 Size of the market and characteristics – all types

Using the assumptions in section 6.3.3 and the values for timber, plastic and steel in section 6.3.2 and the values for glass in section 6.3.4, the market size is calculated for timber, plastic, and steel fire doors in Table 6-6 and summarised for all fire doors in Table 6-7. The total market value for fire doors is estimated at £2.7 billion and the study team believe that there is a medium level of certainty that the value is in the region of £2.5–3 billion, representing approximately 5-6 million fire doors.

Table 6-6 Estimate of the UK annual market value for timber, plastic, and steel fire doors

Item	Amount
Number of fire doors (timber, plastic and steel)	
Number of timber fire doors manufactured and certified by BWF members per year	2,500,000
% of all timber fire doors made by BWF members (assumption)	50%
Implied total number of timber fire doors manufactured per year	5,000,000

Item	Amount
Assumed % of all fire doors that are timber	85%
Estimated total number of fire doors	*5,882,353*
Timber	
Approximate value for certificated timber fire doorset	£500
Approximate value for uncertificated timber fire doorset	£250
Assumed % of all fire doors that are uncertificated	20%
Estimated number of uncertificated timber fire doors manufacturer per year	1,000,000
Estimated number of certificated timber fire doors manufacturer per year	4,000,000
Estimated market value of the timber fire doors	*£2,250 million*
Plastic	
Assumed % of all fire doors that are plastic doors	10%
Estimated number of plastic doors	588,235
Assumed % of plastic doors that are fire doors	5%
Estimated market value of plastic fire door market	*£112 million*
Steel	
Assumed % of all fire doors that are steel doors	5%
Estimated number of steel doors	294,118
Assumed % of steel doors that are fire doors	46%
Estimated market value of steel fire door market	*£215 million*
Estimated annual market value of timber, plastic and steel fire doors	***£2,578 million***
Estimated number of timber and steel fire doors used in the UK per year	***5,882,353***

Sources: RPA analysis

Table 6-7 Estimate of the UK annual market value for all fire doors and associated ironmongery

Item	Value	Volume	£/doorset
Timber fire doors	£2,250 million	5,000,000	£375
Plastic fire doors	£113 million	588,235	£191
Steel fire doors	£215 million	294,118	£731
Total excluding glass fire doors	*£2,578 million*	*5,882,353*	-
Glass	£35 million	8,500	£4,118

Item	Value	Volume	£/doorset
Total including glass fire doors	*£2,613 million*	*5,890,853*	-
Assumed cost of ironmongery as % of the value of the doors	20%	-	-
Cost of ironmongery	£522 million	-	-
Total estimated cost of fire doors including ironmongery	***£3,135 million***	**-**	**-**

Sources: RPA analysis

6.3.6 Market distribution – company size

Data about the size of companies is only available to the level of 3 digit SIC codes, using BEIS data published in October 2021, which for the two 6 digit SIC codes described above are:

16.2 Manufacture of products of wood, cork, straw and plaiting materials

22.2 Plastic doors, windows and their frames and thresholds for doors

25.1 Manufacture of structural metal products

The distribution of companies making doors (at the 6 digit SIC level) is likely to be similar to the distribution of companies at the 3 digit SIC level above. The distribution based on numbers of companies is shown in Table 6-8: the distribution based on turnover of companies is shown in Table 6-9.

BEIS data was published in October 2021 and reports estimates for 2021, whereas the Annual Business Survey reports data from 2019.

Table 6-8 Size distribution of firms manufacturing timber, plastics and steel doors based on number of enterprises by SIC code

	Number of enterprises			
SIC code	**Micro**	**Small**	**Medium**	**Large**
162 Manufacture of products of wood, cork, straw and plaiting materials	79.70%	17.20%	2.80%	0.30%
222 Manufacture of plastics products	51.90%	32.80%	13.30%	2.00%
251 Manufacture of structural metal products	56.60%	34.70%	8.00%	0.70%

Source: Eurostat (2018)

Table 6-9 Size distribution of firms manufacturing timber, plastics and steel doors based on turnover by SIC code

	Turnover			
SIC code	**Micro**	**Small**	**Medium**	**Large**
162 Manufacture of products of wood, cork, straw and plaiting materials	N/A	26.40%	N/A	27.00%
222 Manufacture of plastics products	5.20%	N/A	N/A	40.00%
251 Manufacture of structural metal products	9.80%	28.50%	34.70%	27.10%

Source: Eurostat (2018)

Data about the location of companies is only available to the level of 4 digit SIC codes, using data from the ONS UK business: activity, size and location – 2019, which for the two 6 digit SIC codes described above are:

16.23 Manufacture of other builders' carpentry and joinery

22.23 Plastic doors, windows and their frames and thresholds for doors

25.12 Manufacture of doors and windows of metal

The distribution of companies making doors (at the 6 digit SIC level) is likely to be similar to the distribution of companies at the 4 digit SIC level above and is shown in Table 6-10.

Table 6-10 Regional distribution of firms manufacturing timber, plastics and steel doors

	England	Wales	Scotland	Northern Ireland
162 Manufacture of products of wood, cork, straw and plaiting materials	81%	4%	11%	3%
222 Manufacture of plastics products	85%	7%	4%	4%
251 Manufacture of structural metal products	85%	4%	4%	6%

Source: (ONS ABS, 2019)

6.3.7 Exports versus imports

The exports minus the imports provide the balance of trade. This data is available for timber, plastic, and iron or steel doors and frames. Overall, the UK imports timber doors worth approximately £254 million annually and exports timber doors worth approximately £23 million annually. Annual imports of plastic doors are approximately £89 million and annual exports of plastic doors are approximately £28 million. Annual imports of iron or steel doors are approximately £57 million and annual exports of steel doors are approximately £26 million. Indonesia, South Korea and Germany are the biggest sources of imports of timber, plastic and steel doors respectively. Ireland is the biggest recipient of the UK's exports of all three types of door.

Overall, this leads to an approximate trade balance for all three types of fire door of -£323 million.

It was not feasible to provide the imports, exports, and trade balances for glass fire doors because the appropriate SIC codes cannot be defined, and therefore the imports and exports of glass fire doors cannot be extracted and analysed.

The table in 11.14 summarises the countries with which the UK has a trade deficit or surplus for timber and steel doors, thresholds, and frames.

6.3.8 Summary of the fire doors market analysis

The market data for fire doors is summarised in Table 6-11. These are values based primarily on 2019 values and the values in 2022 are likely to be approximately a third higher, see 2.7.6.

Table 6-11 Summary of the fire door market analysis

Variable	Value
Estimated total annual market value for fire doors, including ironmongery	£2.5-3 billion
Study team's confidence in estimated market value	Medium
Estimated total number of fire doors used per year	5,890,853
Estimated number of enterprises manufacturing fire doors	10,875
Trade balance for timber, plastic and steel doors	-£323 million

Sources: (ONS ABS, 2019; ONS PRODCOM, 2019; UK Trade Info, 2019), RPA consultation

6.4 Major players

The following table provides examples of companies associated with fire door production, at the different levels of the supply chain.

Table 6-12 Major players in the fire door market analysis

Stakeholder type	Examples of companies
Product manufacturers	Pilkington UK Ltd, Pyroguard, Sentry Door, Integrated Doorsets Solutions Ltd, Premdor Crosby Ltd, Masonite, Midland Building Products Ltd, Heron Bros Ltd
Distributors	Fire Glass UK Ltd, Onlinedoorstore, Robert Price BM Ltd, Doorways
Installers/subcontractors	Laing O'Rourke, The Window Company (Contracts) Ltd, Horbury Joinery, Seddon Construction Ltd, Cannon Glass & Glazing Ltd, Optima Contacting Ltd, Westgate Global Ltd, Radii Partitioning Ltd
Certifiers	Warringtonfire, BM Trada, Cromwell Fire, United Kingdom Testing and Certification (UKTC), British Woodworking Federation Fire door alliance
Trade associations	Architectural and Specialist Door Manufacturers Association (ASDMA), British Woodwork Federation (BWF), Door & Hardware Federation (DHF), Guild of Architectural Ironmongery (GAI); Association of Composite Door Manufacturers

Sources: Association member lists

6.4.1 Certifiers

UK legislation (HM Government, 2022) requires manufacturers placing fire doors on the UK market to provide evidence of performance to resist the spread of a fire. There are a number of schemes that provide certification which include self-declaration, certification and third-party certification:

Self-declaration

A manufacturer makes their own claim of compliance by design and testing, declaring performance and safety has been achieved.

Test certification

A manufacturer provides the customer with a certificate detailing that the door has been tested to meet fire safety standards.

Dual certification

A manufacturer ensures it has achieved 'Secured by Design' to cover both fire and security. The manufacturer is required to obtain a third-party certification to indicate it has met standards BS 476:22 and Product Assessment Specification 24 (PAS 24), enhanced security performance requirements for doorsets and windows for external fire doorsets (BSI, no date).

6.5 Supply chain mapping

6.5.1 Supply chain mapping – Fire door doorsets

Workshop participants highlighted that fire door maintenance is a challenge. If a fire door has a faulty part, is it necessary to replace the whole fire door or just the part? The replacement process often depends upon the relationship with the manufacturer. A similar question arises if the manufacturer is no longer making the part. Does the whole door need replacing, or can the broken part be replaced by one from a different manufacturer? (see also Case study 5 in section 6.5.5) These are important considerations, since regulations can have an impact on the ongoing cost of maintaining functioning fire doors for public sector stakeholders e.g., hospitals or school.

Workshop participants also highlighted the challenge related to the process of recycling fire doors (meaning using the same product in the same form but in a different context/place), e.g., how prevalent this practice might be, whether it is allowed, how to certify this process?

In an interview, a contractor indicated that there are two ways of purchasing fire doors. The first way is from a door manufacturer that produces a doorset, which is the safest way of achieving a fire-resistant doorset. This mainly happens for purchases of 25-50 fire doors. However, if fewer than 25-50 similar fire doors are required, then the likelihood is that a contractor will purchase bespoke fire doors. The problem within the industry is that a buyer of a lower number of doors will purchase the door leaf/frame and ironmongery all separately and construct it onsite. This may lead to not having a fire test certificate that covers all components on site. The interviewee further highlights that fire-resistant foam or pads are often used to fill the gaps between door interfaces and the building itself, this is due to construction dimensional tolerances. Often the use of the fire pads and foams to fill the gaps have not been part of a test.

6.5.2 Ironmongery

Ironmongery includes handles, hinges and door closers.

In an interview, a trade association highlighted that an architect would speak to the ironmonger to get the specification, then it is up to the contractor or sub-contractor to place the order and take responsibility for delivering the specification. (However, it has subsequently been pointed out that depending upon the contract, completeness of specification and procurement pathway, the contractor or subcontractor may change the ironmongery order for a variety of reasons including cost, quality and lead time.) The contractor will ask the ironmonger to provide the related documentation e.g. operation and maintenance manual, declaration of performance, environmental performance declaration, installation information etc. The contractor will then give this information to the client.

Furthermore, it was highlighted that during the tender process there would be a specification of ironmongery, which would be sent through to the survey engineers and architect and put into the tender documents, giving the price and amount. When the tender is won by the main contractor, the contractor then decides what route to take, i.e. fire door set or fire door assembly. As mentioned above, the specification may be sufficiently open that the contractor is able to change the ironmongery.

In terms of checking that the fire door assembly has the right hardware, in the past there used to be a Clerk of Works who would be employed by the client to carry out this check. Now the policing comes from the contractor and building control that will check to sign off on the building upon completion.

The following supply chain maps set out the routes that can be taken by the stakeholders. Descriptions of these routes through the supply chain are provided below.

6.5.3 Supply chain mapping – fire doorset systems

Figure 6-1 shows the supply chain mapping for fire doorsets of timber, plastic, metal and glass. There are many potential variations within this mapping including:

- Raw material companies are often combined with processing and refining.
- Raw material companies may also be the product manufacturer
- There could be many tiers of component manufacturers.
- The product manufacturer may have additional tiers for research and development, testing and accreditation to enable customised or bespoke products.
- Product manufacturers may obtain components such as ironmongery or partly prepared door leaves from multiple component manufacturers and create the final doorset.
- Product manufacturers can also be an installer, this is more prevalent for glass and metal door sets.
- Product manufacturers may sell directly to a main contractor, specialist sub-contractor and/or specialist installer.
- An approved licensed processor under the BWF Fire Door Alliance Scheme may obtain components from different component manufacturers which are certificated under the third-party scheme and make changes to the doorset according to the manufacturer's specifications, which is supplied to an installer.
- There are often distributors (wholesalers, retailers and builders' merchants) operating at many stages of the upstream.
- Consumers may purchase a fire door set from fulfilment service providers. This is more prevalent for plastic and timber fire doorsets.
- A main contractor may purchase a fire doorset that will pass to a specialist installer
- There could be many tiers of sub-contractors.
- A specialist sub-contractor under a large contractual package may sub-contract to a specialist installer.

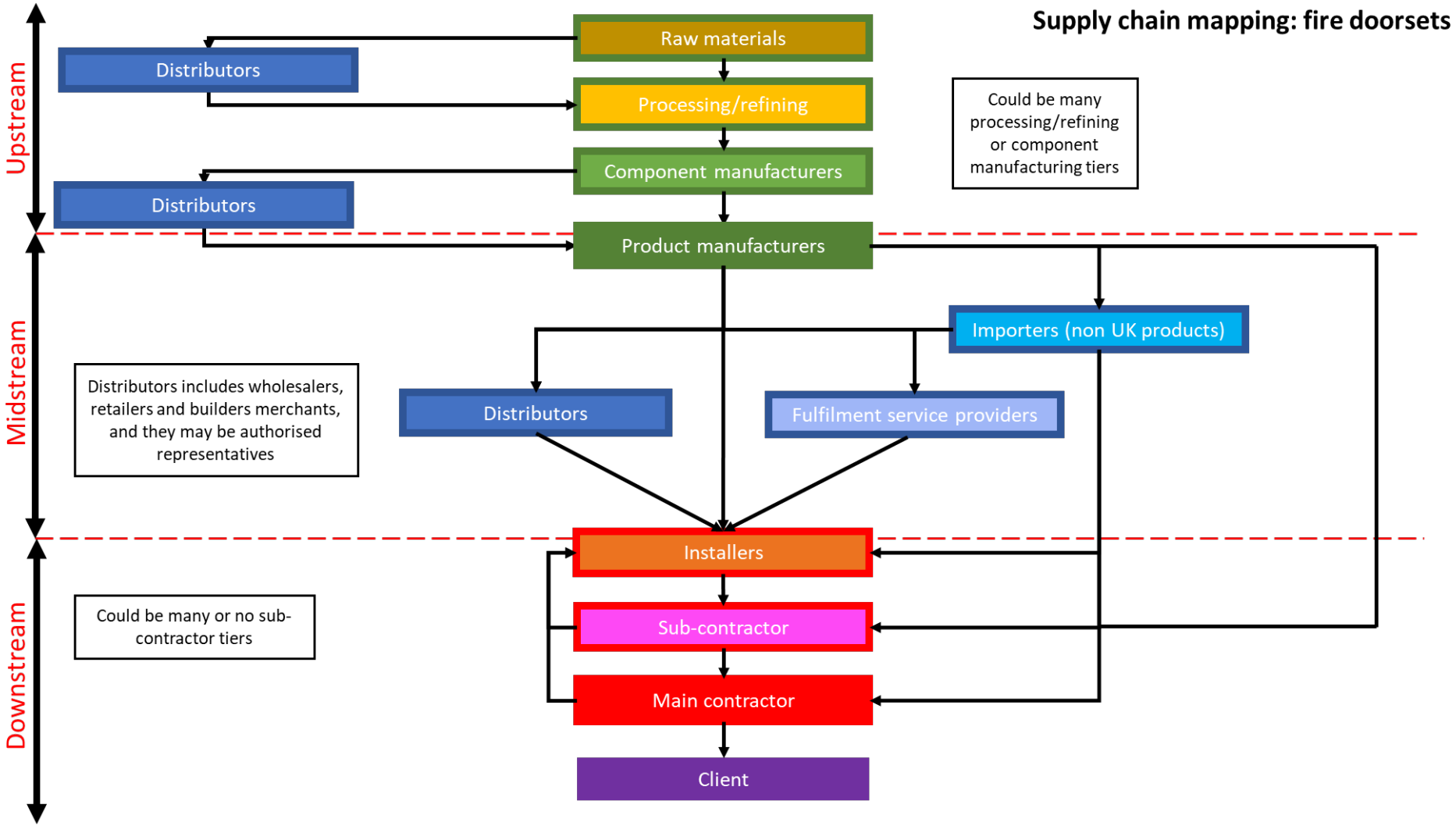

Figure 6-1 Supply chain map fire doorsets – timber, plastic, glass and metal

Source: RPA

6.5.4 Supply chain mapping – fire door assemblies

Figure 6-2 shows the supply chain mapping for fire door assemblies of timber, plastic, metal and glass is supplied. There are many potential variations within this mapping including:

- Raw material companies are often combined with processing and refining.
- There could be many tiers of component manufacturers.
- An installer, subcontractor or main contractor may purchase individual components from various component manufacturers. A door leaf component manufacturer may specify which components meet the requirements of the fire door specification.
- A component manufacturer may supply parts of a fire door such as
    - ironmongery directly to the main contractor, subcontractor, or installer
    - intumescent sealants directly to a distributor who will sell directly to a main contractor, subcontractor or installer.
    - door leaf directly to a main contractor, subcontractor or installer.
- There are often distributors (wholesalers, retailers and builders' merchants) operating at many stages of the upstream.
- A minority of main contractors, subcontractors and installers may purchase a fire door component from a fulfilment service provider.
- A main contractor, subcontractor may purchase fire door components from a distributor that are pass onto a specialist installer. This is more prevalent for larger contractual packages.
- There could be many tiers of sub-contractors.
- A specialist subcontractor under a large contractual package may subcontract to a specialist installer.

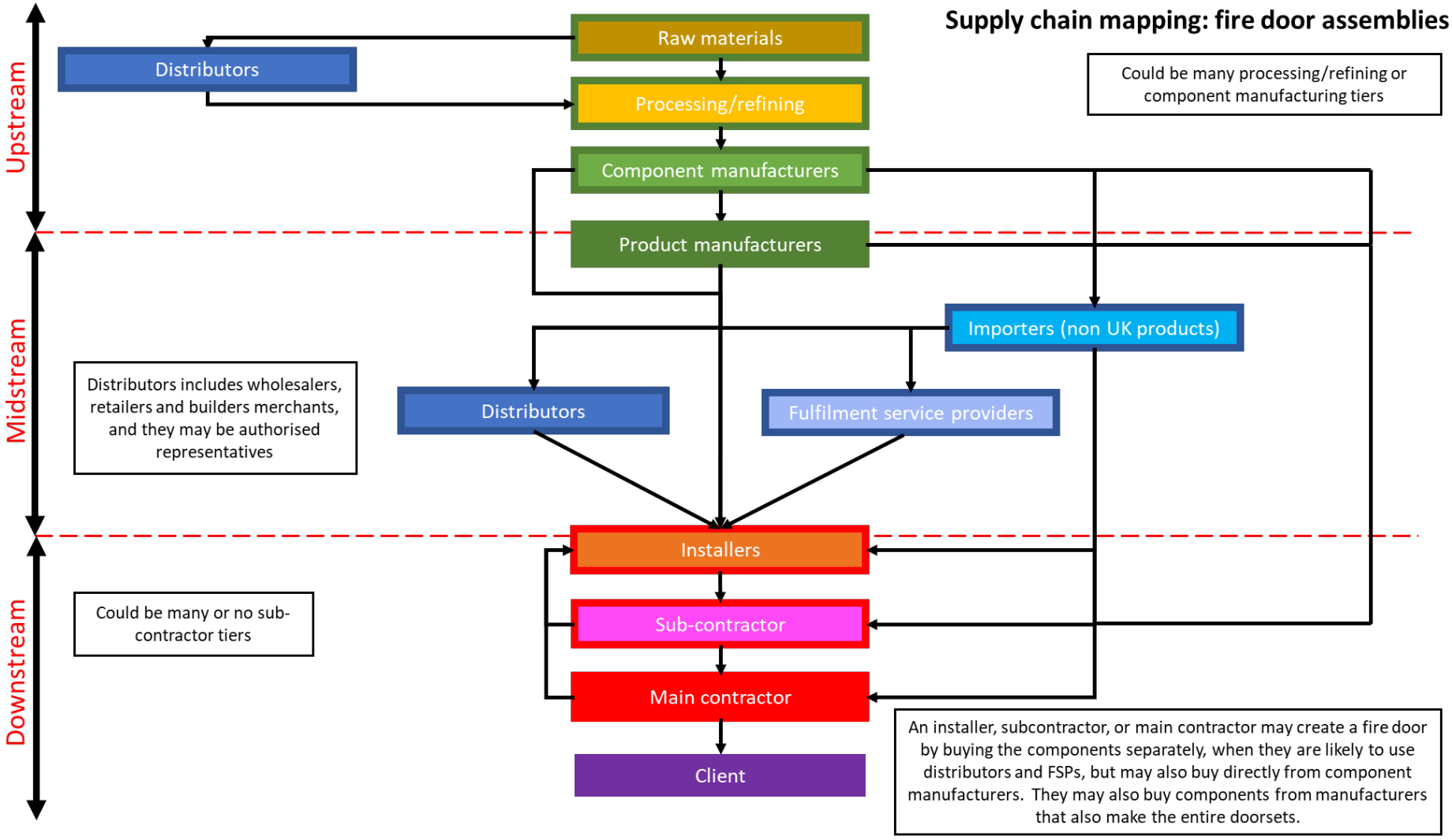

Figure 6-2 Supply chain map for fire door assemblies – timber only

Source: RPA

6.5.5 Information flow – Fire door sets and fire door assemblies

As noted in section 6.1.1, there are two main fire door types (fire doorsets and fire door assemblies). When a doorset is supplied, it may not be supplied complete, it may be missing, e.g., the handles to avoid them being damaged during the remainder of the build, with these installed later by the main contractor. This distinction does not affect the supply chain.

Table 6-13 and Table 6-14 set out the types of information that is passed through the supply chain for fire doorsets and fire door assemblies. Descriptions of these flows through the supply chain are given in section 2.9.1.

Case study 7: Remaining challenges in standards' development and implementation in newbuilds, and maintenance and refurbishment of existing buildings

As presented across sections 7 to 10, there is a wide range of standards and regulations covering construction products. An introduction of the BIM models for new buildings is another step in the direction of ensuring products' safety and an efficient flow of information across the construction project lifecycle (see section 2.5). However, aspects related to the maintenance, servicing and repairs of buildings are not currently covered by industry standards, and this lack of standards and regulations can create some challenges.

The **Building Information Modelling** (BIM) is a process which generates and manages the digital representation of a new building. The BIM model represents the physical and functional characteristics of the building before it is constructed. It supports the construction work across the life cycle, from planning and design to construction and operation (UK BIM Framework, no date). For instance, rather than drawings, manufacturers provide designers with active data to use in design drawings containing all the construction data needed to replace, operate, and maintain the building.

The UK Government's BIM strategy stated that from 2016 all construction projects have to comply with the Level 2 BIM requirements (NBS BIM Toolkit, no date). However, according to some interviewees, the BIM model has not yet been widely adopted by the industry. According to one interviewee, this is due to BIM models providing too much information and because many professionals across the construction life cycle do not know how to use this information. The same interviewee noted that contractors find working with BIM models difficult and time-consuming, particularly at early contract award stage, and may tend to persuade the main client to drop BIM model adoption.

As pointed out by another interviewee, **many construction products are often co-branded** (products are branded with both the manufacturer and distributors' name) and re-branded (the product is sold as a white-label product, which other manufacturers put their own name on). This raises questions about **how the unique identifier codes may work when products are frequently co- and re-branded.**

According to consulted stakeholders, the lack of industry-wide standards for maintenance, servicing and refurbishment of existing

buildings creates a regulatory void[15] for existing building stock. Manufacturers' product information may be available and used to inform maintenance and refurbishment decisions. In addition, a document known as SFG20 (BESA, 2020) created by the Building Engineering Services Association (BESA) provides a specification for building services' maintenance, and it could be used to give a direction to those with responsibilities for building stock upkeep. According to some interviewees, the approach to building maintenance and refurbishment often depends on the size of projects. For instance, a facility manager of a large building may decide whether to use a specialist contractor (e.g., firestopping contractor) whereas the general manager of a smaller building may use a 'jobbing' builder.

During the workshop dedicated to fire doors, participants highlighted other complexities related to products' maintenance. For instance, questions arise **when a particular part of a fire door becomes faulty. The decision of whether it is necessary to replace the whole door or just the faulty part** often depends upon the relationship with the manufacturer, and the possible options when the manufacturer is no longer making the part (see also section 6.5.1). Workshop participants also highlighted the **challenge of recycling fire doors** (meaning using the same product in the same form or refurbished but in a different context/place). The stakeholders did not know how prevalent this practice might be, whether it is allowed, or how to certify this process, but believed that that it would be increasingly considered. All these aspects are relevant and important considerations since regulations can have an impact on the ongoing cost for public-sector stakeholders such as hospitals or schools. The operation and maintenance manual could cover the need to consider how to maintain the integrity of fire doors; this could include providing the BIM.

For the list of all case studies, see section 2.4.4.

In an interview, a trade association indicated that traditionally an architect would choose the fire door and hardware which would only come together when it arrives on site. However, the interviewee said that as design and build has become more common in the UK, in some cases cost has become more important than specification and design.

In an interview, a trade association explained that for bespoke and specialist doors, no manufacturing is undertaken until the specification has been finalised, including drawings, guidance on assembly and handling, a list of components by name and references to test evidence. The trade association said that it can take more than one year to obtain the required fire testing for specialist doors. For bespoke doors it may be more, up to 18 months for a test programme to be completed and it can take six months for the test report. This time period is due to the limited capacity for fire testing rather than the length of the testing itself.

One stakeholder said that off-the-shelf products generally have typically poor information flow.

[15] According to some consulted stakeholders, regulations and standards related to maintenance, servicing and refurbishment of existing buildings would ensure quality and safety of repairs. However, it has to be noted that this aspect was not discussed in detail.

In general, fire doors are highly specialised products requiring specific technical information. However, the level of technical knowledge is generally quite poor, and this is further exacerbated by the poor flow of information between manufacturers and installers. Multiple meanings for key terms like ‘fire doors’ could further exacerbate the situation.

Traceable labels with a unique ID may be present on a timber doorset that have undergone third-party certification such as BWF Fire Door Alliance or BM TRADA for Q-MARK. The unique ID on the product gives online access to information that is linked to test reports for manufacturers, door processors, installers, inspectors, and client to check on the history and correct use of the door.

Table 6-13 Information flows between tiers in the fire doorset supply chain

Information flow type	**From**	Raw	CompM	ProdM	ProdM	FSP	DistP	Inst	SubC	MainC
	To	CompM	ProdM	LP	DistP	Inst	Inst	SubC	MainC	Client
Building Information Modelling (BIM)			√	√	√					
Brochure/leaflet		√	√	√			√	√	√	√
BSI Kitemark (on product and/or packaging)			√	√	√	√	√	√	√	√
Company datasheet					√	√				
COSHH		√						√	√	√
Declaration of performance (DOP)					√	√				
Info on packaging			√	√	√	√	√	√		
Info on product			√	√	√	√	√	√	√	√
Installation guide						√				
Manufacturer's logo			√	√	√		√	√	√	
Manufacturer's training*			√	√			√	√		
Operation & maintenance manual										√
QR/bar code										
Safety data sheets		√	√	√		√	√	√	√	√
Technical info			√	√			√	√	√	√
Third party certification (voluntary)			√	√	√		√			
UKCA/CE mark on product and/or packaging (external fire doors)			√		√		√	√	√	
Unique ID on product (timber only)					√	√	√	√	√	√
Warranty										

Source: RPA

*Note: * Media for information is via paper/online, or on products or packaging, where indicated*
A tick means this is believed to exist: No tick could mean that it does not exist, sometimes exists or it was not found. Not all options were covered in surveys and interviews

Key to tiers:												
Raw	Proc	CompM	DistRM	LP	ProdM	DistP	FSP	Inst	SubC	MainC	Client	Cons
Raw materials	Processing / refining	Component manufacturer	Distributor of raw materials	Licensed processor	Product manufacturer	Distributor	Fulfilment service provider	Installer	Sub-contractor	Main contractor	Client	Consumer

Table 6-14 Information flows between tiers in the fire assembly supply chain

Information flow type	From	Raw	CompM	FSP	DistP	Inst	SubC	MainC
	To	CompM	DistRM	Inst	Inst	SubC	MainC	Client
Building Information Modelling (BIM)			√					
Brochure/leaflet		√	√		√	√	√	√
BSI Kitemark (on product and/or packaging)			√	√	√	√	√	√
Company datasheet			√	√				
COSHH		√				√	√	√
Declaration of performance (DOP)								
Info on packaging			√	√	√	√		
Info on product			√	√	√	√	√	√
Installation guide				√				
Manufacturer's logo			√		√	√	√	
Manufacturer's training*					√	√		
Operation & maintenance manual								√
QR/bar code								
Safety data sheets		√	√	√	√	√	√	√
Technical info			√		√	√	√	√
Third party certification (voluntary)			√		√			
UKCA/CE mark on product and/or packaging (external fire doors)								
Unique ID on product (timber only)				√	√	√	√	√
Warranty								

Source: RPA

*Note: * Media for information is via paper/online, or on products or packaging, where indicated*
A tick means this is believed to exist: No tick could mean that it does not exist, sometimes exists or it was not found. Not all options were covered in surveys and interviews

Key to tiers:											
Raw	Proc	CompM	DistRM	ProdM	DistP	FSP	Inst	SubC	MainC	Client	Cons
Raw materials	Processing/ refining	Component manufacturer	Distributor of raw materials	Product manufacturer	Distributor	Fulfilment service provider	Installer	Sub-contractor	Main contractor	Client	Consumer

7 Insulation

7.1 Definitions

The term ‘insulation’ is broad. The verb ‘to insulate’ refers to ‘the process of reducing the rate of heat transfer, sound transmission or the flow of electric current’ (Gorse, 2012). As such, the term ‘insulation’ defines the property of a material and therefore ‘insulation product’ can be any product that changes the thermal, acoustic or electrical properties of the buildings.

The study focuses on thermal insulation only with product types being defined by raw/primary materials rather than properties or qualities of materials. Thermal insulation is defined as:

- A material that has a low thermal conductivity, thus reducing the amount of heat that will flow through it; and
- The process of applying insulation material to a building to reduce its heat loss (Gorse, 2012).

As agreed with the client, the study focuses only on the physical products and does not cover the process of applying insulation material.

In construction, thermal insulation is considered a specific dedicated proprietary product that is included within the construction fabric to improve thermal resistance, normally to reduce heat loss or heat gain. Insulation can also be applied to engineering services, such as pipes and ducts used to distribute hot or cold water or another medium for the purpose of public health, heating, cooling, ventilation or comfort. When used in engineering services, insulation can protect from freezing or condensation. The study considers both insulation for the fabric of the building and for engineering services.

Most insulation products are covered by designated standards under the Construction Products Regulation, as well as voluntary British Standards to calculate the performance of the insulation properties themselves or other performance ratings, such as fire resistance. The latter typically requires laboratory testing to prove fire resistance.

There is also a focus upon the environmental impact of insulation products. Most products are formed from mineral wool or oil-based polymers. There is a growing industry of alternative materials used for insulation, such as hempcrete or compressed straw.

There are many insulation products, including unbranded products and accessory products such as small pads of insulation that are dedicated to cover small parts of construction, such as insulated wall ties, insulation pads or casings that cover a specific valve.

7.1.1 Insulation product types

The following subsections provide descriptions of the most common types of insulation product available on the UK market. The most common types of insulation product found in the UK are as follows:

- Insulation blankets (rolls and batts),
- Rigid insulation boards,
- Blown-in/loose fill insulation,
- Insulation beads,

- Spray foam insulation,
- Foil-based insulation,
- Insulation for building services/engineering,
- Structural insulated panels (SIPs).

Subsequent sections provide more detail on these insulation products.

7.1.1.1 Insulation blankets (rolls and batts)

Blanket insulation can take the form of a roll or a batt. A batt is a piece of insulation material that has been pre-cut allowing for more efficient installation. Rolls can be used for longer sections or areas of a unique size.

An image of an insulation batt is available on Insulation Superstore website (Insulation Superstore, no date). An image of an insulation roll is provided in the following figure.

Figure 1-2 Insulation roll
Figure 7-1 Source: (Unifrax, no date) CC BY 3.0 (picture resized)

A variety of materials can be used to manufacture insulation blankets, these are summarised in the table below.

Table 7-1 Materials used to manufacture insulation blankets

Insulation blanket material	Description
Mineral wool (also called rock or slag wool insulation)	Mineral wool insulation is made from rock, blast furnace slag, and other raw materials. It is generally more expensive than fiberglass wool (production is more energy intensive) and therefore less frequently used in domestic applications. It is virtually non-combustible because it is made from oxidised

Insulation blanket material	Description
	minerals that cannot burn. These properties make it desirable for commercial buildings and high-temperature applications (e.g. petrochemical industry)
Fiberglass wool	Fiberglass insulation is made from recycled glass fragments and sand. It is mainly used for domestic applications, for walls and lofts. It can also be used in HVAC and pipework, twin-skin profiled steel wall cladding and timber framed buildings.
Natural fibres	Natural fibre insulation is derived from cellulose, cotton, flax, hemp, straw, wood fibre, and wool.

Sources: (ASBP, 2022) and consultation data

7.1.1.2 Rigid insulation boards

Rigid insulation boards take the form of rigid foam boards. They can be used to insulate various parts of a building, including roofs and walls.

A variety of materials can be used to manufacture insulation boards, the insulation board product types and the materials used are summarised in the table below.

Table 7-2 Materials used to manufacture insulation boards

Insulation board material	Description
Polyurethane (PUR)	Can be used as an insulation core in metal composite panels, also in structural insulated panels (SIPs). It is used as rigid foam boards in roofs, partial fill cavity walls and ground floors.
Polyisocyanurate (PIR)	PIR boards are primarily used in walls, roofs and floors. It can also be used on pipework and ductwork.
Expanded polystyrene boards (EPS)	EPS can come in the form of boards or 'blown beads'
Extruded polystyrene boards (XPS)	Same applications as for EPS, but can withstand greater levels of compression
Phenolic boards	Phenolic boards have a high strength to density ratio that makes them ideal for areas where thickness needs to be limited. They also have a high level of heat and fire resistance which make them ideal for pipework insulation. They are also used in building façades.
Cellular glass insulation boards	Cellular glass insulation boards contain recycled glass and sand as base materials.

Figure 7-2 Polyisocyanurate insulation board
Source:(thingermejig, 2008), CC BY-SA 2.0

7.1.1.3 Loose fill/blown-in insulation

Loose fill insulation can be blown into a cavity or applied in lofts and compacted under floors. There are three main types of loose fill insulation:

- Fibreglass loose fill,
- Cellulose loose fill,
- Rock Wool insulation.

The benefit of loose fill insulation is that it can be blown into cavity walls without taking up internal room space, and that it can be used in hard to reach/awkwardly shaped areas of a building.

7.1.1.4 Insulation beads

Insulation beads are typically made from expanded polystyrene (EPS). They are used to insulate cavity walls. To install the beads, a hole is drilled into the wall and the beads are 'blown' into the wall. The benefit of insulation beads is that they are quick to install and can be installed on site with no storage required.

7.1.1.5 Spray foam insulation

Spray foam insulation is generally made from polyurethane (PUR). It can come in two forms: open cell and closed cell spray foam. Closed cell spray foam is rigid once set, while open cell spray foam is less dense; for this reason, closed cell spray foam is considered the better thermal insulator.

One of the benefits of spray foam insulation, is that it does not need to be thick – this allows a loft, for example, to be insulated and still used for storage. PUR spray foam is frequently used for repairs. (Which, 2021).

Figure 7-3: Spray foam insulation
Source: (Fatemeh Atash Jameh, 2020), CC BY -SA 4.0 (picture resized)

7.1.1.6 Foil-based insulation

Foil-based insulation is found in the following forms:

- Rigid polyethylene bubble sheets with a foil layer,
- Flexible polyethylene bubble sheets with one or two foil layers,
- Multifoils.

These products are typically more expensive than other insulation options and not therefore often used on housing developments.

7.1.1.7 Insulation for building services/engineering

Thermal insulation of building services covers the insulation of pipework and ductwork. Any services that operate above or below ambient temperature require thermal insulation. Hot thermal insulation includes building services above ambient temperature such as heating, whereas thermal insulation includes refrigerated water services. Specialist services include temperatures much higher than boiling point such as steam or low cryogenic temperatures. For the products used to insulate pipework and ductwork, the raw material is provided to a main product manufacturer (e.g. Kingspan) who will then make a finished product. This finished product may, however, be further refined by other companies who make variations of the finished product.

Figure 7-4 Insulation around HVAC duct work
Source: (MTA Capital Construction Mega Projects, 2018) CC BY 2.0 (image resized)

7.1.1.8 Structural insulated panels (SIPs)

Structural insulated panels or 'SIPs' consist of an insulated foam core (usually polystyrene board or polyurethane foam), sandwiched between two boards (usually OSB – oriented strand board). The polyurethane foam can be used to make slimmer panels (Homebuilding & Renovating, 2021).

,

Figure 7-5 Structural Insulated Panel with OSB Facings and EPS Core
Source: (StructuralInsulatedPanels, 2005), CC BY-SA 4.0 (image resized)

Summary of materials used in insulation

The table below provides a summary of the insulation product categories and the materials used in these products.

Table 7-3 Summary of the insulation product categories and the materials used in these products

Insulation product type	Materials commonly used	Common uses
Insulation blankets (rolls and batts)	Mineral wool Fibreglass wool Natural fibres such as wood fibre, cellulose, cotton, flax, hemp and sheep's wool	Good for insulating accessible places, e.g. lofts, ceilings, and floors
Rigid insulation boards	Polyurethane (PU/PUR), polyisocyanurate (PIR), expanded polystyrene (EPS), extruded polystyrene (XPS), phenolic, wood fibre	Large areas and cavity walls. Also used for flat roofs and ground floors. Provided in standard sizes and can also be cut to size on-site without compromising their integrity.
Blown-in/loose insulation	Cellulose, fibreglass, mineral wool	Irregularly shaped areas with obstructions. Can be used as a top-up for existing insulation in lofts.
Insulation beads	Expanded polystyrene (EPS)	Predominantly used to insulate cavity walls.
Spray foam insulation	Polyurethane	Irregularly shaped areas with obstructions. Roofs and cavity walls, as well as floors.
Foil-based insulation	Aluminium, polyethylene, polypropylene	Lofts, walls, ceilings, floors, conservatories
Insulation for building services/engineering		Ductwork, pipework
Structural insulation panels	Oriented strand board (OSB), polystyrene board, polyurethane foam, PIR, insulation based on natural fibres	Low-rise social housing and apartments, modular buildings

7.2 Legislation and voluntary initiatives

7.2.1 Legislation

7.2.1.1 UK Building Regulations

The UK Building Regulations were updated in 2018 to ban combustible materials in the external wall of buildings. See Section 4.2.1.1 for further details on the regulation of insultation materials in cladding under the Building Regulations.

The UK Building Regulations also regulate the use of insulation more directly. Part L of Schedule 1 of the UK Building Regulations states that:

> Reasonable provision shall be made for the conservation of fuel and power in buildings by–
>
> (a) Limiting heat gains and losses–
>
> i. Through thermal elements and other parts of the building fabric; and
>
> ii. From pipes, ducts and vessels used for space heating, space cooling and hot water services;
>
> (b) Providing fixed building services which–
>
> i. Are energy efficient;
>
> ii. Have efficient controls; and
>
> iii. Are commissioned by testing and adjusting as necessary to ensure they use no more fuel and power than is reasonable in the circumstances.

7.2.1.2 U-values

Part L of the Building Regulations for England and Wales (Conservation of fuel and power) and Section Six (energy) of the Scottish Standards set the levels of thermal insulation required when carrying out building work; these are expressed as 'U-values'.

A U-value is defined as a 'measure of the ability of a building element or component to conduct heat from a warmer environment to a cooler environment. It is expressed as the quantity of heat (in watts) that will flow through $1m^2$ of area divided by the difference in temperature (degrees Kelvin) between the internal and external environment. The unit is $W/(m^2K)$. The higher the value of $W/(m^2K)$, the greater the heat-loss and the less energy efficient the building.'(*The Building Regulations 2010*, 2010)

Insulation products with a specific dimension (usually their thickness) are sold with a thermal resistance value, known as an R-Value, expressed in units of m^2K/W.

Where the thickness of an insulation product is not known, the material typically has a thermal conductivity, known in the UK as lambda (λ) value, expressed as W/mK.

Building designers calculate the U-Value of a building based on the combination of thermal performances of each part of a building fabric, eg. bricks, insulation, and internal blocks and plaster finish etc.

Building engineering services, such as pipes and ducts have varying insulation layers to prevent heat loss, heat gain or condensation. The requirements for these are generally defined within specific British Standards.

7.2.1.3 UK Construction Products Regulations

For an introduction to the UK's Construction Products Regulation (CPR), see Section 11.1.2. A summary of the designated standards relevant to insulation products under the UK's CPR is provided in the subsection below.

7.2.2 Designated standards under the CPR

The table below summarises the designated standards relevant to insulation. Some of the standards designate the use (e.g. for building equipment and industrial installations) and some also the area of use (e.g. in a wall).

Table 7-4 Designated standards relevant to insulation

Reference number of the designated standard	Title of the designated standard
EN 13162:2012+A1:2015	Thermal insulation products for buildings — Factory made mineral wool (MW) products — Specification
EN 13163:2012+A1:2015	Thermal insulation products for buildings — Factory made expanded polystyrene (EPS) products — Specification
EN 13164:2012+A1:2015	Thermal insulation products for buildings — Factory made extruded polystyrene foam (XPS) products — Specification
EN 13165:2012+A2:2016	Thermal insulation products for buildings — Factory made rigid polyurethane foam (PU) products — Specification
EN 13166:2012+A2:2016	Thermal insulation products for buildings — Factory made phenolic foam (PF) products — Specification
EN 13167:2012+A1:2015	Thermal insulation products for buildings — Factory made cellular glass (CG) products — Specification
EN 13168:2012+A1:2015	Thermal insulation products for buildings — Factory made wood wool (WW) products — Specification
EN 13169:2012+A1:2015	Thermal insulation products for buildings — Factory made expanded perlite board (EPB) products — Specification
EN 13170:2012+A1:2015	Thermal insulation products for buildings — Factory made products of expanded cork (ICB) — Specification
EN 13171:2012+A1:2015	Thermal insulation products for buildings — Factory made wood fibre (WF) products — Specification
EN 14063-1:2004	Thermal insulation products for buildings — In-situ formed expanded clay lightweight aggregate products — Part 1: Specification for the loose-fill products before installation
EN 14063-1:2004/AC:2006	Thermal insulation products for buildings — In- situ formed expanded clay lightweight aggregate products — Part 1: Specification for the loose-fill products before installation
EN 14064-1:2010	Thermal insulation products for building equipment and industrial installations — Factory made mineral wool (MW) products — Specification

Reference number of the designated standard	Title of the designated standard
EN 14303:2009+A1:2013	Thermal insulation products for building equipment and industrial installations — Factory made mineral wool (MW) products — Specification
EN 14304:2009+A1:2013	Thermal insulation products for building equipment and industrial installations — Factory made flexible elastomeric foam (FEF) products — Specification
EN 14305:2009+A1:2013	Thermal insulation products for building equipment and industrial installations — Factory made cellular glass (CG) products — Specification
EN 14306:2009+A1:2013	Thermal insulation products for building equipment and industrial installations — Factory made calcium silicate (CS) products — Specification
EN 14307:2009+A1:2013	Thermal insulation products for building equipment and industrial installations — Factory made extruded polystyrene foam (XPS) products — Specification
EN 14308:2009+A1:2013	Thermal insulation products for building equipment and industrial installations — Factory made rigid polyurethane foam (PUR) and polyisocyanurate foam (PIR) products — Specification
EN 14309:2009+A1:2013	Thermal insulation products for building equipment and industrial installations — Factory made products of expanded polystyrene (EPS) — Specification
EN 14313:2009+A1:2013	Thermal insulation products for building equipment and industrial installations — Factory made polyethylene foam (PEF) products — Specification
EN 14314:2009+A1:2013	Thermal insulation products for building equipment and industrial installations — Factory made phenolic foam (PF) products — Specification
EN 14315-1:2013	Thermal insulating products for buildings — In- situ formed sprayed rigid polyurethane (PUR) and polyisocyanurate (PIR) foam products — Part 1: Specification for the rigid foam spray system before installation
EN 14316-1:2004	Thermal insulation products for buildings — In- situ thermal insulation formed from expanded perlite (EP) products — Part 1: Specification for bonded and loose-fill products before installation
EN 14317-1:2004	Thermal insulation products for buildings — In- situ thermal insulation formed from exfoliated vermiculite (EV) products — Part 1: Specification for bonded and loose-fill products before installation

Reference number of the designated standard	Title of the designated standard
EN 14318-1:2013	Thermal insulating products for buildings — In- situ formed dispensed rigid polyurethane (PUR) and polyisocyanurate (PIR) foam products — Part 1: Specification for the rigid foam dispensed system before installation
EN 14319-1:2013	Thermal insulating products for building equipment and industrial installations — In-situ formed sprayed rigid polyurethane (PUR) and polyisocyanurate foam (PIR) products — Part 1: Specification for the rigid foam spray system before installation
EN 14320-1:2013	Thermal insulating products for building equipment and industrial installations — In-situ formed dispensed rigid polyurethane (PUR) and polyisocyanurate foam (PIR) products — Part 1: Specification for the rigid foam spray system before installation
EN 14933:2007	Thermal insulation and light weight fill products for civil engineering applications — Factory made products of expanded polystyrene (EPS) — Specification
EN 14934:2007	Thermal insulation and light weight fill products for civil engineering applications — Factory made products of extruded polystyrene foam (XPS) — Specification
EN 15501:2013	Thermal insulation products for building equipment and industrial installations — Factory made expanded perlite (EP) and exfoliated vermiculite (EV) products — Specification
EN 16069:2012+A1:2015	Thermal insulation products for buildings — Factory made products of polyethylene foam (PEF) — Specification

7.2.3 British Standards

For an introduction to British Standards and the BSI Kitemark, see section 11.1.9. The table below lists some of the most common British Standards relevant to insulation.

Table 7-5 British Standards most relevant to insulation

British Standard/specification created by the BSI	Title of the British Standard/specification
BS EN 826	Thermal insulating products for building applications. Determination of compression behaviour
BS 5422:2009	Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40oC to +700oC.

BS EN 13914-1:2005	Design, Preparation and Application of External Rendering
PAS 2035:2019	Retrofitting Dwellings for improved Energy Efficiency – Specification and Guidance

PAS 2035:2019 Retrofitting Dwellings for improved Energy Efficiency – Specification and Guidance

PAS 2035:2019, a publicly available specification (PAS) was published and designed by the British Standards Institution (BSI) and sponsored by BEIS. This document acts as a guide for applying measures to improve the energy efficiency of existing buildings.

When granted PAS 2035:2019 certification, installers can apply the TrustMark.

7.2.4 Voluntary initiatives

7.2.4.1 Independent third-party approvals

The British Board of Agrément (BBA) provides a voluntary third-party certification for insulation products. The aim of the certification is to confirm that the manufacturer's claims have been independently tested and verified.

7.3 UK Market size

7.3.1 Product types and their SIC codes

Data are not provided on the end use of the insulation products, although some materials are almost exclusively used in insulation. Insulation materials may be used in cladding systems and fire barriers, as well as insulation for non-construction uses, including automotive and ships. Estimates exclude the materials that do not go into insulation products. The classifications in this section do not follow the exact format of the product types within the definitions, as it is not possible to segregate the data to this format.

The figures provided in this section are based upon desk research and were discussed with the stakeholders. However, these figures still present a high degree of uncertainty. The study team are fairly confident that the figures provided are of the right order of magnitude, however, the team are aware that there are variables that may greatly influence the value of the market that have not been taken into account.

Table 7-6 summarises the SIC codes identified for manufacture of insulation products.

Table 7-6 SIC codes identified for insulation

Code	Description
23990	Manufacture of other non-metallic mineral products n.e.c.
23140	Manufacture of glass fibres
20160	Manufacture of plastics in primary forms
22190	Manufacture of other rubber products
22210	Manufacture of plastic plates, sheets, tubes and profiles

Table 7-7 summarises the PRODCOM codes identified.

Table 7-7 PRODCOM codes identified for insulation

Code	Description
23991910	Slag wool, rock wool and similar mineral wools (EXCLUDING: - Glass wool) and mixtures thereof in bulk, sheets or rolls INCLUDING: - intermixtures - ceramic fibres
23991930	Mixtures and articles of heat insulating, sound insulating or sound absorbing mineral materials EXCLUDING: - slag wool, rock wool and similar mineral wools and intermixtures; exfoliated vermiculite, expanded clays, foamed slag and similar expanded mineral materials and intermixtures - articles of asbestos-cement, of cellulose fibre-cement or the like - ceramic products
23991920	Exfoliated vermiculite, expanded clays, foamed slag and similar expanded mineral materials and mixtures thereof
23141297	Glass fibres and articles thereof INCLUDING: - glass wool EXCLUDING: - staple fibres, rovings, yarn, chopped strands, woven fabrics - voiles, webs, mats, mattresses, boards and similar non-woven products - stone or slag wool and articles thereof - electrical insulators and parts thereof - optical fibres, fibre bundles or cables, brushes of glass fibres*
22197310	Vulcanized cellular rubber articles
22214150	Plates, sheets, film, foil and strip of cellular polyurethanes
22214180	Plates, sheets, film, foil and strip of cellular plastics EXCLUDING: - of polymers of styrene - of polymers of vinyl chloride - of polyurethanes - of regenerated cellulose
20165670	Polyurethanes, in primary form

7.3.2 Size of the market and characteristics

The number of enterprises has been collected through the ONS Annual Business survey (ONS ABS, 2019). Classifications such as “Manufacture of other non-metallic mineral products n.e.c.” and “Manufacture of glass fibres” are likely to include more insulation uses than “Manufacture of plastics in primary forms”. Table 7-8 summarises the number of enterprises in each classification relevant to insulation and the turnover for these firms, with a column summarising the insulation materials relevant to each classification. In total, 1,555 companies operate in classifications relevant to insulation and £14,162 million of turnover was generated in 2019 by companies in sectors relevant to the manufacture of insulation. The table also shows the total 2019 production data of the insulation materials.

These figures are an overestimation of the number of enterprises and turnover of the insulation market, however lack of data indicating the proportion of activity in these sectors that relates to insulation, prevents more accurate estimation.

Table 7-8 Number of enterprises and turnover in insulation manufacture

Classification		Product type	Enterprises UK 2019	Turnover UK 2019
23.99 - Manufacture of other non-metallic mineral products n.e.c.		Mineral wool	172	£1,190 million
	23991910 – Slag wool, rock wool and similar mineral wools		£326 million	
	23991930 - Mixtures and articles of heat insulating, sound insulating or sound absorbing mineral materials		£225 million	
	23991920 - Exfoliated vermiculite, expanded clays, foamed slag and similar expanded mineral materials and mixtures thereof		£12 million	
23.14 - Manufacture of glass fibres		Glass wool	38	£474 million
	23141297 - Glass fibres and articles thereof		£293 million	
20.16 - Manufacture of plastics in primary forms		Spray polyurethane foam	370	£5,271 million
	20165670 - Polyurethanes, in primary forms		£386 million	
22.19 - Manufacture of other rubber products		Nitrile rubber	521	£1,970 million
	22197310 - Vulcanized cellular rubber articles		£20 million	
22.21 - Manufacture of plastic plates, sheets, tubes and profiles		PUR, PIR and phenolic foam boards	454	£5,257 million
	22214150 - Plates, sheets, film, foil and strip of cellular polyurethanes		£541 million	
	22214180 - Plates, sheets, film, foil and strip of cellular plastics		£183 million	
Total			**1,555**	**£14,162 million**

Sources: (ONS ABS, 2019; ONS PRODCOM, 2019)

7.3.3 Market segmented by product type

Table 7-9 shows the market size for each insulation material. As previously stated, the market size is a calculation of production, plus imports, minus exports, to demonstrate the actual requirement for insulation products within the UK. Values for UK production, imports, exports and total market size are unadjusted values from ONS and UK Trade Info, estimated market size presents the total market size adjusted based on the assumptions. For insulation, the assumption is based on the scope of the classification as some classifications are less granular than others. For example, the classification for slag and rock wool (80%) is more relevant to insulation than polyurethanes in primary forms, used for spray polyurethane foam (10% assumption). Note, that these figures have been

presented to trade associations during consultation, however confidence for all estimates remains low. Overall, the UK insulation market is estimated at £970 million, with a quantity of 680 million kg.

Natural fibre is not included in those calculations as data are not available. Consultation with trade associations suggests that the value of the natural fibre market is currently less than 0.1% of the market. Additionally, these values are for insulating materials, not necessarily the finalised insulation product.

During the workshop, industry associations agreed that the value for the insulation market is likely to be between £1 billion and £4 billion. This includes the added value factor of sales as an insulation product, as well as other more niche insulation products of which the study team is probably still unaware. Additionally, PUR/PIR insulation accounts for 40% of the total market size of finished insulation products according to information from trade associations gathered during the workshop.

Turnover of Kingspan Group Limited[16], one of the largest insulation manufacturers, was around €6.5 billion (£5.5 billion) in 2021, whilst only 20% of sales can be attributed to insulation, this equates to £1.1 billion (note that this includes manufacturing in countries outside of the UK and is an estimate). This does however support that the £1 billion is a lower bound, and that £4 billion is a likely upper bound. The figures presented here are probably lower than the value of the actual market for insulation products and should therefore be taken as a lower bound.

The total market value for insulation is estimated at £1 billion, but the study team believe this is likely to be an underestimate and believes that there is a medium level of confidence that the value is in the region of £1 – 4 billion.

Table 7-9 Total estimated annual market size of insulation products

	UK Market size	Quantity (kg)
Slag wool and rock wool		
UK Production	£326 million	250,379,000
Imports	£37 million	31,585,000
Exports	£102 million	66,518,000
Total market size	£261 million	215,446,000
Assumption	80%	
Adjusted market size	**£209 million**	**172,357,000**
Other mineral wools		
UK Production	£225 million	144,112,000
Imports	£73 million	37,172,000
Exports	£80 million	30,888,000
Total market size	£218 million	150,396,000
Assumption	80%	
Adjusted market size	**£175 million**	**120,317,000**
Vermiculite		
UK Production	£12 million	11,940,000
Imports	£14 million	65,908,000
Exports	£26 million	12,468,000
Total market size	-£1 million	65,380,000
Assumption	25%	

[16] The bottom up approach to estimating the market size could have been used for insulation, but there are still many issues with this approach as explained in section 2.7.1.

	UK Market size	Quantity (kg)
Adjusted market size	**-£250,442**	**16,345,000**
Glass wool		
UK Production	£293 million	290,525,000
Imports	£62 million	14,797,000
Exports	£64 million	6,129,000
Total market size	£292 million	299,194,000
Assumption	90%	
Adjusted market size	**£263 million**	**269,274,000**
Nitrile rubber		
UK Production	£20 million	9,293,000
Imports	£15 million	2,457,000
Exports	£13 million	932,000
Total market size	£22 million	10,818,000
Assumption	1%	
Adjusted market size	**£219,000**	**108,000**
Polyurethane rigid foam		
UK Production	£541 million	126,291,000
Imports	£99 million	36,500,000
Exports	£90 million	22,178,000
Total market size	£550 million	140,614,000
Assumption	10%	
Adjusted market size	**£55 million**	**14,061,000**
Other rigid foam (including polyethylene)		
UK Production	£183 million	53,116,000
Imports	£92 million	14,984,000
Exports	£117 million	18,942,000
Total market size	£158 million	49,158,000
Assumption	40%	
Adjusted market size	**£63 million**	**19,663,000**
Spray polyurethane		
UK Production	£386 million	152,564,000
Imports	£125 million	39,875,000
Exports	£107 million	38,396,000
Total market size	£403 million	154,043,000
Assumption	10%	
Adjusted market size	**£40 million**	**15,404,000**
Total estimated UK annual market size for Insulation	**£970 million**	**669,714,000**

Sources: (Eurostat, 2019); (ONS PRODCOM, 2019; UK Trade Info, 2019)

7.3.4 Market distribution

The data for market distribution is sourced from Eurostat (2018) and is only provided on a high level 3 digit NACE (SIC) code basis. The high-level data suggests a similar situation to that of the other products, in that 98% of enterprises are SMEs, with 60% being micro enterprises. Yet, 49% of turnover in the industry is attributed to large enterprises.

Table 7-10 summarises the size distribution of firms by SIC code. In most instance, large firms are the smallest class by number of enterprises but largest by turnover, however for

the manufacture of plastics products 63% of turnover is attributed to SMEs. Table 7-10 Size distribution of firms by SIC code.

Table 7-11 Size distribution of firms manufacturing insulation based on number of enterprises by SIC code

	Number of enterprises			
SIC code	**Micro**	**Small**	**Medium**	**Large**
Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	59%	24%	14%	3%
Manufacture of rubber products	55%	31%	12%	3%
Manufacture of plastics products	60%	27%	11%	2%
Manufacture of glass and glass products	65%	25%	9%	2%
Manufacture of abrasive products and non-metallic mineral products n.e.c.	63%	23%	12%	2%

Source: Eurostat (2018)

Table 7-12 Size distribution of firms manufacturing insulation based on turnover by SIC code

	Turnover			
SIC code	**Micro**	**Small**	**Medium**	**Large**
Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	3%	8%	34%	55%
Manufacture of rubber products	4%	13%	26%	57%
Manufacture of plastics products	7%	18%	38%	37%
Manufacture of glass and glass products	8%	16%	27%	48%
Manufacture of abrasive products and non-metallic mineral products n.e.c.	2%	5%	14%	79%

Source: Eurostat (2018)

Table 7-13 demonstrates the distribution of manufacturers of insultation materials across England, Wales, Scotland and Northern Ireland. the data shows that the vast majority of firms operate out of England. Note, that not all of these firms will be producing insulation, however they are registered to SIC Codes relevant to insulation.

Table 7-13 Regional distribution of firms manufacturing insulation

	England	Wales	Scotland	Northern Ireland
2399: Manufacture of other non-metallic mineral products n.e.c.	155	10	5	10
2314: Manufacture of glass fibres	35	0	5	0
2219: Manufacture of other rubber products	435	25	25	25
2221: Manufacture of plastic plates; sheets; tubes and profiles	395	25	15	20
2016: Manufacture of plastics in primary forms	315	15	70	25
Total	**1335**	**75**	**120**	**80**

Source: (ONS ABS, 2019)

7.3.5 Exports v Imports

The exports minus the imports provide the balance of trade. The unadjusted balance of trade is £205,551,794, meaning that the UK are in a trade surplus of insulation materials. Consultation with firms across the supply chain suggests that finished insulation products are not often imported or exported as they are bulky. However, data suggests that the raw materials themselves are imported and exported prior to implementation in a finished product. Overall, the UK have 158 trade partners of insulation materials. Imports primarily come from the U.S., Belgium and Japan, and exports go to Australia, Germany and Italy primarily.

This data is summarised in 11.14.

7.3.6 Summary of the insulation market analysis

Table 7-14 summarises the total market size of the insulation market. The market size and market size by product type are based on PRODCOM data, displayed in Table 7-9. The number of enterprises data comes from the ONS Annual Business Survey, summarised in Table 7-8. Overall trade balance data is covered in 11.14. These are values based primarily on 2019 values and the values in 2022 are likely to be approximately a third higher, see 2.7.6. The study team's confidence is medium for the overall estimated market value, however low for division between product types.

Table 7-14 Summary of insulation market

Variable	Value
Estimated total annual market value for insulation	£1 billion – £4 billion
Study team's confidence in estimated market value	Medium
Estimated total quantity of insulation used per year	669,714,000 kg
Estimated number of enterprises manufacturing insulation materials	1,555

Variable	Value
Trade balance for insulation materials	£205 million

Sources: (ONS ABS, 2019; ONS PRODCOM, 2019; UK Trade Info, 2019), RPA consultation

7.4 Major players

The following table provides examples of companies associated with insulation production, at the different levels of the supply chain.

Table 7-15 Companies associated with insulation production

Stakeholder type	Examples of companies
Raw materials	Covestro, Huntsman, BASF
Component manufacturers	ROCKWOOL, Knauf, Kingspan, Siderise, Saint Gobain, Xtratherm
System manufacturers	ROCKWOOL, Knauf, Kingspan Siderise, Saint Gobain, Xtratherm
Distributors	SIG, Encon Insulation, Jewson, Travis Perkins
Trade associations	Insulation Manufacturers Association (IMA), Mineral Wool Insulation Manufacturers Association (MIMA), Thermal Insulation Contractors Association (TICA), Thermal Insulation Manufacturers and Suppliers Association (TIMSA), The Alliance for Sustainable Building Products (ASBP)

Sources: Association member lists

7.5 Supply chain mapping and information flows

7.5.1 Supply chain mapping

As shown in Figure 7-6, generally most insulation products (two industry associations suggested 70% or more) are sold via distributors such as SIG and Encon to a subcontractor, with delivery direct to the site. The widespread use of distributors makes it difficult for manufacturers to track the end use of their products.

For smaller self-build projects, an installer/consumer may purchase insulation products via fulfilment service providers, although information obtained during the workshop indicated that those carrying out such projects would still be more likely to obtain insulation products via merchants such as Travis Perkins. Consumers will also purchase insulation products for DIY and renovation projects through wholesalers such as B&Q and Homebase.

Most insulation is manufactured in the UK and not transported long distances because it is bulky and light. This is not however true for some natural insulation products such as wood fibre, which is not manufactured at all in the UK and is instead imported from Germany, Austria, Poland and Belarus, among others.

During consultation, it was indicated that for ‘large projects’ (refer to Section 2.8.5 for a definition of large and small projects) and for specialised ‘self-build’ projects that require for instance the use of natural fibre products, product manufacturers are more likely to

deal with the main contractor/sub-contractor directly (without the involvement of a distributor), with the products delivered directly to the site.

Therefore, there are two main supply chain routes: through distributors as shown in Figure 7-6 and for large projects direct from manufacturer to main contractor/sub-contractor as shown in Figure 7-7.

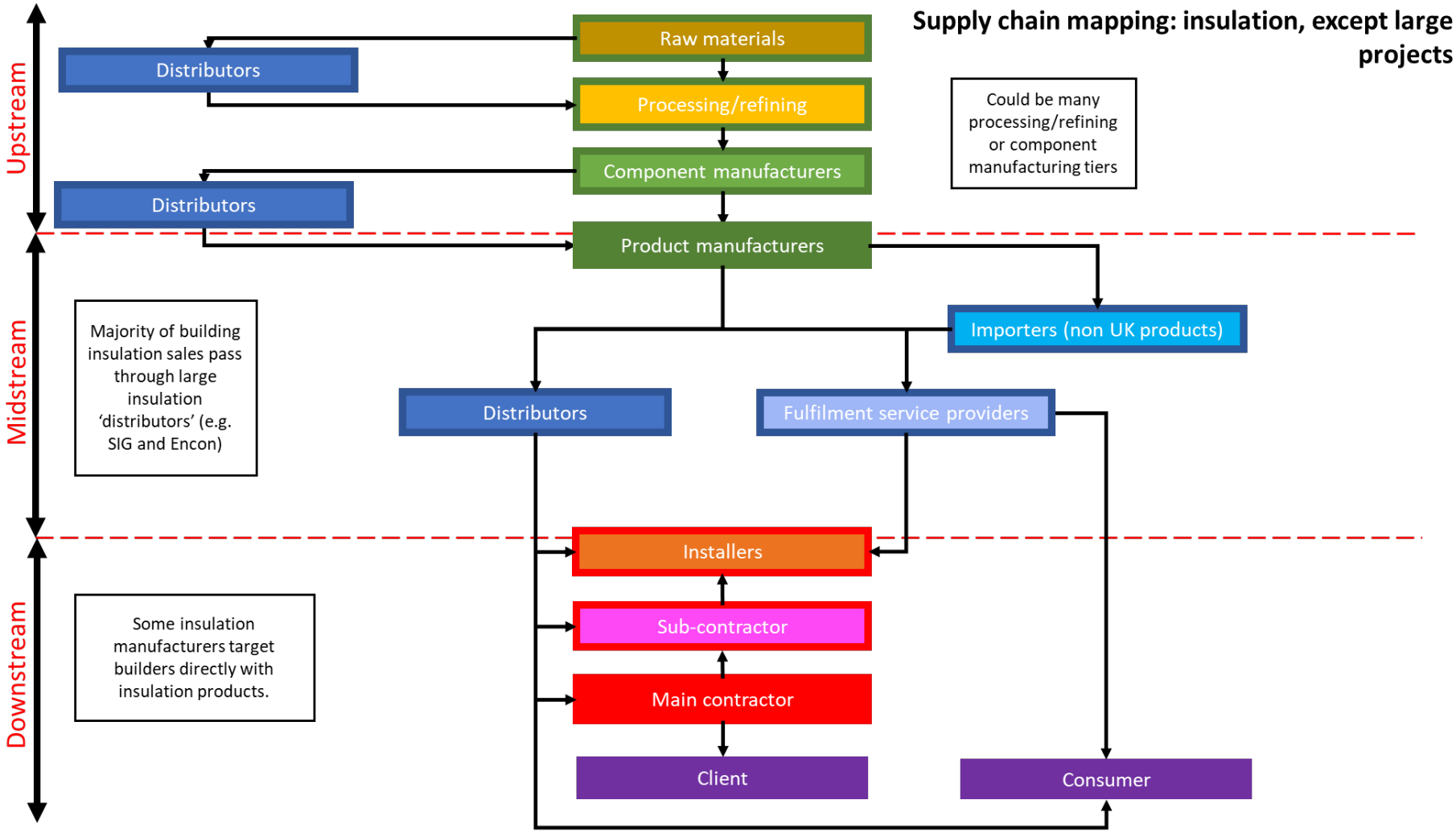

Figure 7-6 Supply chain map: insulation, except large projects
Source: RPA

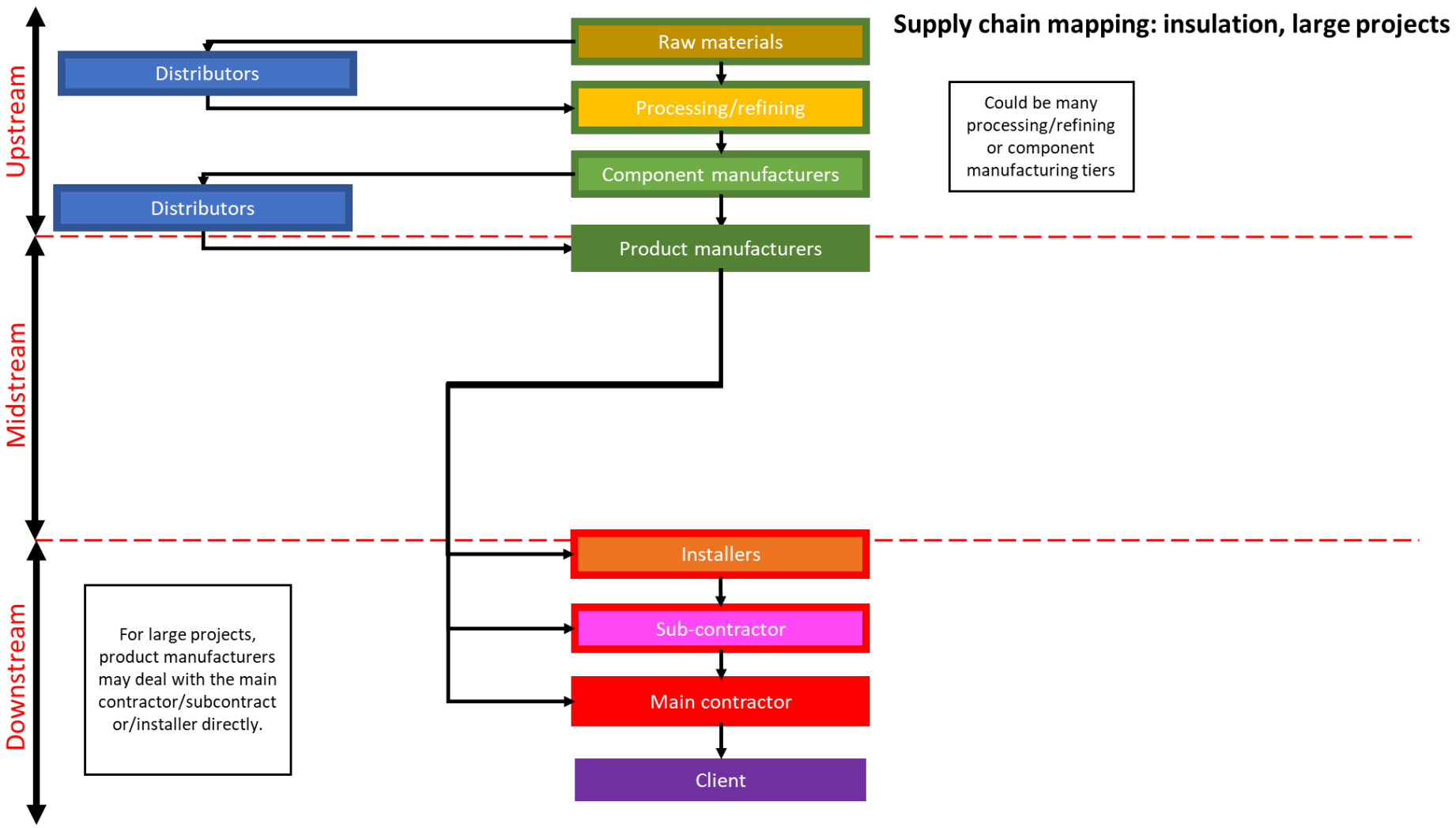

Figure 7-7 Supply chain map: insulation, large projects
Source: RPA

7.5.2 Information flow

As illustrated in Table 7-16, a safety data sheet may be provided by a raw material supplier to a component manufacturer. Descriptions of these flows through the supply chain are given in section 2.9.1.

A declaration of performance will also be required at the level of the component manufacturer and the product manufacturer if the materials used are covered by a designated standard or a UK technical assessment under the CPR. See section 7.2.2 for further details on which products are covered by a designated standard.

Table 7-16 Information flows between tiers in the insulation supply chain

Information flow type	From	Raw	CompM	ProdM	FSP	DistP	Inst	SubC	MainC
	To	CompM	ProdM	DistP	DistP	Inst	SubC	MainC	Client
Building Information Modelling (BIM)			√	√					
Brochure/leaflet									
BSI Kitemark (on product and/or packaging)			√	√	√	√	√	√	√
Company datasheet									
COSHH		√	√	√	√	√	√	√	√
Declaration of performance (DOP)				√					
Info on packaging					√	√	√		
Info on product					√	√	√	√	√
Installation guide									
Manufacturer's logo			√	√	√	√	√	√	√
Manufacturer's training*									
Operation & maintenance manual									√
QR/bar code									
Safety data sheets		√							
Technical info			√	√					
Third party certification (voluntary)			√	√					
UKCA/CE mark on product and/or packaging			√	√	√	√	√	√	√
Unique ID on product									
Warranty			√	√					

Source: RPA

*Note: * Media for information is via paper/online, or on products or packaging, where indicated*
A tick means this is believed to exist: No tick could mean that it does not exist, sometimes exists or it was not found. Not all options were covered in surveys and interviews

Key to tiers:											
Raw	Proc	CompM	DistRM	ProdM	DistP	FSP	Inst	SubC	MainC	Client	Cons
Raw materials	Processing/ refining	Component manufacturer	Distributor of raw materials	Product manufacturer	Distributor	Fulfilment service provider	Installer	Sub-contractor	Main contractor	Client	Consumer

8 Results

8.1 Findings related to methodology

8.1.1 Challenges related to data collection

The study team applied a mixed-method stepwise approach to data collection. Challenges encountered related predominantly to secondary data, due to a lack of sources of direct relevance to the project's research questions. The study team identified and reviewed a small number of sources that discussed overall approaches to describing and analysing supply chains and information flows. These approaches were not however specific to the construction sector, and the study team therefore had to tailor the supply chains and information flow maps to the aims of the project. A further challenge was the lack of secondary data on market size which meant that the study team had to make numerous assumptions to extrapolate findings on the UK market sizes.

As explained in section 2.3, primary data were collected from key stakeholders across the UK through online survey questionnaires, interviews and validation workshops. Challenges with primary data were also encountered, due to a relatively small number of stakeholders engaging with the project. As the stakeholders represented in the supply chain maps were difficult to engage directly, the study team reached out to the relevant trade association representatives. Trade associations themselves are not directly represented in the supply chain maps (although they may represent a single type of actor or a combination of actors such as manufacturers, distributors and installers), and the results may therefore be skewed towards the knowledge of their members. It should however be noted that the trade associations consulted were knowledgeable and provided detailed information on the relevant products. They also clearly expressed real concerns about how current practices have led to quality issues, unsafe practice, how to improve safety and how to enforce the law.

Finally, deciding on the breadth and number of questions to be answered was also a challenge. The interview questionnaires were long and many respondents dropped out before completing the questionnaire; similarly all the interviews conducted lasted much longer than originally estimated.

8.1.2 Challenges related to data analysis – evidence gap maps

As outlined in section 2 and in the section above, due to a lack of secondary data, the study results are predominantly based on the primary data collected during consultation activities conducted as part of this study. Challenges were however also encountered with regard to primary data collection, particularly regarding data availability, quality and reliability (as explained in section 2). To ensure transparency of the research process, Table 8-1 below presents an evidence gap map for all products, outlining data availability, as well as the type of sources that informed the research findings and conclusions. The aim of this table is to explicitly present the extent to which the evidence can be considered robust and reliable, and the impact that it had on the analysis, conclusions and recommendations.

Table 8-1 Evidence gap map for all products

	Cabling	Cladding	Fire barriers (firestoppers)	Fire doors	Insulation
Data/sources	**Quality/sources**				
Market size					
Secondary data available	Amber	Red	Red	Amber	Amber
Primary data available	Amber	Amber	Amber	Amber	Amber
Secondary data sources	ONS, BEIS, HMRC Trade data, Eurostat	ONS, BEIS, HMRC Trade data, Eurostat	NA	ONS, BEIS, HMRC Trade data, Eurostat	ONS, BEIS, HMRC Trade data, Eurostat
Primary data sources	Interviews and workshop	Interviews and workshop	Interviews and workshop	Interviews and workshop	Interviews and workshop
Supply chain mapping					
Secondary data available	Red	Red	Amber	Amber	Red
Primary data available	Amber	Green	Amber	Amber	Green
Secondary data sources	None found	None found	Manufacturers' websites, literature, data sheets	Manufacturers' websites, literature and data sheets	None found
Primary data sources	Online survey, interviews and workshop	Online survey, interviews and workshop	Online survey, interviews and workshop	Online survey, interviews and workshop	Online survey, interviews and workshop
Information flows					
Secondary data available	Red	Red	Amber	Amber	Red
Primary data available	Green	Amber	Amber	Amber	Amber
Secondary data sources	None found	None found	Manufacturers' websites, literature, data sheets	Manufacturers' websites, literature, data sheets	None found
Primary data sources	Online survey, interviews and workshop	Online survey, interviews and workshop	Online survey, interviews and workshop	Online survey, interviews and workshop	Online survey, interviews and workshop

Note: Green: relevant sources identified; robust analysis feasible;
Amber: relevant sources identified, some analysis feasible; and
Red: no relevant sources identified; no analysis feasible.

8.2 Findings related to market size

The key information related to market size for all five products is summarised in Table 8-2. The values for the market sizes are given as ranges for the products where sufficient data was available: cables, fire doors and insulation. The study team has a medium level of confidence that the values are in these ranges. The market sizes for cladding and fire barriers were more difficult to analyse as little data was available; the confidence in these values is low. In addition, as the latest complete data was often only available for 2019 (and later data are likely to have been affected by Covid), the study team has used 2019 data. The study team calculates that there has been an approximate increase of 30% in costs between 2019 and 2022, see section 2.7.6, but this has not been applied.

There were some issues specific to the relevant products, predominantly relating to data gaps.

For cables, the data available only provide a simplified breakdown of cable types. Product types identified by the study team, such as twisted pair cables and fire-resistant cables, do not have a separate classification provided by Eurostat or the ONS. It is likely that these cables will instead have been broken down into the voltage that they are designed to handle, and therefore the low and high voltage data will contain the information on these product types. Additionally, data are not collected for extra low voltage cables, the data for low voltage cables will therefore contain both low voltage and extra low voltage cables.

For cladding, one challenge in analysing the market is the lack of a SIC code that relates specifically to cladding. As a result, there is little industry data available: the only subset of cladding for which there are data is composite sandwich panels. A bottom-up approach (see section 2.7.1) was also not feasible. Trade data are also complex, as in some cases the full system is imported, and on other occasions only certain components are imported. As data are not collected on cladding types, there are no available data on import and export flows of cladding systems and their components.

For firestoppers, there are serious challenges in analysing the market; the greatest being the variety of firestoppers and the fact that they cannot be identified against any SIC codes. As a result, there is no industry data available. A bottom-up approach (see section 2.7.1) was also not feasible due to many specialist companies making many different types of firestopper. These companies also tend to make a wide range of other products, they also often make products that may then be refined into more specialist firestopping products by other companies, which means the same product may be counted more than once in the market size.

For insulation, as it is often sold integrated into other components, such as structurally insulated panels (SIPs), cladding, roofing systems, prefabricated buildings, specialist applications, hot water cylinders, and boilers, making the market size is difficult to identify.

Data for insulation is more granular for certain materials than for others. For example, data for mineral wool contains more data relevant to insulation and is therefore likely to be closer to the actual market size, unlike the classifications for spray polyurethane foam and other plastic based insulations. Notably, the data provided is likely to only capture the value of insulation materials, and not insulation products. Furthermore, there is no data available to allow the study team to separate the insulation materials into the defined product types.

Table 8-2 Summary information for all five products

Product	Product types (note 1)	Estimated market size (confidence)	Trade balance (note 2)	Market concent'n	Supply chain divisions	Information flow divide
Cabling	High voltage Low voltage Fibre optic Coaxial	£1.75 – 2 billion (Medium)	-£870 million	Moderate	Large projects Small projects	No split
Cladding	Single skin cladding Built-up assembly/twin skin Sandwich panels or insulated panels Rainscreen Curtain walling External rendered wall insulation	NA except £363 million for composite sandwich panel cladding only (Low)	NA, except -£43 million for composite sandwich panels. Curtain walling 95% imported	NA	Approved cladding systems 'Pick and mix' Curtain walling	No split
Firestopping	Coated stone wool batts/boards Sealants/mastic coatings Mortars (compound) Preformed elastomeric seals Bags/pillows/cushions Pipe closures Plugs/blocks Cavity barriers Curtain wall seals at junctions of floor slabs Stone wool mineral fibre slabs and strips Foams (silicone, polyurethane) Cable transits and sleeves Partial penetration fire-stopping devices/systems Pattressing	£1 billion (Low)	NA	NA	Firestopping - all Cavity barriers	No split
Fire doors	Timber Plastic Iron/steel Glass	£2.5 – 3 billion (Medium)	-£323 million	Fragmented	Doorsets Door assemblies	Doorsets Door assemblies
Insulation	Insulation blankets (rolls & batts) Rigid insulation boards Blown-in/loose fill insulation Insulation beads Spray foam insulation Foil-based insulation Insulation for building services/engineering Structural insulated panels (SIPs).	£1 - 4 billion (Medium)	£205 million	Concentrated	Insulation – all Large projects	No split

Source: RPA based upon 2019 data. Approximate 30% increase in costs between 2019 and 2022, see section 2.7.6
Notes: Amber= medium confidence= red: low confidence. 1 Most products have several different segmentation methods; 2 Trade balance for approximate SIC codes

8.3 Findings related to supply chain mapping

Overall, it can be seen from Table 8-2 that the two biggest determinants in the mid- and upstream supply chain mapping were:

- Size of project
- Multiple or single suppliers (or systems versus 'pick and mix')

The interrelationship between the size of a project and the type of a contract means that broadly, the smaller the project, the more likely it is to be traditional, whereas bigger projects are more likely to be design and build or more complex management contracts.

For example, in smaller and/or non-specialist projects, it is more likely that an installer will select and purchase firestopping products via small retailers, distributors and/or fulfilment service providers (FSPs) such as Alibaba and Amazon. According to stakeholders, FSPs could account for as much as half of the market for small projects. Smaller manufacturers (SMEs) tend to specialise in the production of speciality types of cables.

Furthermore, most firestopping products are sold via a distributor or FSP to a subcontractor and/or installer, with delivery direct to the site. The widespread use of distributors makes it difficult for manufacturers to track the end use of their products. Product manufacturers do not install firestopping systems.

Compiling system products from single versus multiple sources was a key differentiator for fire doors and cladding. For fire doors, fire doorsets are supplied by one manufacturer as a system and fire door assemblies are bought from multiple suppliers on a 'pick and mix' basis. In addition, raw material companies are often combined with processing and refining and there could be many tiers of component manufacturers. The product manufacturer may have additional tiers for research and development, testing and accreditation to enable customised or bespoke products. Furthermore, product manufacturers may obtain components such as ironmongery or partly prepared door leaves from multiple component manufacturers and create the final doorset.

Cladding systems are similar to fire doors in that, although approved systems and "pick and mix" are both bought from multiple sources, for approved systems, the sources are all approved by the manufacturer of the major component (see Case study 4). Products assembled from uncontrolled multiple sources (fire door assemblies and "pick and mix" cladding) were also found by stakeholders to be risky, and stakeholders clearly wanted to move away from these practices.

For cladding systems, based on current information, it is not clear to what extent they receive approval as a whole system, in comparison to that received at the component level. There is no specific definition of cladding systems and therefore no designated standard under the Construction Products Regulation, but it will be important to understand whether a system can be covered by a third-party approval, or perhaps a UK Technical Assessment under the CPR. Where assessments do cover an entire cladding system, further information is required on the level of detail supplied in these assessment documents, and the extent to which this information is shared throughout the supply chain.

Workshop participants highlighted that fire door maintenance is a challenge. For instance, questions arise when there are faulty parts whether it is necessary to replace the whole door or just the faulty part: much depends upon the relationship with the manufacturer[17].

The consultation covered all of the actors in the supply chain. Ideally, more input would have been gathered from designers, clients, and main contractors.

Finally, it is worth noting that it is not uncommon for some projects, even some worth many millions, sometimes go ahead with no initial design at all. There may not even be a contract, only a verbal agreement to do some work for an agreed amount of money. This is particularly common for fast track and maintenance projects.

8.4 Findings related to information data flows

The information flows were remarkably similar for all five products. A linear information flow model was prevalent, albeit some stakeholders noted the need for circular information flows. Some stakeholders also suggested a reporting and checking loop, as related to product selection and application, and the provision of accompanying information in these processes.

In addition, there seems to be confusion related to information provision required by the mandatory standards/regulations and voluntary schemes. Consulted stakeholders observed that many people believe that some voluntary standards/regulations are mandatory. However, the majority of schemes are voluntary rather than mandatory, so compliance is not binding for stakeholders, and as such, it cannot be enforced. Consequently, there are no mandatory reporting requirements and no assigned responsibility for checking compliance.

There were a few specific issues for some products. For cables, it is not clear to what extent the use of distributors supplying cables limits the amount of information provided with the product. However, the large and expanding amount of information that is included in the cable marking, as well as the ongoing quality assurance and surveillance activities have to be noted, as they help to ensure high quality standards and traceability of information.

Findings related to stakeholders' roles in the product information flows have been presented in Case study 8 below. This highlights several issues around the development of the specification as this is one of the flows: who is responsible for the detailed specification and who can change the specification.

Case study 8: The roles of manufacturers, distributors and customers in the product information flows

Many interviewees observed that **product information is often poorly disseminated through the supply chain**. This is particularly prevalent when there are **intermediaries** (distributors, wholesalers, fulfilment centres, but also main contractors and multiple subcontractors) **between manufacturers of products and product installers**[18]. Many of these intermediaries are

[17] A similar question may also arise in relation to cladding products. However, this aspect was not mentioned by and discussed with stakeholders thus it is not feasible to provide evidence on this aspect.
[18] Interviewees also observed that dividing up construction projects into many work packages delivered by sub-contractors also weakens the information flows in the construction sector. This is because it requires technical information exchanges between sub-contractors which may be difficult to implement when working with multiple sub-contractors responsible for specific pieces of work. However, as this aspect is outside the scope of this case study, it is not covered in the case study narrative.

large national distributors that sell many product lines, thus, in the opinion of some interviewees, their technical understanding is limited for both the product and application. Such distributors tend to rely on the manufacturers' expertise. However, once they obtain relevant information about product functionalities, they may supply cheaper alternatives, which may not fully meet all the technical details of the original manufacturers' products.

Some interviewees highlighted that **product manufacturers should know how and where their product is used, and that they should share this information with their distributors**[19] to ensure they understand the products and their intended use. Otherwise, distributors cannot provide advice to customers about the correct selection and application of products. However, one interviewee observed that manufacturers often have non-technical Area Sales Managers to provide this information, and they have little training or experience in relation to the installation and use of the product.

However, several interviewees also observed that many manufacturers want to know where their products are being sold and where/what they are used for. Yet, for products which are widely sold through distributors (such as firestoppers and insulation), it is challenging for manufacturers to track the end use of their products. This challenge also results from the fact that the distributors do not necessarily know or inform the manufacturers, as they themselves may not ask their customers the correct questions[20] or fully understand all applications the products may be used for within a chosen project. The survey results provide a similar observation showing that sub-contractors and installers need to consult technical information (such as safety data sheets and the declaration of performance) provided by the product manufacturers as distributers provide only limited information with the products that they sell.

The product selection also is largely down to **the customer** (product end-users) **and how well informed they are about** the required parameters of **products**, such as quality, lifecycle, performance details. According to some interviewees, many construction professionals do not have detailed technical knowledge about the specific products they need in all sectors in which they operate. Several interviewees also observed that the technical specifications during the tendering process are often based on previous legacy projects and outdated information (e.g. due to copying and pasting legacy/withdrawn technical specifications) and/or a brief performance specification which is vague and left to the contractor's interpretation[21]. Thus, **technical specifications may not capture technical or best practice changes highlighting the critical role of the specifier and the extent to which they bind subsequent players in the supply chain**. The financial pressures to deliver projects cost-effectively can also increase risks through value

[19] It has to be noted, however, that this approach may not be practical due to a mass-produced generic production by some manufacturers, and because it would create a significant responsibility on the manufacturers.
[20] As per footnote above, this would not be a practical approach for many distributors selling a wide range of products.
[21] This approach is often necessary to ensure that the contractors will tender for the work and can see the opportunity to 'value engineer' cost out by cheaper product specification.

engineering[22] resulting in poor performing or incorrect product selection. Disruptions in the supply chain and long product lead-times may also result in using 'available' alternatives that differ from the original design specifications. According to one interviewee, **all these situations create risks that the original specification is not adhered to or becomes lost as procurement takes the lead rather than compliance and performance**.

All these examples provided in this case study indicate the importance of having well-informed distributors, (sub-) contractors and clients (including building end users) to make informed choices about the selection and application of correct products for specific construction settings.

For the list of all case studies, see section 2.4.4.

[22] In general, the impact of value engineering can be both positive and negative. However, in the context of situations described in this paragraph, the impact is negative.

9 Discussion and conclusions

9.1 Conclusions related to methodological aspects

Several conclusions relating to the methodology may be drawn from the evidence collected for this study. These are discussed in the following sub-sections.

9.1.1 Definitions

The scope of this study was wide and, as a first step, the study team had to define the products that would be included. However, defining several products and their sub-products has proved difficult, with long discussions in interviews and workshops. Cladding and fire barriers are particularly challenging as the terms are much broader in their meaning than OPSS had anticipated for this study. For these two products, the products analysed in the study are:

- Cladding: cladding systems (manufacturer approved arrangements)
- Fire barriers: firestopping.

However, even these more bounded definitions were not straightforward. There was much discussion about whether certain cladding systems fell within the study scope, particularly structural insulated wall panels (SIPs) and external rendered wall insulation (EWI). Firestopping that takes place within another system such as HVAC systems, cladding, suspended ceilings and raised floors, was also subject to considerable debate: they were excluded.

The definition of a ‘fire door’ also needs to be clarified. Stakeholders explained that the definition of a fire doorset depends upon the type of standard used. Sometimes ‘fire escape doors’ or ‘fire exit doors’ are incorrectly referred to as ‘fire doors’, but fire exit doors do not necessarily need to meet the function of fire doors which compartmentalise fire in a building. Using the term ‘fire escape doors’ or ‘fire exit doors’ simply means that they are on the means of escape from the building. As a further complication, it is not uncommon for residential buildings (particularly more expensive dwellings) to put fire doors into places where they are not required. This is because the developer wants all the internal doors to be the same and fire doors are often sturdier and appear better quality and safer.

9.1.2 Identifying and motivating stakeholders to get involved in this study

The study team faced challenges with identifying relevant stakeholders within specific organisations, and motivating stakeholders to contribute to this research study. The difficulty in arranging interviews and workshops could be due to many large organisations in the construction industry appearing to lack a senior outward-looking member of staff with responsibility for regulatory affairs. This is common in other heavily regulated industries, such as chemicals. This person might sit in the occupational safety and health (OSH) or other central functional departments such as innovation and product development. Stakeholders mostly interested in participating in the study represented product manufacturers, probably because their products are already regulated, they understand the value of getting engaged in the policy-oriented research studies, and they are used to engaging. A similar forward-looking mindset was also found among trade association representatives representing collective voices of other individual stakeholders.

The study team suspects that installers, contractors, and distributors have had relatively little need to engage with product regulators in recent years and have not needed to employ people in these roles: there was often no-one whose job it is to speak to regulators or to consultants such as the study team. Consultant designers and contractors and clients were the least represented, it seems this industry is more responsive to receiving regulation rather than engaged in forming it. This may be due to commercial reasons, where engaging in forming regulation does not offer a short-term financial return but responding to regulation does. In the future, this type of person is important to OPSS for stakeholder engagement. It is possible that the increasing level of regulation anticipated for the construction industry will lead to all types of companies making someone responsible for these engaging in forming regulations.

The difficulty in arranging interviews is also likely to have resulted from the study scope being too broad. The product landscape was too vast, even after the study team had narrowed down the definitions. At the same time, the five products covered by this research represented just a small fraction of business for many stakeholders, in particular for mid- and upstream supply chain stakeholders (distributors, installers and (sub-)contractors), and thus they did not feel that they could contribute a detailed assessment of the aspects investigated in this project.

In general, confidentiality was not a challenge for most stakeholders. However, some interviewees made specific remarks about the confidential nature of some information that was provided during stakeholder engagement activities.

It was also challenging to engage interviewees for the validation workshops. As a result, most workshops consisted of participants representing three organisations. Many stakeholders that had already been interviewed believed that they had given the study team all the information they had and could not provide more insights. At the beginning, many stakeholders did not understand the research process, that the findings to be presented at workshops were based on multiple sources of information, nor that workshops would provide an opportunity to comment on the findings and conclusions reached by the study team. However, once at the workshop, participants were really engaged. All workshops tended to have a lengthy discussion about the definition of the product and its sub-products, and of the legislation and voluntary initiatives surrounding the product and its testing. Practical factors also played a role; it was difficult to arrange an hour's interview with most stakeholders and the workshops had to be at least three hours to cover the information. Many stakeholders were simply unwilling to devote this much of their time to this additional activity.

9.2 Conclusions related to market size

The construction products market is highly complex and interrelated. It is difficult to establish the appropriate level of detail/complexity at which the market and supply chains should be analysed: if the analysis is at too high a level, it is not meaningful; if it is too detailed/complex, it is nearly impossible to understand every construction product, given the endless combinations and permutations of how they can be used together and the contractual arrangements that could be used to install them. In addition, whilst some of this complexity has evolved simply to reduce cost, some of it has evolved to make innovative use of products, which might also involve the reduction of cost, but might also improve performance or at least provide the same performance for lower cost.

The study team considered using data from a variety of sources, and carefully examined the relevance and usefulness of each source for the purpose of this study. Difficulties in

arriving at the market size were related to product definitions, as well as methodological and confidentiality issues. Firstly, product and sub-product definitions varied greatly between sources, and where similar/identical definitions were applied they covered and/or excluded different products. Identified sources often did not cover the whole product market as defined in this study. For instance, the cumulative market value of fire doors had to combine the individual values for timber, metal, plastic and glass fire doors. Similarly, the raw materials used in insulation products are often provided by the main product manufacturer, but the finished product may be further refined by other companies, and this has an impact on the value of the finished products. In addition, each product had many variations and different names (depending on the manufacturer), meaning that the omission of some product ranges and types was unavoidable. For instance, the steel framework and the intumescent strips were not initially included in the cladding market size estimations, and the numbers were only re-adjusted upon receiving feedback during the workshop. Secondly, the value of the overall market also depended on the applied methodological approach, i.e., applying the top down vs. bottom-up approach, reporting on actuals vs. the overall market size, and the assumptions that had to be made for products with multiple components and raw materials. Whilst the top-down approach had significant issues, the study team believes that a bottom-up approach would be even more unreliable because it is requires obtaining data from many companies, data which are often confidential, and which every company disaggregates in a different manner.

A further complicating factor is that companies making insulation and firestoppers often make a wide range of other products, which are often then developed into more specialist insulation and firestopping products by other companies, which means the same piece of insulation may be counted more than once in the market size. Insulation is also a key component of firestoppers.

Finally, data accessibility was also a challenge as some market reports and data are confidential; this limited to what extent and how the study team could include information in the report. In addition, challenges with data accessibility also arose when most of a particular product type was imported, for example according to one trade association workshop participant, 95% of curtain walling used in the UK is imported.

All these aspects raise the question: is the market size too complex to assess? It may be too difficult to arrive at a definitive answer to this question, but it is worth considering different viewpoints across stakeholder groups and their understanding of the current supply chains. This study has created a basis, which can be built upon in the future. Many stakeholders thanked the study team for even attempting to do this.

9.3 Conclusions related to supply chain mapping

9.3.1 Responsibilities and accountabilities of stakeholders

Evidence collected in this study suggests that there should be greater focus on who is responsible for what: specifying, checking, and enforcing the design, installation, and handover of the building and its components. When it comes to specifying, given the split responsibility, there also needs to be rigorous change control over the specification documentation to identify who replaced which products, coupled with supporting documentation to validate performance, both safety and quality. This is a simple step with a profound impact. Furthermore, it was also suggested that there should be a requirement for the checker to raise with enforcers any changes made that could have an impact on safety. Stakeholders also highlighted the importance of maintaining detailed records of exactly when, why, and by whom all these checks were carried out, to be given to the

client at handover. These records must be maintained during the lifetime of the building by the subsequent dutyholder. The study team's understanding of the Hackitt report (Hackitt, 2018), revised CPR ('Construction Products Regulations 2022 (draft)', 2022), and the Building Safety Act ('The Building Safety Act', 2022), is that legislation and guidance is moving in this direction.

9.4 Conclusions related to information data flows

Findings from this study highlight the need for product information to be consistently provided throughout the supply chain. Crucially, since most product approval schemes are still voluntary rather than mandatory, enforcing them (e.g., with reporting) is challenging.

In addition, even when stakeholders meet the requirements of voluntary schemes (e.g., voluntary third-party approval), certifying stand-alone products may still, in many cases, be insufficient to demonstrate compliance with Building Regulations.

Furthermore, the practices of 'boxing and badging', as it was reported to be happening with some cladding products, when products are purchased and bulk and re-labelled, may mask information about the products' origin as well as safety-related and other relevant information.

The results of this project also emphasise the role of information provision in selecting and installing the correct product. Many consulted stakeholders believed that the main causes of breaches in safety and standards relate to incorrect product selection and installation, rather than the safety of the products themselves. This raises questions about the role of manufacturers in assisting with these processes and whether they should be required to provide more information on these aspects, such as the compatibility of products, and whether individual products meet specific requirements. However, this could be challenging for a manufacturer to provide as they would need to pre-empt all the ways in which their products could be used and combined with other products. If there was a clear request for certain information, manufacturers are likely to respond.

However, the widespread use of distributors (e.g., for firestopping products) must also be noted as it limits manufacturers' ability to track the end use of their products, and how they could potentially be further involved in correct product selection and installation. The relatively less extensive product knowledge of distributors has also been observed by firestopping stakeholders, as subcontractors and installers often revert back to the product/component manufacturers to obtain information on products purchased elsewhere. In addition, clients, consultant designers and contractors frequently receive insufficient information too.

Furthermore, the prevalence of YouTube videos showing people how to install products also raises concerns, as it is not practically possible to know if the presented installation method is correct. The lack of any well-established firestopping installation training provided by industry stakeholders also deserves noting as it can indicate a low level of firestopping installation skills.

Purchasing products through small retailers and/or fulfilment service providers (which the study found to be relatively common for cables and firestopping products) also raises questions about the level of information provision and assistance with product selection that is available (or not) through these selling channels.

This project also identified challenges with information flows when products have circular supply chains and/or are sent back up the supply chain after delivery. When viewed through the sustainability lens, the re-use and retrofitting of products (e.g., insulation) can

be seen as a positive outcome. However, it also creates ambiguities related to product information provision; products may be incorrectly labelled when returned to the supply chain, users of second hand and damaged products may be misinformed, and there could be breaches of building regulations and safety standards.

Consumers may also not be so well informed when it comes to the use of more environmentally friendly and sustainable products, such as insulation products using alternative materials like hempcrete or compressed straw.

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11 Annexes

11.1 Background

11.1.1 Dame Judith Hackitt report

Following the 2017 Grenfell Tower fire, an independent review of the building regulations and fire safety was conducted. This review was led by Dame Judith Hackitt and in May 2018 the final version of the review report was published. This report is entitled 'Building a Safer Future – Independent Review of Building Regulations and Fire Safety' Golden Thread (Hackitt, 2018).

Within the context of the present study being conducted by RPA Ltd., the Building a Safer Future report provides a useful foundation for understanding some of the key issues faced within the sector, particularly with regard to information flows and factors affecting procurement within the supply chain.

Chapter 8 of the Hackitt report ('Golden thread of building information') sets out recommendations for holding and maintaining records of documentation relevant to building and fire safety. The aim of the golden thread is to ensure that information is systematically held and maintained. Often, for example, it is unclear when changes have been made to a building that alter it from the original design. Building owners, furthermore, do not possess the necessary information to effectively manage building safety across the full life cycle of the building. This lack of information can also complicate refurbishment activities, where it may be difficult to evaluate the effects that any changes may have on the safety of the building. It will be important for this study to pinpoint information that is provided by e.g., manufacturers and to what extent that information is passed down the supply chain.

Chapter 9 ('Procurement and Supply') highlights that contracts are currently underpinned by the motivation to conduct building works as quickly and as cheaply as possible, with lack of an emphasis on quality.

11.1.2 Overview of the regulations and standards governing construction products

Construction products and the buildings in which they are used are governed by a range of legislation and voluntary standards in the UK. The study team have undertaken an assessment of the regulations and standards governing construction products. This section reflects the evidence that the study team has collected, which presents its understanding of the sector as it stands

The main regulations governing obligatory requirements for buildings and their associated construction products are:

- The UK Building Regulations; and
- The UK Construction Products Regulations (CPR).

The UK **Building Regulations** set out specific requirements for *building* design and construction (including measures for ensuring fire safety).

The **CPR** sets out rules for the marketing of *construction products* in the UK. It provides designated standards for construction products, which act as a technical basis for assessing their performance.

In addition to regulation, there is a wide range of **British Standards** covering the performance of construction products and/or their components. Some British Standards are voluntary, while others are specified in legislation.

Furthermore, *voluntary* **third-party approval** is provided by several organisations (such as the British Board of Agrément) specialising in the performance of construction products. These third-party approvals can attest to a product's compliance in line with the multiple regulations (such as the Building Regulations, the Construction Products Regulation) and standards applicable to that product. Furthermore, third-party approval assesses key factors such as structural performance, weathertightness, thermal insulation, condensation risk, performance in relation to fire and durability.

The subsections below describe the above regulations and standards governing construction products in the UK in further detail.

In many cases the legislation governing the construction products sector can differ across the devolved nations. The table below lists key legislation governing the construction sector and indicates in which of the UK's devolved nations the legislation applies.

Table 11-1 Key pieces of legislation governing UK construction and the nations in which they apply

	Nation in which the legislation is applicable			
	England	***Northern Ireland***	***Scotland***	***Wales***
The Building Regulations 2010	✓			✓
The Building Regulations (Northern Ireland) 2012		✓		
Building (Scotland) Regulations 2004			✓	
Construction Products Regulations 2020 (CPR)	✓		✓	✓
Construction (Design and Management) Regulations 2015	✓		✓	✓
Construction (Design and Management) Regulations (Northern Ireland) 2016		✓		
Fire Safety Order 2005	✓			✓
Fire (Scotland) Act 2005			✓	
The Fire Safety Regulation (Northern Ireland) and The Fire and Rescue Service (Northern Ireland) Order 2006		✓		
Control of Substances Hazardous to Health 2002 (COSHH)	✓	✓	✓	✓

11.1.3 Building Safety Act

The Building Safety Bill was announced in 2019 following the findings of the Hackitt report. The final bill was published on 28 April 2022 as the 'Building Safety Act 2022'; however, the final version has not yet been published.

The aims of this Act are to 'reform the safety system for residential properties by appointing a Building Safety Regulator, giving a greater voice to residents, driving industry change and creating a national framework for increased oversight' (UK Parliament, 2022).

Key changes to be brought about by this Act are:

- The creation of a Building Safety Regulator;
- The creation of a New Home Ombudsman;
- Amendments to the Building Act 1984;
- Creation of provisions specific to 'higher risk buildings'; and
- Reform of the regulation of architects and construction products, among others.

11.1.4 Construction Products Regulations

The UK Government drafted the following two pieces of legislation (one in 2019 and one in 2020) to implement the EU's Construction Products Regulation (CPR) prior to the UK's exit from the EU:

- Construction Products (Amendment etc.) (EU Exit) Regulations 2019
- Construction Products (Amendment etc.) (EU Exit) Regulations 2020

According to the UK's Construction Products Regulations, a person who supplies a construction product that is covered by a **designated standard** or conforms to a **UK Technical Assessment** that has been issued, needs to provide a 'declaration of performance'.

A UK Technical Assessment may be carried out where a designated standard does not exist under the CPR for a given construction product. This UK Technical Assessment acts as an alternative means for manufacturers to draw up a declaration of performance for their product and obtain the UKCA mark. To undertake a UK Technical Assessment, a manufacturer must submit a request to a UK technical assessment body (listed on the UKMCAB database), who will then assess the product and produce a UK Technical Assessment Document. This document can then be used to obtain a declaration of performance, enabling the product to be UKCA marked.

The declaration of performance for an individual product must be provided by the manufacturer to the customer, and generally contains the following information:

- Reference to the product-type;
- The name, registered trade name or registered trademark and contact address of the manufacturer;
- System(s) of assessment and verification of constancy of performance of the construction product;
- Reference number and date of issue of the designated standard or the UK Technical Assessment which has been used for the assessment of each essential characteristic;

- Where applicable, the reference number of the Specific Technical Documentation used and the requirements with which the manufacturer claims the product complies;
- The intended use(s) of the construction product in accordance with the applicable designated technical specification;
- The list of essential characteristics, as determined in the designated technical specification for the declared intended use(s);
- The performance of at least one of the essential characteristics of the construction product, relevant for the declared intended use(s);
- Where applicable, the performance of the construction product, by levels or classes, or in a description;
- The performance of those essential characteristics of the construction product which are related to the intended use or uses; and
- When a UK Assessment Document has been issued for that product, the performance, by levels or classes, or in a description, of the construction product in relation to all essential characteristics contained in the corresponding UK Assessment Document.

The UKCA mark is to be applied to any construction product with a valid declaration of performance. Previously, under the European version of the CPR, the CE mark was applied instead. The CE mark is currently valid in the UK until 1 January 2023.

Under the Brexit Withdrawal Agreement, EU conformity markings will continue to be used within Northern Ireland, indicating that goods meet EU standards. However, if a third-party conformity assessment is carried out by a UK entity a UKNI mark is required. UKNI markings are not valid within the EU or Great Britain.

The draft new Construction Products Regulations (CPR) in 2022 sees the introduction of a general safety requirement to ensure that a construction product is not made available on the market unless it is deemed safe. Most notably for this study, the draft new CPR sees the creation of a list of safety critical construction products, where their failure would result in death or serious injury.

The safety critical standard must set out:

- Intended uses of the product;
- Safety critical properties of the product;
- The required performance of the product in relation to each safety critical property; and
- The system of assessment required.

11.1.5 Building Information Modelling (BIM)

In 2011, the UK government published the Government Construction Strategy which included the Building Information Modelling (BIM). BIM is a process of creating a digital model and managing information on a construction project throughout its whole life cycle. Under the UK BIM Framework 2019 (previously BIM Level 2), several standards were defined in collaboration with the UK BIM Alliance, British Standards Institution (BSI) and the Centre for Digital Built Britain in accordance with the ISO 19650 series.

BIM allows for a clear definition of information needed by a client and for the standards, methods, processes, deadlines and protocols that will govern its production. As part of this, a digital description within a 3D model and structural data such as product, execution and handover information are created (UK BIM Framework, no date).

Chapter 8 of the Hackitt Report further reinforced the need for a BIM approach to ensure the design, construction and/or operation of a building, as well as maintenance of appropriate safety information during a building's life cycle (Hackitt, 2018).

11.1.6 Voluntary industry-wide initiatives

In 2018, in response to the recommendations set out in Chapter 7 of the Hackitt Report, the Construction Products Association (CPA) established the Marketing Integrity Group (MIG). The MIG sought to create an independent code of practice for product information to help drive change and ensure clear, accurate, up-to-date, accessible, and unambiguous information is relayed when making decisions about using products within the design, specification, installation, use and maintenance of a building's life cycle (Turk, no date). The MIG launched a Call for Evidence on Construction Products Information in March 2019, the results of which have been made available on the association's website (CPA, 2019).

The CPA also initiated the drafting of the Code of Construction Product Information (CCPI). This code contains eleven clauses which aim to ensure that robust information is communicated in an unambiguous manner to internal and/or external stakeholders involved in the construction, refurbishment, or maintenance of a building. The CPA launched an industry-wide consultation on the CCPI, the results of this consultation have been made available on the website dedicated to the CCPI code (CCPI, 2021).

11.1.7 Third-party certification

Third party certification is often used by manufacturers to obtain an independent verification of their product's performance.

The use of third-party certification often involves a manufacturer submitting a product to be tested for a specific test, for example, resistance to fire. The test is performed to an agreed standard, often in accordance with a British Standard. The product is given a rating and a certificate recording the performance of the product during the test.

It is quite normal for a product to be tested simulating a specific application or with other products. For example, a fire door leaf with specific ironmongery and door frame, or a firestopping product within a specific wall type.

The third-party certificate is often limited to the specific arrangement of product(s) used during the test. If an alternative arrangement is used, then the specific alternative arrangement may require testing in order for the third-party test to be relevant.

11.1.8 RIBA

Royal Institute of British Architects Plan of Work (RIBA, 2020) (see Figure 11-1) has eight stages (from 0 to 7) which acts as a guide for clients of the process of designing and constructing a building. The RIBA Plan of work explains the stage outcomes, core tasks and information exchanges required at each stage.

It does not identify precisely when the planning application is needed, typically it is either at stage 2 or 3. Typically, developers want to minimize the design fees until they have secured the planning application.

Stage 2 covers the minimal information necessary for planning. It is always a risk of the contractor going to stage 3 with minimal information as they may need to go back to the designer for additional technical information if they cannot achieve certain aspects of the plan.

Assuming that the contractor is engaged at stage 3 or earlier, architects will develop a more detailed design plan which will include the full design team i.e. structural/civil engineers and services engineer. It is now more common for a fire engineer to also be included from beginning to end. The new Safety Bill supports this practice and is seen as vital for maintaining the Golden Thread (Hackitt, 2018).

Historically, clients have not wanted to include fire engineers at the beginning to save fees. They have wanted fire engineers to come in to do a short exercise at stage 4 before submitting to building regulator. However, this created risks because when the contractor was appointed at the later stage, the design strategy may have changed, and it might have had an impact on / deviated from the fire strategy, but the fire engineer was no longer appointed as part of a team.

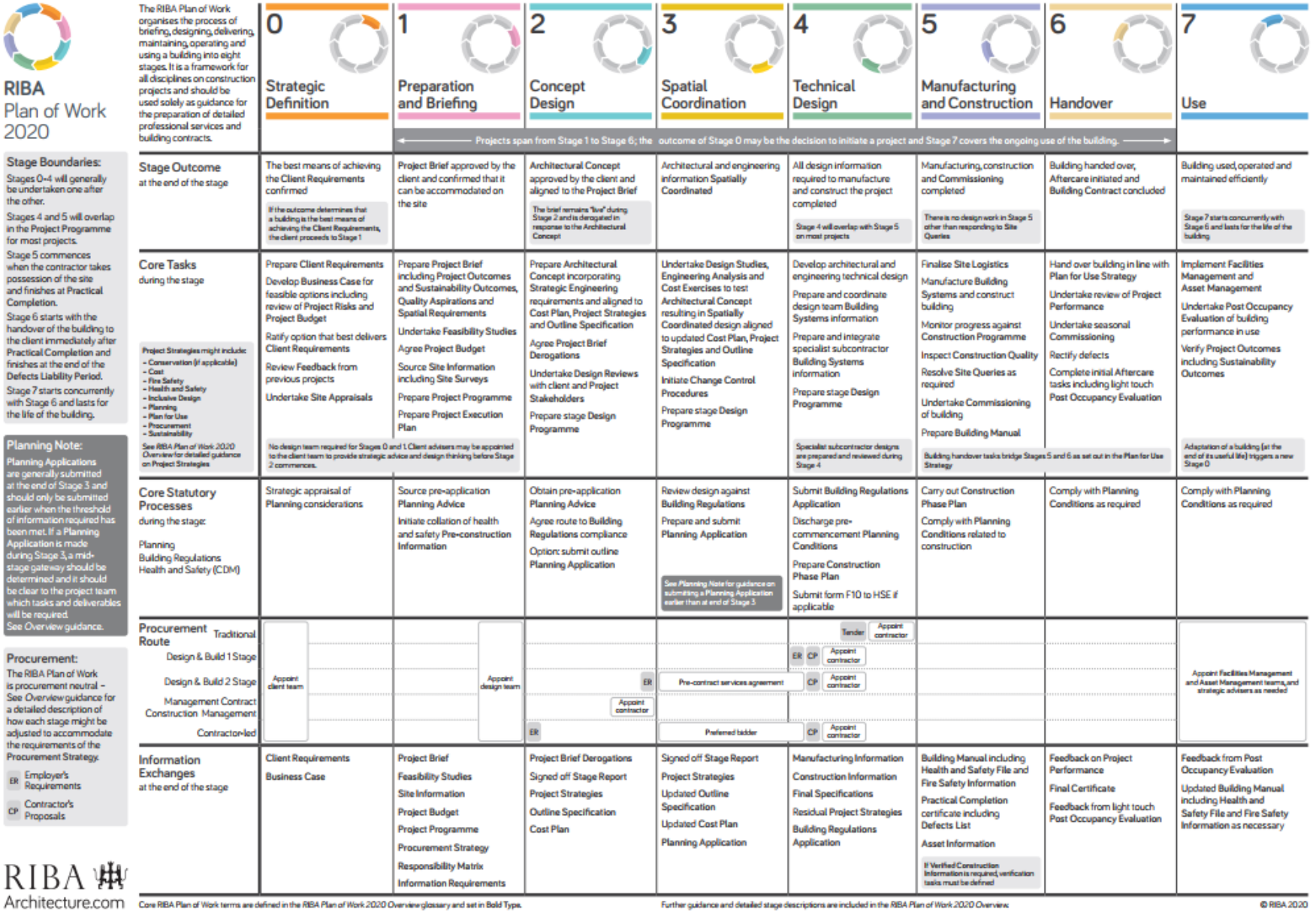

Figure 11-1 RIBA Plan of work Source: (RIBA, 2020)

11.1.9 British Standards and International Standards

British Standards are created by industry experts, based on their consensus on best practice. The creation of these standards is facilitated via the British Standard Institution (BSI)[23].

British Standards are developed using the processes set out in 'BS 0, A standard for standards'. These processes involve the use of a committee of experts who have an interest in the content and application of the standard, and draft standards are subject to consultation. This process aims to ensure that the standard will be accepted by the vast majority of stakeholders wishing to apply it.

British Standards may be developed in the UK, or, in most cases, are adoptions of international standards developed under similar processes(BSI, 2022).

Manufacturers therefore often comply with these standards to demonstrate that they have indeed followed best practice. These standards are also considered to be an authoritative means for manufacturers, designers and/or installers to ensure that final use of the product is sound. They can be used in the design and manufacturing of a product, the testing of a product or the design and application of a product.

British Standards are not the same as regulation and following a standard does not guarantee that a manufacturer is working within the relevant laws

British Standards can differ significantly from one another; the conditions set out in some standards essentially amount to advice and guidance, while other standards are much more prescriptive and set out absolute requirements. Different product types and user groups can have needs for different forms and levels of standardization, and the BSI tries to accommodate all these needs (BSI, 2022).

A key British Standard relevant across all construction products is the BS 476 series which determines how building materials and structures will perform in a fire. BS 476 also determines the appropriate fire tests for a given product and grades the level of fire resistance.

11.1.9.1 Categories of British Standard

The categories of British Standard (BS), as set out by BSI (BSI, 2022), are as follows:

- **Specification:** a highly prescriptive standard setting out detailed absolute requirements. commonly used for product safety purposes or for other applications where a high degree of certainty and assurance is required by its user community. For example the BS specification PAS 8671:2022 'Built environment: Framework for competence of individual Principal Designers' specifies the competence thresholds that should be met by the duty holder with the function of the Principal Designer, and additional competencies for working on higher-risk buildings (HRBs).
- **Codes of practice** recommend sound good practice as currently undertaken by competent and conscientious practitioners. They are drafted to incorporate a degree of flexibility in application, whilst offering reliable indicative benchmarks. They are commonly used in the construction and civil engineering industries. For example BS 8214 Code of practice for fire door assemblies gives recommendations for the specification, installation and maintenance of timber-based fire doors, and

[23] BSI is a private company incorporated by the British Royal Charter which is granted by the UK Privy Council. (BSI, 2022)(BSI, 2022)(BSI, 2022)

has been updated to also include guidance associated with the sealing between the door assembly and the surrounding structure.

- **Methods** are also highly prescriptive, setting out an agreed way of measuring, testing or specifying what is reliably repeatable in different circumstances and places, wherever it needs to be applied. A vocabulary is a set of terms and definitions to help harmonize the use of language in a particular subject or discipline. For example, the BS series 476 sets out the appropriate methods for fire testing various elements of a building's structure and how to grade them according to fire resistance, e.g. BS 476-7:1997 describes fire tests for building materials and structures and sets out the method of test to determine the classification of the surface spread of flame of products
- **Guides** are published to give less prescriptive advice which reflects the current thinking and practice amongst experts in a particular subject. For example BIP 2044:2020 is a companion guide to BS 5839-6:2019 (the current code of practice on the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises); the guide provides comprehensive guidance and gives full background explanations including the practical application of the standard's recommendations.

11.1.9.2 BSI Kitemark

Products that have been tested and deemed to conform to the relevant British Standards are marked with the BSI Kitemark.

According to the BSI, 'the BSI Kitemark is a quality mark that shows a construction product or service meets the applicable and appropriate British, European, international or other recognised standard for quality, safety, performance and trust.'

11.1.10 Building Regulation across the UK

Within the UK, building regulation ensures that buildings are constructed and altered in a safe manner. More specifically, UK building regulation ensures that:

- The structure of new/altered buildings remains sound;
- Buildings adequately resist the spread of fire (internally and externally);
- Buildings adequately resist contaminants and moisture;
- Buildings provide reasonable resistance to sound;
- Buildings have adequate means of ventilation;
- Buildings are constructed in such a way that they ensure adequate provision of water;
- Buildings allow for adequate drainage and waste disposal;
- Buildings have adequate combustion appliances and fuel storage systems;
- Buildings are built in a way that prevents falling, collision, impact, etc.;
- Reasonable provisions have been made for conservation of fuel and power;
- There is reasonable access to the building;
- Any glazing is safe; and
- Buildings are designed in a way that ensures electrical safety.

Building regulation in the UK consists of several pieces of legislation. Each of the devolved nations is responsible for drawing up their own guidance and is covered by a different piece of legislation (except in the case of Wales which is covered by the same legislation as England). Explanations of the different building regulation applicable in each devolved nation are provided in the following subsections. Table 11-1 provides an overview of the building regulations applicable in each devolved nation.

11.1.10.1 England

Building Regulation 2010 is applicable in England. A series of documents approved by the Secretary of State have been produced in conjunction with Building Regulation 2010 to give practical and technical guidance on how to meet the requirements of Building Regulation 2010. One of these documents is particularly relevant to this study:

- Approved Document B: Fire safety
  - Volume 1: Dwellinghouses
  - Volume 2: Buildings other than dwellinghouses

11.1.10.2 Wales

Building Regulation 2010 is also applicable in Wales. However, as of 31 December 2011, under The Welsh Minsters (Transfer of Function) (No.2) Order 2009, new regulations and guidance will be implemented by the Welsh government. One of these documents is particularly relevant to this study:

- Approved Document Part B: Fire safety
  - Approved Document B Volume 1: Dwellinghouses; and
  - Approved Document B Volume 2: Buildings other than dwellinghouses

11.1.10.3 Scotland

The Building (Scotland) Act 2003 applies in Scotland and gives Scottish Ministers the responsibility for making building standards and associated technical guidance documents, which include:

- Building standards technical handbook 2020: domestic buildings (April 2021 Addendum); and
- Building standards technical handbook 2020: non-domestic buildings (April 2021 Addendum).

11.1.10.4 Northern Ireland

The Building Regulations (Northern Ireland) 2012 applies in Northern Ireland and sets out the performance requirements for the design and construction of a building, structural alteration or extension and any material changes within a building. The Department of Finance and Personnel is responsible for publishing guidance documents to support the Building Regulation, including:

- Technical Booklet B – Materials and workmanship
- Technical Booklet C – Site preparation and resistance to contaminants and moisture
- Technical Booklet D: Structure
- Technical Booklet E – Fire Safety
- Fuel and power
  - Technical Booklet F1 – Conservation of fuel and power in dwellings

    - Technical Booklet F2 – Conservation of fuel and power in buildings other than dwellings
- Technical Booklet G – Resistance to the passage of sound
- Technical Booklet H – Stairs, ramps, guarding and protection from impact
- Technical Booklet J – Solid waste in building
- Technical Booklet K – Ventilation
- Technical Booklet L – Combustion appliances and fuel storage
- Technical Booklet M – Physical infrastructure for high-speed communications networks
- Technical Booklet N - Drainage
- Technical Booklet P – Sanitary appliances, unvented hot water storage systems and reducing the risk of scalding
- Technical Booklet R – Access to and use of buildings
- Technical Booklet V - Glazing

11.1.11 Regulatory Reform (Fire Safety) Order 2005

This order applicable only to England and Wales places the responsibility on individuals within an organisation to carry out risk assessments to identify, manage and reduce the risk of fire within a non-domestic building.

Scotland's requirements on general fire safety for non-domestic buildings are covered in Part 3 of the Fire (Scotland) Act 2005 and is supported by the Fire Safety (Scotland) Regulations 2006. Northern Ireland is supported by The Fire Safety Regulation (Northern Ireland) and The Fire and Rescue Service (Northern Ireland) Order 2006.

11.1.12 Fire Safety Act 2021

Amendment of Regulatory Reform (Fire Safety) Act, 2005 to clarify that it will apply to the structure and external walls and any common parts including all doors between domestic premises and common parts of any building containing two or more sets of domestic premises.

11.1.13 The Construction (Design and Management) Regulations 2015

The Construction (Design and Management) Regulations 2015 (the so-called 'CDM Regulations) are a set of regulations that apply to the whole construction process on all construction products from concept to completion and set out the duties of key roles within the construction process to ensure projects meet health and safety requirements. As detailed by the HSE, the CDM Regulations are intended to improve the health and safety standards of the construction industry by helping those working within it to:

- Sensibly plan the work so the risks involved are managed from start to finish;
- Have the right people for the right job at the right time;
- Cooperate and coordinate their work with others;
- Have the right information about the risks and how they are being managed;
- Communicate this information effectively to those who need to know; and
- Consult and engage with workers about the risks and how they are being managed (HSE, no date a).

Key duties defined (HSE, 2015) include:

- Principal designer: to plan, manage and coordinate the planning and design work;
- Principal contractor: to plan, manage and coordinate the construction work;
- Client: a building owner, user or managing agent having maintenance, building work or other minor works carried out in connection with a business has legal duties for the health and safety of workers during the maintenance or construction work;
- Domestic client: someone having work done on their own home, or the home of a family member must appoint a principal designer and a principal contractor when there is more than one contractor. However, if the domestic client does not appoint these roles, then their duties are automatically transferred to the contractor or principal contractor. Alternatively, a written agreement with the designer can assign the domestic client's duties to the designer.

11.1.14 Control of Substances Hazardous to Health (COSHH)

Control of Substances Hazardous to Health 2002 (COSHH) is a set of regulations to protect workers from ill health when working with specific substances and materials. According to (HSE, no date b), employers must ensure there are preventative procedures in place to reduce workers' exposure to hazardous substances by implementing a risk assessment approach and ensuring the following processes are recorded:

- Finding out what the health hazards are;
- Deciding how to prevent harm to health (risk assessment);
- Providing control measures to reduce harm to health;
- Making sure they are used;
- Keeping all control measures in good working order;
- Providing information, instruction and training for employees and others;
- Providing monitoring and health surveillance in appropriate cases;
- Planning for emergencies.

11.1.15 Procurement strategy

One key factor influencing the supply chain for any construction product is who holds the responsibility for product selection, and how detailed, fixed and specific the product specifications are. The principal designer such as the architect or engineer has responsibility for the overall design work, but the principal contractor who has purchasing responsibilities may wish to substitute products within the scope of the design specifications.

In the simplest instance, a product specified by the principal designer may be substituted by the principal contractor by agreement with the principal designer as long as the substituted product meets the specific performance requirements. The reason for the substitution could be due to product availability or budgetary constraints. For example, the supplier of thermal insulation may be changed if the original insulation is out of stock; but the material type, dimensions, and technical performance of (say) thermal insulation remain the same.

A more complicated situation may be that the principal contractor wishes to change a wall construction entirely and, as a result, the choice of thermal insulation within the wall will be affected. Again, this change will need to be agreed with the principal designer who has responsibility for the design. The reason for a larger change is likely to be similar to that for the simple change, for example due to product availability or budgetary constraints. But the change is more strategic and rather than being limited to (say) the manufacturer, it

could affect the whole product choice and in some cases be used as the reason to omit a product. For example, if a wall has a dedicated thermal insulation product within its composition comprising bricks and blocks and plasterboard, it could be changed to a whole wall manufactured with a proprietary product.

The process described briefly above is commonly referred to within the construction industry as Value Engineering or Value Management, commonly abbreviated to VE. The principle of VE is to determine the function and performance criteria and identify products at the lowest cost. There is typically a large debate during projects around the determination of alternative products meeting the criteria, especially with more complex products that form part of systems.

The above example is a straightforward overview of a simple VE exercise comparison: the reality is that the principles have a large bearing on the final product of construction. The degree to which the processes alter varies from project to project depending upon details such as the procurement strategy, detail of initial design or specification by the client, and client and other supply chain dynamics. Examples include where a contractor has only part design responsibility, budget constraints alter during a project, or differences between the contractors or client's appetite for change.

The responsibility for product selection lies with the responsibility for design, and this depends upon the procurement strategy for the project. There are many procurement strategies: traditional, design and build, management contracting, partnering, Private Finance Initiative and many others (CIOB, 2010). However, procurement strategies fall into broadly two types:

- Responsibility for design falls on the client (or their representatives such as architects and engineers); and
- Responsibility for design falls on the main contractor (or their subcontractors or installers).

The responsibility for design is often complicated with different "people" responsible at different stages and overlaps of responsibilities among professional designers (such as architects and engineers), between disciplines and between specialist contractors.

In the analysis of the supply chains, the study team will consider whether there is any clear difference between the supply chains for these two broad types and if so, describe both supply chains.

Any further consideration of the procurement strategies is a complex issue and beyond the scope of this study.

11.2 Literature review reporting template and a list of sources identified during the literature review

11.2.1 Literature review template

Main category	Source 1	Source 2
ID number		
Reference / Source (Harvard style)		
Is this source relevant? (1) Yes (2) No		
What type of analysis is this source relevant for? (1) Market analysis (2) Supply chain mapping (3) Supply chain information flows (4) Background		
Source type and source quality (1) academic paper, policy paper, grey literature, industry publication, market research report (2) quantitative data, economic study, company literature and data, (3) Robustness of evidence (Low risk of bias, risk of bias, high risk of bias) (4) Transparency (conflict of interest and funding sources declared?)		
Geographical area covered		
Time period covered		
Abstract / Summary / Scope		
Product (insulation, cladding, fire doors, fire barriers, electric cabling, general documents)		
Sub-product type		
Key components of each product		
Population (company, trade organisation, etc.) For companies, record information on company size, including micro (up to 10 persons employed), small (10-49), medium (50-249, large (250+).		
Supply chain mapping - Tier in the supply chain (1) Raw material supplier (2) Component manufacturer (3) Manufacturer (4) Distributor (5) Wholesaler/retailer (6) Installer (7) (Sub)contractor (8) Designer / client (9) Other		
Supply chain information flows		

Main category	Source 1	Source 2
Legislation / regulation/ guidelines / industry standards / schemes / obligations related to information provision - requirements and type of information (1) For individual products (please specify if particular legislation / regulation covers more than one product) (2) For individual tiers and between tiers		
Practical information about supply chain information flows Received from earlier tier (supplier)		
Practical information about supply chain information flows Send to following tier (buyer)		
Supply chain information flows - for Products Compliance, reporting and enforcement (1) Level of compliance / conformity - Quality Assurance mechanisms to check conformity (2) Level of compliance / conformity in practice (3) Communicating information on conformity (4) Enforcement mechanism (imposing restrictions, sanctions etc.) (5) Obstacles and drivers for information flows		
Supply chain information flows - for Tiers and between Tiers Compliance, reporting and enforcement (1) Level of compliance / conformity - Quality Assurance mechanisms to check conformity (2) Level of compliance / conformity in practice (3) Communicating information on conformity (4) Enforcement mechanism (imposing restrictions, sanctions etc.) (5) Obstacles and drivers for information flows		
Market analysis - Size of the market (separately for each product, and for each tier/function in the supply chain) (1) Number of companies in the sector (2) Total employment in the sector (directly employed) (3) Overall and/or average turnover of companies in the sector (include currency)		
Market analysis - Characteristics of companies (1) Size of company (incl. average size in the sector), number of branches / sites (2) Main focus of activity (3) Geographical location of companies		
Market analysis - Product market size (1) Annual volume of products (final products, components, raw material (in what unit - number of products, tonnage/kilos?) (separately for each product - defining which components are critical for a final product) Specify number and unit, e.g. 5kg per year, 1,000 fire doors per year (2) Monetary value of products (potentially as ranges)		
Market analysis - market distribution		

Main category	Source 1	Source 2
(1) Value / levels / share of imports / exports for each product / component / production / manufacturing (in terms of value / volume / percentage of products) (2) countries products imported from / exported to (3) number of products available on the market (how many) (4) pricing structure and relationship between price and quality		
Impact of Covid (whether this has already or will in the future have an impact upon supply chains, particularly bringing them closer to home)		

11.2.2 List of sources identified during literature searches

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- Davies, H. (2018) What can we learn from the Grenfell Tower disaster?: Priorities for sustainable change, Journal of Sustainable Design and Applied Research, Vol. 6(1), pp. 51-55.
- Eadie, R., Perera, S.C. (2016), The state of construction e-Business in the UK, http://usir.salford.ac.uk/id/eprint/39948/1/C__Users_pms085_Documents_CIT_CIT%20Publications_The%20State%20of%20Construction%20e-Business%20in%20the%20UK_The%20State%20of%20Const.%20e-Business%20in%20the%20UK_8Aug2016.pdf
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- Matheson, A. F., Charge, R., Corneliussen, T. (1992), Properties of PVC compounds with improved fire performance for electrical cables, Fire Safety Journal, Volume 19, Issue 1, 1992, Pages 55-72, ISSN 0379-7112, https://doi.org/10.1016/0379-7112(92)90005-W. (https://www.sciencedirect.com/science/article/pii/037971129290005W)
- Mohamed, I.F., Edwards, D.J., Mateo-Garcia, M., Costin, G. and Thwala, W.D.D., 2019. An investigation into the construction industry's view on fire prevention in high-rise buildings post Grenfell. *International journal of building pathology and adaptation*.
- Muriro, A., Woos, G.D. (2010), A comparative analysis of procurement methods used on competitively tendered office projects in the UK, http://usir.salford.ac.uk/id/eprint/23055/
- Nuss, P. and Ciuta, T. (2018), Visualization of raw material supply chains using the EU criticality datasets.
- Rodríguez-Soria, B., Domínguez-Hernández, J., Pérez-Bella, J.M. and del Coz-Díaz, J.J., 2014. Review of international regulations governing the thermal insulation requirements of residential buildings and the harmonization of envelope energy loss. Renewable and Sustainable Energy Reviews, 34, pp.78-90.
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- Vrijhoef, R. (2011), Supply chain integration in the building industry, PhD thesis. https://repository.tudelft.nl/islandora/object/uuid:bc30b618-9b1b-4389-8a19-8a3ece1fea62?collection=research
- Vrijhoef, R., Koskela, L. (2000), The four roles of supply chain management in construction, European Journal of Purchasing & Supply Management, DOI: 10.1016/S0969-7012(00)00013-7.
- Cladding Materials Library | https://claddingmaterialslibrary.com/

11.3 Stakeholders participating

Table 11-2 Stakeholders contacted and participating in the study

Stakeholder type (or representative trade association)	Number contacted	Number surveyed	Number interviewed	Number attending workshops
Trade association	40	12	17	18
Raw materials	55	9	6	
Component manufacturer	89	19		
Product manufacturer		46		
Fulfilment service provider	43	0		
Distributor (incl. building merchants, wholesalers, retailer)		20		
Installer	20	4		
Subcontractor	58	13		
Main contractor		20		
Client	1			
Stakeholder representing more than one tier	35			
Other (architect, designer, construction and service engineering, construction management, housing association)	22			

Source: RPA

The following aspects have to be noted related to engagement with stakeholders:

- Numbers refer to individuals contacted rather than organisations. On many occasions there were several individual staff members from the same organisation contacted.
- There wasn't always a clear cut in how stakeholders have been grouped in particular categories. In addition, there is also some overlap between categories. For that reason we have merged some categories of stakeholders in this table.

Table 11-3 Interviews by product and stakeholder type

	Trade association	Other interviewee type	Total
Cables	3	1	4
Cladding	3		3
Fire barriers	1		1
Fire doors	4		4
Insulation	2	1	3
All product types	4	4	8
Total	**17**	**6**	**23**

Source: RPA

11.4 Interview guide

Construction products supply chain

Details	
Name	
Email	
Name of organisation	
Country	
Name of interviewer(s)	
Date/time of call	
Confidentiality	I am happy for our organisation to be named alongside our responses I am happy for our responses to be used as long as we are not named, even if we could still be possibly identified. I do not want my responses to be identifiable as from my organisation
Are there any sections which are confidential and should not be used in the report? Please indicate these clearly.	Yes (identified) No

Section A: Introduction

Risk and Policy Analysts Ltd (RPA) (www.rpaltd.co.uk) is undertaking this study for the Office for Product Safety & Standards (OPSS) which sits within the Department for Business, Energy & Industrial Strategy (BEIS).

The study is mapping supply chains to understand:

- characteristics of the construction products' market,
- procurement processes and practices across the construction products' supply chains, and
- flow of information between suppliers and buyers in the supply chains.

The study focuses on five construction products: cables, cladding, fire barriers, fire doors and insulation. This study involves the collection of information from key stakeholders across the UK through questionnaires, interviews, focus groups and workshops.

Ask about permission to record interview.

Question	Response
Role and organisation of interviewee	
What is your role/experience related to construction products?	
What is your organisation's scope (which of the study's construction product(s) do you cover)? Tick all that apply.	Cables Cladding Fire barriers Fire doors Insulation
What is your organisation's: • size (number of members), • location	
What is your members typical function in the supply chain? Tick all that apply.	
What is the typical profile of your members: • location of members (UK-based, international) • size of members' companies	
Can you tell us who are your most important or largest members? Particularly those relevant to the study? Can you put us in touch with the right person to speak to there?	
Market size	
What volume and/or value of the UK's market (per construction product) do your members cover? If total not known for all members, what is the market volume and/or value of the most important / largest members? (Estimates/best guess is helpful: how many zeroes or to the nearest 10%.)	

How important are imports and exports for your members (for their products / components relating to the study)? • For buying components / products • For selling components / products Does it differ between members / products?	
Are there any important market trends and/or other factors that influence you and your members' way of working, their products, relationships with their buyers and suppliers? Tick all that apply.	New legislation and regulations related to products' content and/or safety New legislation and regulations related to importing and/or exporting [product] and components New product and/or component development Changing demand in the construction industry in the UK Changing demand in the construction industry outsize of the UK Other factors. Please specify.
What are the main challenges that your members have experienced in the last two years?	
Supply chain mapping	
Who is your organisation / your members working with in the construction products supply chain: • other trade associations / bodies, • key buyers • key suppliers Can you put us in touch with the right person to speak to there?	
Is there a prominent pattern for your members' products procurement routes: • contractor design (design and build),	

• client design (traditional). What factor(s) determine the purchasing routes?	
To what extent do you think your members have mapped their supply chain processes showing the flow of materials from their suppliers to them right back to the source of raw materials?	
To what extent do you think your members understand how their products are used by their buyers, and move up in the supply chain to the point of being installed?	
Information flows	
Do your members have any processes in place to ensure the flow of information from their suppliers and to their buyers?	
What are the main drivers and obstacles in the supply chain information flows?	
Are there any regulations and/or industry standards related to information provision in the supply chain? If yes, <u>what type of information</u> do they cover? Tick all that apply	Information about product's content Information about products' intended / recommended use Information about health and safety risks and other hazards Installation information Other. Please specify.
Does your organisation have any processes to check whether and how your members comply with those regulations and/or industry standards related to information provision in the supply chain? Do you know whether / to what extent your members comply with those requirements?	

What is your estimate of the proportion of the [product] component and product companies in the UK as a whole to be fully or partly compliant with these requirements related to information provision?	
General	
Given that the objective of this study is to give you an opportunity to contribute to the current evidence collection to highlight the current state of play and to raise any concerns you may have in regard to the supply chain in relation to the construction products regulations - are there any particular aspects that you think this study should cover, and/or OPSS should consult stakeholders about? Why? Which aspects / stakeholders? In what timeframe?	
Do you have any other comments?	
Do you have any evidence, reports, data that you can share with us to provide more detail on the areas of interest to this study?	
Would you be willing to pilot the online survey questionnaire?	
Are you happy for the study team to contact you for further clarification or discussion about your responses?	

11.5 Privacy statement

The table below provides the privacy notice for online survey data which will be obtained and used for the study.

11.5.1 Data processing descriptor	11.5.2 Narrative
Identity of the data controller	The Office for Product Safety and Standards (the Office) which is part of the Department for Business, Energy and Industrial Strategy (BEIS) Address: 1 Victoria Street, London, SW1H 0ET, UK Switchboard: +44 300 068 5884 / +447733111604 Email: Shireen.Bobat@beis.gov.uk
Identity of the data processor	RPA project manager: Sophie Garrett Address: Risk & Policy Analysts (RPA) Ltd Suite C, 2nd Floor, The Atrium, St Georges Street, Norwich, Norfolk, NR3 1AB, UK Switchboard: 01603 558442 Email: sophie.garrett@rpaltd.co.uk
Subject matter of the processing	The processing is needed to enable RPA to carry out their contract to analyse and map the construction products supply chain.
Duration of the processing	Duration of the contract (expected to be from November 2021 to end of June 2022)
Nature and purposes of the processing	Storage of data on RPA's computer systems in a secure manner in line with our data protection policies; Analysis of data provided to and gathered by RPA to analyse the supply chains of construction products; Reporting of results to OPSS in a draft final report and final report.
Type of personal data	***Data collected by RPA:*** Contact details for stakeholders (name of contact, address, telephone number, email address);

	Survey responses from stakeholders.
Categories of data subject	Stakeholders
Plan for return and destruction of the data once the processing is complete	Analysis to be retained in case of queries.

11.6 Email to survey participants

Dear xxxxxxxxxx

I am contacting you regarding **the Construction products supply chain study** that Risk & Policy Analysts UK Ltd (RPA) is currently carrying out **for the Department for Business, Energy & Industrial Strategy (BEIS)**. I sent you an initial email about this study in early January.

The study is mapping supply chains to understand:

1 characteristics of the construction products' market,

2procurement processes and practices across the construction products' supply chains, and

3 flow of information between suppliers and buyers in the supply chains.

We are currently **launching an online survey** and very much hope you can **help us by distributing the survey links to your members and associates**.

The survey focuses on a selected range of construction products, including cables, cladding, fire barriers, fire doors and insulation. **If your organisation's and/or your members' activities are relevant to more than one product, please complete a separate survey questionnaire for each product.**

Given the different roles of stakeholders in the construction products supply chain, we have prepared **separate surveys for each stakeholder type**. Please complete the survey questionnaire most relevant for your area of activity in the supply chain.

- **Trade associations**: https://www.smartsurvey.co.uk/s/ConstructionProductsTradeAssociations/
- **Raw materials suppliers**: https://www.smartsurvey.co.uk/s/ConstructionProductsRawMaterialsSuppliers/
- **Manufacturers of Components and End Products**: https://www.smartsurvey.co.uk/s/ConstructionProductsManufacturers/
- **Distributors, Wholesalers and Retailers**: https://www.smartsurvey.co.uk/s/ConstructionProductsDistributorsWholesalersRetailers/
- **Installers, Sub-contractors and Main contractors**: https://www.smartsurvey.co.uk/s/ConstructionProductsInstallersSubcontractorsMainContractors

The **deadline** for submitting your survey answers is the **11th of March 2022**.

You will find the supporting letter from OPSS [here], the Frequently Asked Questions document [here] and the privacy statement [here]. These documents are also embedded in the survey questionnaire.

Please do not hesitate to get in touch if you would like any further information on this project.

Many thanks in advance for all your help.

11.7 Online survey questionnaire

There were five separate questionnaires:

- Trade associations:
- Raw materials suppliers:
- Manufacturers of Components and End Products:
- Distributors, Wholesalers and Retailers:
- Installers, Sub-contractors and Main contractors:

Many of the questions are the same in each questionnaires, or similar, and are best analysed together for each of the five products.

Throughout the questionnaire, a code was often used to indicate the tier to the study team and these appear in the questionnaire below, to avoid repeating five similar questionnaires. This makes it easier to work out which questions relate to each other. In the tables below are numbers: these refer to the question numbers in the specific questionnaire. The interrelationship between the questions in the different questionnaires is also shown in 11.8

Code	Tier in supply chain
None	Trade association
A	Raw materials supplier A
B	Manufacturer of components B
C	Manufacturer of end product C
D	Distributor D
E	Wholesaler E
F	Retailer F
G	Installer G
H	Sub-contractor H
I	Main contractor I

Questionnaire

The Office for Product Safety & Standards (OPSS) which sits within the Department for Business, Energy & Industrial Strategy (BEIS) has commissioned Risk & Policy Analysts (RPA), together with BWL Consulting, to conduct a study to develop its evidence base for construction products. This research will review current practices across the construction products' supply chains and provide insight into how the supply chains operate. This research will form a baseline on the basis of which future research proposals, focusing on different aspects of the construction products' supply chains, are expected to be developed.

The study focuses on a selected range of construction products, including:

- Cables
- Cladding
- Fire barriers
- Fire doors
- Insulation

This study involves the collection of information from key stakeholders across the UK through questionnaires, interviews, focus groups and workshops.

The aim of this survey is to give you an opportunity to contribute to the current evidence collection to highlight the current state of play and to raise any concerns you may have in regard to the supply chain in relation to the construction products regulations. You can access a support letter from OPSS (here) and the answers to some frequently asked questions (here).

If your organisation's activities are relevant to more than one product, please complete a separate survey questionnaire for each product.

The deadline for submitting your answers is the 6th of April 2022.

If you have any questions about the survey, please contact: constructionproducts@rpaltd.co.uk

The survey is conducted in line with the ethical principles of informed consent and voluntary participation. Your responses will be handled in the strictest confidence by RPA. Personal details (name, organisation name) will not be published. Information about your organisation (size, location, products) will be reported in an anonymised summary format. RPA works hard to ensure that your organisation cannot be identified from these details. Your response will be only used for the purpose of this study.

Yes, I agree to take part in this study. ☐ (Question 1 in all versions of the survey)

Please provide the following details about your organisation		Trade Associations	A	B/C	D/E/F	G/H/I
First name*	Open text	2	2	2	2	2
Surname*	Open text	3	3	3	3	3
Email address*	Open text	4	4	4	4	4
What is your organisation's name? *	Open text	5	5	5	5	5
Type of organisation*	☐ Trade association ☐ Raw materials supplier A ☐ Manufacturer of components B ☐ Manufacturer of end product C ☐ Distributor D ☐ Wholesaler E ☐ Retailer F ☐ Installer G ☐ Sub-contractor H ☐ Main contractor I			6	6	6
Please indicate the size of your company	☐ Micro (<10 employees) ☐ Small (11-50 employees) ☐ Medium (51-250 employees) ☐ Large (>250 employees)		6	7	7	7
Where is your company's main location/headquarters in the UK?	☐ England ☐ Wales ☐ Scotland ☐ Northern Ireland ☐ Not located in the UK. Please specify where your company is located		7	8	8	8

Please provide the following details about your organisation		Trade Associations	A	B/C	D/E/F	G/H/I
Which of the following products are relevant to your company's business activities? * Please select the product for which you are completing this survey. If more than one product is relevant to you, please complete a separate survey questionnaire for each product.	☐ cables(s) ☐ cladding ☐ fire barrier(s) ☐ fire door(s) ☐ insulation		8	9	9	9
Are there any particular types of [product] that are particularly relevant to your organisation?	Open text			10	10	10

All types of company except trade association

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
A **What is <u>the value</u> of your company's sales contributing to [product] in the UK?** (Please estimate/round to give the number of zeroes and the first number, e.g. £600,000, £8 million etc.)	(open text box)		9			
B to I **What is <u>the value</u> of your company's sales for [product] in the UK?**	(open text box)			11	11	11

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
(Please estimate/round to give the number of zeroes and the first number, e.g. £600,000, £8 million etc.)						
A **What is <u>the volume</u> of your company's sales contributing to [product] in the UK?** Please estimate using the appropriate units for the product: • Cabling – km • Cladding – m^2 • Insulation – m^3 • Fire doors – number • Fire barriers – number or m^3	(open text box)		10			
B to I **What is <u>the volume</u> of your company's sales for [product] in the UK?** Please estimate using the appropriate units for the product: • Cabling - km • Cladding - m^2 • Insulation - m^3 • Fire doors - number • Fire barriers - number or m^3	(open text box)			12	12	12
Relationships with suppliers						
B and C	(Open text box)			13		

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
What are the main raw materials or components for your [product]? How many suppliers do you have for each?						
D/E **How many [product] manufacturers supply you?**	(Open text box)				13	
G/H/I **How many product manufacturers supply you with [product]?**	(Open text box)					13
G, H and I **Which type of supplier do you use for [product]?** Please indicate the share of [product] per supplier type. For instance, 60% of your products are sourced by distributors and 40% are sourced by your sub-contractors.	☐ Product manufacturer (ourselves) (open text box in %) ☐ Product manufacturer (third party) ☐ Distributor (open text box in %) ☐ Wholesaler (open text box in %) ☐ Retailer (open text box in %) ☐ Sub-contractor (open text box in %) ☐ Main contractor (open text box in %) ☐ Client (open text box in %) ☐ Other (open text box in %) Please specify					14
B and C **Where do you source the raw materials and components for your [product] from?**	☐ Predominantly from the UK (over 50% of components and/or products) ☐ Predominantly from outside of the UK			14		

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
	☐ I don't know					
G, H and I **Who are your main suppliers of [product]?** Please specify their names and location.	(Open text box)					15
B/C **Who defines your [product] specification?** Please indicate the percentage of [product] specified by the following stakeholders/factors.**:**	☐ Standard specification to meet the minimum standards (open text box in %) ☐ Contractor design specification (open text box in %) ☐ Client design specification (open text box in %) ☐ Other parties. Please specify.			15		
G/H/I **Who defines your product(s) specification?** Please indicate the percentage (in %) of product(s) specified by the following stakeholders/factors**:**	☐ Standard specification to meet the minimum standards (open text box in %) ☐ Contractor design specification (open text box in %) ☐ Client design specification (open text box in %) ☐ Other parties. Please specify.					16
B/C, G/H/I **If you answered 'other parties', please specify.**	Open text			15a		16a
G/H/I **To what extent do you have flexibility to substitute alternative product(s)?**	☐ Fully ☐ Not at all ☐ It varies. Please specify.					17

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
	☐ Don't know					
G/H/I **If you answered 'it varies', please specify:**	Open text					17a
B to I **To what extent do you agree with the following statements relating to [product]:** We have mapped our supply chain processes showing the flow of material coming from suppliers. Our company is aware of the critical component and raw material suppliers. Our company is aware of the financial stability of our key suppliers. We have mapped the geographical location of our critical supplier(s). We have documented processes for dealing with suppliers. Our company has visually mapped out the key information about our suppliers in the supply chain.	For each sub question: ☐ Yes ☐ No ☐ Don't know			16	14	18
Information Flows						

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
B to I **What type of information does your company receive from your suppliers of [product] components and products?** (Select all that apply)	☐ Information about product's content (technical specification) ☐ Information about product's regulatory compliance and/or certification (e.g. CE marking) ☐ Information about products' intended / recommended use ☐ Information about health and safety risks and other hazards ☐ Installation information ☐ Other (please specify):			17	15	19
B to I **In what format is the following information provided**? ☐ Data safety sheet ☐ Technical manuals ☐ Brochure/leaflet ☐ Unique ID on product giving access online to info ☐ Information on product ☐ Information on packaging ☐ Manufacturers' training	☐paper format ☐ online / digital format ☐ both paper and online / digital format ☐ face-to-face training ☐ online training ☐ supplied ☐ not supplied			18	16	20
B to I **Do you receive the same type and format of information from all of your suppliers?**	☐ Yes ☐ No, it varies. Please specify.			19	17	21

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
	☐ Don't know					
B to I **If you selected 'no, it varies', please specify:**	Open text			19a	17a	21a
B to I **Does your company have any processes in place to ensure flow [of] information from your suppliers?**	☐ Yes (please specify) ☐ No ☐ Don't know			20	18	22
B to I **If you answered 'yes' please specify:**	Open text			20a	18a	22a
B to I **In your professional opinion, to what extent are the manufacturers guidelines/instructions complete?**	☐ Fully ☐ Not at all ☐ They vary. Please specify. ☐ Don't know			21	19	23
B to I **If you selected 'they vary', please specify:**	Open text			21a	19a	23a
B and C **Please provide up to five regulations and/or industry standards related to [product] that you have to comply with.**	(Open text box)			22		
B and C **Do you find it challenging to comply with any of these regulations and/or industry standards?**	Open text			23		

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
B to I **In your professional opinion, to what extent <u>are your suppliers</u> of [product] compliant with <u>Construction Products Regulations Directive?</u>**	☐ Fully ☐ Partly ☐ Not at all ☐ Don't know			24	20	24
B to I **In your professional opinion, to what extent <u>your suppliers</u> of [product] compliant with <u>industry standards</u>?**	☐ Fully ☐ Partly ☐ Not at all ☐ Don't know			25	21	25
B to I **In your professional opinion, to what extent is <u>the rest of the sector</u> for [product] compliant with <u>Construction Products Regulations Directive</u>?**	☐ Fully ☐ Partly ☐ Not at all ☐ Don't know			26	22	26
B to I **In your professional opinion, to what extent is <u>the rest of the sector</u> for [product] compliant with <u>industry standards</u>?**	☐ ☐ Fully ☐ Partly ☐ Not at all ☐ Don't know			27	23	27
B to I **How do your suppliers share information about their conformity with the information flow requirements?** (Select all that apply)	☐ Displaying a logo/label/compliance mark on the product/packaging ☐ Quality declaration / self-certification statement ☐ Publishing a list of certified products, e.g. online			28	24	28

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
	☐ Cross-link to published reports or databased by regulators or independent assessors confirming conformity ☐ They do not share information about conformity ☐ Don't know ☐ Other (please specify): [Open text]					
B/C **Who is this information provision targeted at?** (Select all that apply)	End-product manufacturer (open text box in %) ☐ Distributor (open text box in %) ☐ Wholesaler (open text box in %) ☐ Retailer (open text box in %) ☐ Installer ☐ Sub-contractor (open text box in %) ☐ Main contractor (open text box in %) ☐ Client (open text box in %) ☐ Other stakeholders (please specify) [open text box in %] [open text]			29		

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
D to I **Who is this information provision targeted at?** (Select all that apply)	☐ Distributor (open text box in %) ☐ Wholesaler (open text box in %) ☐ Retailer (open text box in %) ☐ Installer ☐ Sub-contractor (open text box in %) ☐ Main contractor (open text box in %) ☐ Client (open text box in %) ☐ Other stakeholders (please specify) [open text box in %] [open text]				25	29
B to I **Does the end use of the product and size of the project have an impact on the supply chains process for [product]? If yes, how?** For example: domestic, non-domestic buildings or large infrastructural projects, projects under £5 million compared with those between £5 million and £50 million, or those above £50 million	(Open text box)			30	26	30
B to I **Does the type of contract used have any influence on the supply chain process for [product]? If yes, how?**	(Open text box)			31	27	31

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
For example: traditional contract, design and build, management contract or PFI contract.						
Relationships with buyers						
A **Who are you supplying raw materials for [product] to?** Please indicate the percentage of your sales per type of client.	☐ Manufacturer of product component (open text box in %) ☐ Manufacturer of end product (open text box in %) ☐ Distributor (open text box in %) ☐ Other, please specify (open text box in %)		11			
B/C **Who are you supplying [product] or components of [product] to?** Please indicate the percentage of your sales per type of buyer.	☐ Manufacturer of end product (open text box in %) ☐ Distributor (open text box in %) ☐ Wholesaler (open text box in %) ☐ Retailer (open text box in %) ☐ Installer (ourselves) (open text box in %) ☐ Installer (third party) (open text box in %) ☐ Sub-contractor (open text box in %) ☐ Main contractor (open text box in %) ☐ Client (developer, housing association etc) (open text box in %) ☐ Other, please specify			32		

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
D/E/F **Who are you supplying [product] to?** Please indicate the percentage of your sales per type of buyer.	☐ Distributor (open text box in %) ☐ Wholesalers (open text box in %) ☐ Retailers (open text box in %) ☐ Installer (open text box in %) ☐ Sub-contractor (open text box in %) ☐ Main contractor (open text box in %) ☐ Client (developer, housing association etc) (open text box in %) ☐ Other, please specify				28	
A-I **If you answered 'other', please specify.**	Open text		11a	32a	28a	
B - F **Where do you sell [product] to?** Please indicate the approximate percentage of sales to particular regions.	☐ UK (open text box in %) ☐ EU (open text box in %) ☐ Rest of the world (open text box in %) ☐ I don't know (open text box in %)			33	29	
B/C **Who are your main buyers of [product]?** Please specify their names and location.	(Open text box)			34		
A - F **To what extent do you agree with the following statements relating to [product]?**	For each sub question: ☐ Yes ☐ No		12	35	30	

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
We have mapped the geographical location of our customers. We can visualise the flow of goods from our company to customers. We get information from our customers about their demand. We have mapped the flow of products in the downstream supply chain. We can visualise the flow of goods from our company to our customers' customers. The mapping of our downstream supply chain processes permits our company to identify areas for further analysis. We have documented processes for dealing with buyers.	☐ Don't know					
A **What type of information does your company share with your buyers of materials for {product]?** (Select all that apply)	☐ Information about product's content (technical specification) ☐ Information about product's regulatory compliance and/or certification (e.g. CE mark) ☐ Information about products' intended / recommended use		13			

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
	☐ Information about health and safety risks and other hazards ☐ Installation information ☐ Other (please specify): [Open text]					
B to F **What type of information does your company share with your buyers of [product]?** (Select all that apply)	☐ Information about product's content (technical specification) ☐ Information about product's regulatory compliance and/or certification (e.g. CE mark) ☐ Information about products' intended / recommended use ☐ Information about health and safety risks and other hazards ☐ Installation information ☐ Other (please specify): [Open text]			36	31	
A - F **In what format is the following information provided?** ☐ Data safety sheet ☐ Technical manuals ☐ Brochure/leaflet ☐ Unique ID on product giving access online to info ☐ Information on product ☐ Information on packaging	☐paper format ☐ online / digital format ☐ both paper and online / digital format ☐ face-to-face training ☐ online training ☐ supplied ☐ not supplied		14	37	32	

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
☐ Manufacturers' training						
A **Do you share the same type and format of information with all your buyers of materials for [product]?**	☐ Yes ☐ No, it varies. Please specify ☐ Don't know		15			
B to F **Do you share the same type and format of information with all your buyers of [product]?**	☐ Yes ☐ No, it varies. Please specify ☐ Don't know			38	33	
A-F **If you selected 'no, it varies', please specify below:**	Open text		15a	38a	33a	
A **Does your company have in place any processes to ensure flow of information to your buyers of materials for [product]?**	☐ Yes. Please specify ☐ No ☐ Don't know		16			
B - F **Does your company have in place any processes to ensure flow of information to your buyers of [product]?**	☐ Yes. Please specify ☐ No ☐ Don't know			39	34	
A – F **If you selected 'yes', please specify below:**	Open text		16a	39a	34a	
A - F **To what extent is your company compliant with existing legislation and/or industry**	☐ Fully ☐ Partly, please specify ☐ Not at all, please specify why		17	40	35	

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
standards related to information provision requirements?						
A – F **If you selected 'partly', or 'not at all', please specify below:**	Open text		17a	40a	35a	
A - F **How does your company share information about conformity with the information flow requirements?** (Select all that apply)	☐ Displaying a logo/label/compliance mark on the product/packaging ☐ Quality declaration / self-certification statement ☐ Publishing a list of certified products, e.g. online ☐ Cross-link to published reports or databased by regulators or independent assessors confirming conformity ☐ My company does not share information about conformity ☐ Don't know ☐ Other. Please specify: [Open text]		18	41	36	
A **Who is this information provision targeted at?** (Select all that apply)	☐ Component and end-product manufacturers ☐ Installers, sub-contractors, main contractors ☐ Consumers		19			

Zooming in into specific product						
Market size		**Trade Associations**	**A**	**B/C**	**D/E/F**	**G/H/I**
	☐ Other stakeholders. Please specify: [Open text]					
B/C **Who is this information provision targeted at?** (Select all that apply)	☐End-product manufacturers ☐ Installers, sub-contractors, main contractors ☐ Consumers ☐ Other stakeholders. Please specify: [Open text]			42		
D/E/F **Who is this information provision targeted at?** (Select all that apply)	☐ Installers, sub-contractors, main contractors ☐ Consumers ☐ Other stakeholders. Please specify: [Open text]				37	
Additional information requests						
Are there any particular aspects that you think this study should cover, and/or OPSS should consult stakeholders about?	Open text		20	43	38	32
Is there anything else you would like to add?	Open text		21	44	39	33
Please tick if you are happy for the study team to contact you for further clarification or discussion about your responses?	☐ Yes.					

Trade association

Please provide the following details about your organisation

First name	Open text	2
Surname	Open text	3
Email address	Open text	4
What is your organisation's name?	Open text	5
How many members do you have?	Open text	6
What is the geographical location of your members? Please select all that apply.	☐ England ☐ Wales ☐ Scotland ☐ Northern Ireland ☐ Not located in the UK. Please specify where your company is located.	7
What function do your members have in the construction products supply chain? (Please select all that apply)	☐ Raw materials supplier ☐ Manufacturer of component(s) ☐ Manufacturer of end product(s) ☐ Distributor ☐ Installer ☐ Sub-contractor ☐ Main contractor ☐ Designer/ (architect, consulting engineer etc) ☐ Client (developer, housing association, etc) ☐ Other (please specify): [Open text]	8
Which of the following construction products are relevant to your members' business activities? Please select the product for which you are completing this survey. If more than one product is relevant to your members' business activities, please complete a separate survey questionnaire for each product.	☐ cable(s) ☐ cladding ☐ fire barrier(s) ☐ fire door(s) ☐ insulation	9
Zooming in into specific [product]		
What is <u>the value</u> of the UK's market for [product] and major sub-types of [product]? (Estimates/best guess is helpful: how many zeroes)	(Open text box)	10
What share in terms of the value of the UK's [product] market do your members cover?	☐ <20% ☐ 21-40%	11

	☐ 41-60% ☐ 61-80% ☐ 81-100% ☐ I don't know	
What is the volume of the UK's market for [product] and major sub-types of [product]? (Estimates/best guess is helpful: how many zeroes)	Open text	12
What share in terms of the volume of the UK's [product] market do your members cover?	☐ <20% ☐ 21-40% ☐ 41-60% ☐ 61-80% ☐ 81-100% ☐ I don't know	13
How important are imports of [product] for your members?	☐ Very important ☐ Important ☐ Neutral ☐ Not important ☐ Not important at all ☐ I don't know	14
What share of [product] sold in the UK are imported from other countries?	☐ <20% ☐ 21-40% ☐ 41-60% ☐ 61-80% ☐ 81-100% ☐ I don't know	15
What share of [product] made in the UK are exported and sold in other countries?	☐ <20% ☐ 21-40% ☐ 41-60% ☐ 61-80% ☐ 81-100% ☐ I don't know	16

Are there any regulations and/or industry standards related to [product] information provision in the supply chain?	☐ Yes (route to next question) ☐ No ☐ Don't know	17
If you answered 'yes', please specify the main regulations and/or industry standards related to [product] information provision in the supply chain?	Open text	17a
Does your organisation have any processes to check whether and how your members comply with those regulations and/or industry standards related to information provision in the supply chain?	☐ Yes. Please specify. ☐ No ☐ Don't know	18
If you answered 'yes', please specify below:	Open text	18a
What are the main challenges that your members have experienced in the last two years?	(Open text box)	19
Do you have any evidence, reports, data that you can share with us to provide more detail on the areas of interest to this study? If yes, please specify document titles, websites etc.	(Open text box)	20
Wrapping up		
Are there any particular aspects that you think this study should cover, and/or OPSS should consult stakeholders about?	(Open text box)	21
Is there anything else you would like to add?	(Open text box)	22
Please tick if you are happy for the study team to contact you for further clarification or discussion about your responses?	☐ Yes.	

11.8 Survey questions and question numbers

Section	Absolute number	Question	A	B/C	D/E/F	G/H/I	Trade associations
Stakeholder information	2	First name*	Y	Y	Y	Y	Y
Stakeholder information	3	Surname*	Y	Y	Y	Y	Y
Stakeholder information	4	Email address*	Y	Y	Y	Y	Y
Stakeholder information	5	What is your organisation's name? *	Y	Y	Y	Y	Y
Stakeholder information	6	Type of organisation*	N	Y	Y	Y	N
Stakeholder information	7	Please indicate the size of your company	Y	Y	Y	Y	N
Stakeholder information	8	Where is your company's main location/headquarters in the UK?	Y	Y	Y	Y	N
Stakeholder information	9	Which of the following products are relevant to your company's business activities? *	Y	Y	Y	Y	N
Stakeholder information	10	Are there any particular types of [product] that are particularly relevant to your organisation?	N	Y	Y	Y	N
Stakeholder information	11	How many members do you have?	N	N	N	N	Y
Stakeholder information	12	What is the geographical location of your members? Please select all that apply.	N	N	N	N	Y

Section	Absolute number	Question	A	B/C	D/E/F	G/H/I	Trade associations
Stakeholder information	13	What function do your members have in the construction products supply chain? (Please select all that apply)	N	N	N	N	Y
Stakeholder information	14	Which of the following construction products are relevant to your members' business activities? Please select the product for which you are completing this survey. If more than one product is relevant to your members' business activities, please complete a separate survey questionnaire for each product.	N	N	N	N	Y
Market size	15	What is the value of your company's sales for [product] in the UK? (Please estimate/round to give the number of zeroes and the first number, e.g. £600,000, £8 million etc.)	Y	Y	Y	Y	N
Market size	16	What is the volume of your company's sales for [product] in the UK? Please estimate using the appropriate units for the product.	Y	Y	Y	Y	N
Relationship with suppliers	17	What are the main raw materials or components for your [product]? How many suppliers do you have for each?	N	Y	N	N	N
Relationship with suppliers	18	How many [product] manufacturers supply you?	N	N	Y	Y	N
Relationship with suppliers	19	Which type of supplier do you use for [product]? Please indicate the share of [product] per supplier type. For instance, 60% of your products are sourced by distributors and 40% are sourced by your sub-contractors.	N	N	N	Y	N
Relationship with suppliers	20	Where do you source the raw materials and components for your [product] from?	N	Y	N	N	N

Section	Absolute number	Question	A	B/C	D/E/F	G/H/I	Trade associations
Relationship with suppliers	21	Who are your main suppliers of [product]? Please specify their names and location.	N	N	N	Y	N
Relationship with suppliers	22	Who defines your product(s) specification? Please indicate the percentage (in %) of product(s) specified by the following stakeholders/factors: If you answered 'other parties', please specify.	N	Y	N	Y	N
Relationship with suppliers	23	To what extent do you have flexibility to substitute alternative product(s)? If you answered 'it varies', please specify.	N	N	N	Y	N
Relationship with suppliers	24	To what extent do you agree with the following statements relating to [product]: [6 statements]		Y	Y	Y	N
Information flows	25	What type of information does your company receive from your suppliers of [product] components and products? (Select all that apply)	N	Y	Y	Y	N
Information flows	26	In what format is the following information provided?	N	Y	Y	Y	N
Information flows	27	Do you receive the same type and format of information from all of your suppliers? If you selected 'no, it varies', please specify.	N	Y	Y	Y	N
Information flows	28	Does your company have any processes in place to ensure flow [of] information from your suppliers? If you answered 'yes' please specify.	N	Y	Y	Y	N
Information flows	29	In your professional opinion, to what extent are the manufacturers guidelines/instructions complete? If you selected 'they vary', please specify.	N	Y	Y	Y	N

Section	Absolute number	Question	A	B/C	D/E/F	G/H/I	Trade associations
Information flows	30	Please provide up to five regulations and/or industry standards related to [product] that you have to comply with.	N	Y	N	N	N
Information flows	31	Do you find it challenging to comply with any of these regulations and/or industry standards?	N	Y	N	N	N
Information flows	32	In your professional opinion, to what extent are your suppliers of [product] compliant with Construction Products Regulations Directive?	N	Y	Y	Y	N
Information flows	33	In your professional opinion, to what extent your suppliers of [product] compliant with industry standards?	N	Y	Y	Y	N
Information flows	34	In your professional opinion, to what extent is the rest of the sector for [product] compliant with Construction Products Regulations Directive?	N	Y	Y	Y	N
Information flows	35	In your professional opinion, to what extent is the rest of the sector for [product] compliant with industry standards?	N	Y	Y	Y	N
Information flows	36	How do your suppliers share information about their conformity with the information flow requirements? (Select all that apply)	N	Y	Y	Y	N
Information flows	37	Who is this information provision targeted at? (Select all that apply)	N	Y	N	N	N
Information flows	38	Who is this information provision targeted at? (Select all that apply)	N	N	Y	Y	N
Information flows	39	Does the end use of the product and size of the project have an impact on the supply chains process for [product]? If yes, how?	N	Y	Y	Y	N

Section	Absolute number	Question	A	B/C	D/E/F	G/H/I	Trade associations
Information flows	40	Does the type of contract used have any influence on the supply chain process for [product]? If yes, how?	N	Y	Y	Y	N
Relationships with buyers	41	Who are you supplying raw materials for [product] to? Please indicate the percentage of your sales per type of client. If you answered 'other', please specify.	Y	N	N	N	N
Relationships with buyers	42	Who are you supplying [product] or components of [product] to? Please indicate the percentage of your sales per type of buyer. If you answered 'other', please specify.	N	Y	N	N	N
Relationships with buyers	43	Who are you supplying [product] to? Please indicate the percentage of your sales per type of buyer. If you answered 'other', please specify.	N	N	Y	N	N
Relationships with buyers	44	Where do you sell [product] to? Please indicate the approximate percentage of sales to particular regions.	N	Y	Y	N	N
Relationships with buyers	45	Who are your main buyers of [product]? Please specify their names and location.	N	Y	N	N	N
Relationships with buyers	46	To what extent do you agree with the following statements relating to [product]? [7 statements]	Y	Y	Y	N	N
Relationships with buyers	47	What type of information does your company share with your buyers of materials for {product]? (Select all that apply)	Y	N	N	N	N
Relationships with buyers	48	What type of information does your company share with your buyers of [product]? (Select all that apply)	Y	Y	Y	N	N
Relationships with buyers	49	In what format is the following information provided? [7 statements]	Y	Y	Y	N	N

Section	Absolute number	Question	A	B/C	D/E/F	G/H/I	Trade associations
Relationships with buyers	50	Do you share the same type and format of information with all your buyers of materials for [product]? If you selected 'no, it varies', please specify below.	Y	N	N	N	N
Relationships with buyers	51	Do you share the same type and format of information with all your buyers of [product]? If you selected 'no, it varies', please specify below.	N	Y	Y	N	N
Relationships with buyers	52	Does your company have in place any processes to ensure flow of information to your buyers of materials for [product]? If you selected 'yes', please specify below.	Y	N	N	N	N
Relationships with buyers	53	Does your company have in place any processes to ensure flow of information to your buyers of [product]? If you selected 'yes', please specify below.	N	Y	Y	N	N
Relationships with buyers	54	To what extent is your company compliant with existing legislation and/or industry standards related to information provision requirements? If you selected 'partly', or 'not at all', please specify below.	Y	Y	Y	N	N
Relationships with buyers	55	How does your company share information about conformity with the information flow requirements? (Select all that apply)	Y	Y	Y	N	N
Relationships with buyers	56	Who is this information provision targeted at? (Select all that apply)	Y	N	N	N	N
Relationships with buyers	57	Who is this information provision targeted at? (Select all that apply)	N	Y	N	N	N
Relationships with buyers	58	Who is this information provision targeted at? (Select all that apply)	N	N	Y	N	N

Section	Absolute number	Question	A	B/C	D/E/F	G/H/I	Trade associations
Specific product	59	What is the value of the UK's market for [product] and major sub-types of [product]? (Estimates/best guess is helpful: how many zeroes)	N	N	N	N	Y
Specific product	60	What share in terms of the value of the UK's [product] market do your members cover?	N	N	N	N	Y
Specific product	61	What is the volume of the UK's market for [product] and major sub-types of [product]? (Estimates/best guess is helpful: how many zeroes)	N	N	N	N	Y
Specific product	62	What share in terms of the volume of the UK's [product] market do your members cover?	N	N	N	N	Y
Specific product	63	How important are imports of [product] for your members?	N	N	N	N	Y
Specific product	64	What share of [product] sold in the UK are imported from other countries?	N	N	N	N	Y
Specific product	65	What share of [product] made in the UK are exported and sold in other countries?	N	N	N	N	Y
Specific product	66	Are there any regulations and/or industry standards related to [product] information provision in the supply chain? If you answered 'yes', please specify the main regulations and/or industry standards related to [product] information provision in the supply chain?	N	N	N	N	Y
Specific product	67	Does your organisation have any processes to check whether and how your members comply with those regulations and/or industry standards related to	N	N	N	N	Y

Section	Absolute number	Question	A	B/C	D/E/F	G/H/I	Trade associations
		information provision in the supply chain? If you answered 'yes', please specify below.					
Specific product	68	What are the main challenges that your members have experienced in the last two years?	N	N	N	N	Y
Wrapping up	69	Do you have any evidence, reports, data that you can share with us to provide more detail on the areas of interest to this study? If yes, please specify document titles, websites etc.	N	N	N	N	Y
Wrapping up	70	Are there any particular aspects that you think this study should cover, and/or OPSS should consult stakeholders about?	a	a	a	a	a
Wrapping up	71	Is there anything else you would like to add?	a	a	a	a	a

11.9 Survey analysis - cables

11.9.1 Survey respondent statistics

For the product of cables, there were Twenty-five survey respondents. Not all of the respondents answered every question.

Table 11-4 Type of organisation (N=25)

Survey	Number of respondents (percentage (n))	Type of organisation	Number of respondents (percentage (n))
G/H/I	68% (17)	Sub-contractor	52% (13)
		Main contractor	8% (2)
		Installer	8% (2)
B/C	12% (3)	Manufacturer of end product(s)	12% (3)
		Manufacturer of component(s)	0% (0)
A	8% (2)	Raw materials supplier	8% (2)
D/E/F	8% (2)	Distributor	0% (0)
		Retailer	0% (0)
		Wholesaler	8% (2)
Trade association	4% (1)	Trade association	4% (1)

Source: RPA targeted survey analysis (2022)

Twenty-four of the respondents are companies. Two companies were wholesalers classed as large companies (>250 employees).

One additional respondent is a trade association which has 500 members, with members in England, Wales and Northern Ireland. The functions that its members have in the construction products supply chain are: installer; sub-contractor; main contractor; designer (architect, consulting engineer, etc.); and client (developer, housing association, etc.).

Table 11-5 Size of company (N=24)

Size of company	Number of respondents (percentage (n))
Large (>250 employees)	58% (14)
Medium (51-250 employees)	29% (7)
Small (11-50 employees)	13% (3)
Micro (<10 employees)	0% (0)

Source: RPA targeted survey analysis (2022)

Twenty-three companies had their main location or headquarters in England.The one remaining company had its headquarters in Italy, is a small company (11-50 employees) and a main contractor.

11.9.2 Relationships with suppliers

This section contains questions that were asked in the surveys for B/C, D/E/F and G/H/I (Twenty-two of the respondents answered these surveys). Not all questions were asked for all surveys.

Table 11-6 Question 20. Where do you source the raw materials and components for your product from? (N=1)

Option	Results (percentage (n))
Predominantly from the UK (over 50% of components and/or products)	0% (0)
Predominantly from outside of the UK	0% (0)
I don't know	100% (1)

Source: RPA targeted survey analysis (2022)

Table 11-7 Question 23. To what extent do you have flexibility to substitute alternative product(s)? (N=12)

Option	Results (percentage (n))
Fully	8% (1)
Not at all	25% (3)
It varies	50% (6)
Don't know	17% (2)

Source: RPA targeted survey analysis (2022)

Table 11-8 Question 24. To what extent do you agree with the following statements relating to cables: (N=14)

	Results (percentage (n))		
Statement	**Yes**	**No**	**Don't know**
24.1 We have mapped our supply chain processes showing the flow of material coming from suppliers.	64% (9)	29% (4)	7% (1)
24.2 Our company is aware of the critical component and raw material suppliers.	100% (14)	0% (0)	0% (0)
24.3 Our company is aware of the financial stability of our key suppliers.	100% (14)	0% (0)	0% (0)
24.4 We have mapped the geographical location of our critical supplier(s).	86% (12)	14% (2)	0% (0)
24.5 We have documented processes for dealing with suppliers.	93% (13)	0% (0)	7% (1)

	Results (percentage (n))		
Statement	**Yes**	**No**	**Don't know**
24.6 Your company has visually mapped out the key information about our suppliers in the supply chain.	79% (11)	14% (2)	7% (1)

Source: RPA targeted survey analysis (2022)

11.9.3 Information flows

This section contains questions that were asked in the surveys for B/C, D/E/F and G/H/I (Twenty-two of the respondents answered these surveys). Not all questions were asked for all surveys.

Table 11-9 Question 26. In what format is the following information provided? (N given for each sub-question below)

	Results (percentage (n))							
Information type	**paper format**	**online / digital format**	**both paper and online / digital format**	**face-to-face training**	**online training**	**supplied**	**not supplied**	**N**
26.1 Data safety sheet	0% (0)	58% (7)	42% (5)	0% (0)	0% (0)	0% (0)	0% (0)	12
26.2 Technical manuals	0% (0)	58% (7)	33% (4)	0% (0)	0% (0)	0% (0)	8% (1)	12
26.3 Brochure/leaflet	0% (0)	50% (6)	50% (6)	0% (0)	0% (0)	0% (0)	0% (0)	12
26.4 Unique ID on product giving access online to info	0% (0)	80% (8)	20% (2)	0% (0)	0% (0)	0% (0)	0% (0)	10
26.5 Information on product	0% (0)	60% (6)	40% (4)	0% (0)	0% (0)	0% (0)	0% (0)	10
26.6 Information on packaging	18% (2)	45% (5)	9% (1)	0% (0)	0% (0)	0% (0)	27% (3)	11
26.7 Manufacturers' training	0% (0)	17% (2)	0% (0)	17% (2)	8% (1)	17% (2)	42% (5)	12

Source: RPA targeted survey analysis (2022)

Table 11-10 Question 27. Do you receive the same type and format of information from all of your suppliers? (N=13)

Option	Results (percentage (n))
Yes	62% (8)
No, it varies	23% (3)
Don't know	15% (2)

Source: RPA targeted survey analysis (2022)

Table 11-11 Question 28. Does your company have any processes in place to ensure flow [of] information from your suppliers? (N=13)

Option	Results (percentage (n))
Yes	23% (3)
No	62% (8)
Don't know	15% (2)

Source: RPA targeted survey analysis (2022)

Table 11-12 Question 29. In your professional opinion, to what extent are the manufacturers guidelines/instructions complete? (N=13)

Option	Results (percentage (n))
Fully	85% (11)
Not at all	8% (1)
They vary	0% (0)
Don't know	8% (1)

*Source: RPA targeted survey analysis (2022) *Percentages may not sum to 100 due to rounding.*

Table 11-13 Questions 32-35. In your professional opinion, to what extent… (N given in table for each question)

	Results (percentage (n))				
Statement	**Fully**	**Partly**	**Not at all**	**Don't know**	**N**
32. In your professional opinion, to what extent are your suppliers of cables compliant with Construction Products Regulations Directive?	85% (11)	8% (1)	0% (0)	8% (1)	13
33. In your professional opinion, to what extent your suppliers of cables compliant with industry standards?	92% (12)	8% (1)	0% (0)	0% (0)	13
34. In your professional opinion, to what extent is the rest of the sector for cables compliant with Construction Products Regulations Directive?	31% (4)	38% (5)	0% (0)	31% (4)	13

Statement	Results (percentage (n))				
	Fully	Partly	Not at all	Don't know	N
35. In your professional opinion, to what extent is the rest of the sector for cables compliant with industry standards?	33% (4)	33% (4)	0% (0)	33% (4)	12

Source: RPA targeted survey analysis (2022)

11.9.4 Relationships with buyers

This section contains questions that were asked in the surveys for A, B/C and D/E/F. Not all questions were asked for all surveys.

Table 11-14 Question 46. To what extent do you agree with the following statements relating to cables? (N=2)

Statement	Results (percentage (n))		
	Yes	No	Don't know
46.1 We have mapped the geographical location of our customers.	50% (1)	50% (1)	0% (0)
46.2 We can visualise the flow of goods from our company to customers.	100% (2)	0% (0)	0% (0)
46.3 We get information from our customers about their demand.	50% (1)	0% (0)	50% (1)
46.4 We have mapped the flow of products in the downstream supply chain.	100% (2)	0% (0)	0% (0)
46.5 We can visualise the flow of goods from our company to our customers' customers.	100% (2)	0% (0)	0% (0)
46.6 The mapping of our downstream supply chain processes permits our company to identify areas for further analysis.	100% (2)	0% (0)	0% (0)
46.7 We have documented processes for dealing with buyers.	50% (1)	0% (0)	50% (1)

Source: RPA targeted survey analysis (2022)

Table 11-15 Question 49. In what format is the following information provided? (N=1)

Information type	Results (percentage (n))						
	paper format	online / digital format	both paper and online / digital format	face-to-face training	online training	supplied	not supplied
49.1 Data safety sheet	0% (0)	0% (0)	100% (1)	0% (0)	0% (0)	0% (0)	0% (0)
49.2 Technical manuals	0% (0)	0% (0)	100% (1)	0% (0)	0% (0)	0% (0)	0% (0)

	Results (percentage (n))						
Information type	paper format	online / digital format	both paper and online / digital format	face-to-face training	online training	supplied	not supplied
49.3 Brochure/leaflet	0% (0)	0% (0)	100% (1)	0% (0)	0% (0)	0% (0)	0% (0)
49.4 Unique ID on product giving access online to info	0% (0)	0% (0)	100% (1)	0% (0)	0% (0)	0% (0)	0% (0)
49.5 Information on product	0% (0)	0% (0)	100% (1)	0% (0)	0% (0)	0% (0)	0% (0)
49.6 Information on packaging	100% (1)	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
49.7 Manufacturers' training	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	100% (1)

Source: RPA targeted survey analysis (2022)

Table 11-16 Question 51. Do you share the same type and format of information with all your buyers of cables? (N=2)

Option	Results (percentage (n))
Yes	50% (1)
No, it varies	50% (1)
Don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-17 Question 53. Does your company have in place any processes to ensure flow of information to your buyers of cables? (N=2)

Option	Results (percentage (n))
Yes	50% (1)
No	0% (0)
Don't know	50% (1)

Source: RPA targeted survey analysis (2022)

Table 11-18 Question 54. To what extent is your company compliant with existing legislation and/or industry standards related to information provision requirements? (N=2)

Option	Results (percentage (n))
Fully	100% (2)
Partly	0% (0)
Not at all	0% (0)

Source: RPA targeted survey analysis (2022)

11.9.5 Trade associations

This section contains questions that were asked only in the survey for trade associations. Not all questions received a response.

Table 11-19 Question 63. How important are imports of cabling for your members? (N=1)

Option	Results (percentage (n))
Very important	0% (0)
Important	100% (1)
Neutral	0% (0)
Not important	0% (0)
Not important at all	0% (0)
I don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-20 Question 65. What share of cables made in the UK are exported and sold in other countries? (N=1)

Option	Results (percentage (n))
<20%	0% (0)
21-40%	0% (0)
41-60%	0% (0)
61-80%	0% (0)
81-100%	0% (0)
I don't know	100% (1)

Source: RPA targeted survey analysis (2022)

Table 11-21 Questions 66 and 67. (N=1)

	Results (percentage (n))		
Statement	**Yes**	**No**	**Don't know**
66. Are there any regulations and/or industry standards related to cables information provision in the supply chain?	100% (1)	0% (0)	0% (0)
67. Does your organisation have any processes to check whether and how your members comply with those regulations and/or industry standards related to information provision in the supply chain?	0% (0)	100% (1)	0% (0)

Source: RPA targeted survey analysis (2022)

11.10 Survey analysis – cladding

11.10.1 Survey respondent statistics

For the product of cladding, there were Fifty-four survey respondents.

Table 11-22 Type of organisation (N=54)

Survey	Number of respondents (percentage (n))	Type of organisation	Number of respondents (percentage (n))
G/H/I	53% (29)	Sub-contractor	33% (18)
		Main contractor	19% (10)
		Installer	2% (1)
B/C	25% (14)	Manufacturer of end product(s)	20% (11)
		Manufacturer of component(s)	11% (6)
A	4% (2)	Raw materials supplier	4% (2)
D/E/F	4% (2)	Distributor	4% (2)
		Retailer	0% (0)
		Wholesaler	0% (0)
Trade association	15% (7)	Trade association	15% (7)

*Source: RPA targeted survey analysis (2022) *Some respondents of B/C survey were manufacturers of both components and end-products. **Percentages may not sum to 100 due to rounding.*

Forty-seven respondents were companies, and seven were trade associations. Six trade associations gave its number of members. Two have Five-hundred members, and the other three have Forty-five, ten, and four members.

Table 11-23 Size of company (N=47)

Size of company	Number of respondents (percentage (n))
Large (>250 employees)	47% (22)
Medium (51-250 employees)	21% (10)
Small (11-50 employees)	6% (3)
Micro (<10 employees)	26% (12)

Source: RPA targeted survey analysis (2022)

Table 11-24 Question 8. Where is your company's main location/headquarters in the UK? (N=47)

UK or non-UK	Main location/headquarters	Number of respondents (percentage (n))
UK	England	79% (37)
	Scotland	4% (2)
	Northern Ireland	2% (1)
	Wales	0% (0)
Non-UK	Germany	4% (2)
	Italy	4% (2)
	Ireland	2% (1)
	France	2% (1)
	Austria	2% (1)

Source: RPA targeted survey analysis (2022)

All trade associations have members in England. Five of them also have members elsewhere. Note the table below; respondents could select multiple options.

Table 11-25 Question 12. What is the geographical location of your members? (N=8)

UK or non-UK	Member location	Number of respondents
UK	England	7
	Scotland	3
	Northern Ireland	2
	Wales	3

Source: RPA targeted survey analysis (2022)

11.10.2 Relationships with suppliers

This section contains questions that were asked in the surveys for B/C, D/E/F and G/H/I. Not all questions were asked for all surveys.

Table 11-26 Question 20. Where do you source the raw materials and components for your product from? (N=10)

Option	Results (percentage (n))
Predominantly from the UK (over 50% of components and/or products)	70% (7)
Predominantly from outside of the UK	30% (3)
I don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-27 Question 23. To what extent do you have flexibility to substitute alternative product(s)? (N=17)

Option	Results (percentage (n))
Fully	6% (1)
Not at all	12% (2)
It varies	76% (13)
Don't know	6% (1)

Source: RPA targeted survey analysis (2022)

Table 11-28 Question 24. To what extent do you agree with the following statements relating to cladding:

	Results (percentage (n))			
Statement	**Yes**	**No**	**Don't know**	**N**
24.1 We have mapped our supply chain processes showing the flow of material coming from suppliers.	79% (22)	18% (5)	4% (1)	28
24.2 Our company is aware of the critical component and raw material suppliers.	100% (28)	0% (0)	0% (0)	28
24.3 Our company is aware of the financial stability of our key suppliers.	93% (26)	7% (2)	0% (0)	28
24.4 We have mapped the geographical location of our critical supplier(s).	67% (18)	33% (9)	0% (0)	27
24.5 We have documented processes for dealing with suppliers.	89% (25)	11% (3)	0% (0)	28
24.6 Your company has visually mapped out the key information about our suppliers in the supply chain.	61% (17)	32% (9)	7% (2)	28

Source: RPA targeted survey analysis (2022)

11.10.3 Information flows

This section contains questions that were asked in the surveys for B/C, D/E/F and G/H/I. Not all questions were asked for all surveys.

Table 11-29 Question 26. In what format is the following information provided? (N given for each sub-question below)

	Results (percentage (n))							
Information type	**paper format**	**online / digital format**	**both paper and online / digital format**	**face-to-face training**	**online training**	**supplied**	**not supplied**	**N**
26.1 Data safety sheet	0% (0)	68% (13)	32% (6)	0% (0)	0% (0)	0% (0)	0% (0)	19
26.2 Technical manuals	0% (0)	63% (12)	37% (7)	0% (0)	0% (0)	0% (0)	0% (0)	19
26.3 Brochure/leaflet	0% (0)	67% (12)	33% (6)	0% (0)	0% (0)	0% (0)	0% (0)	18
26.4 Unique ID on product giving access online to info	7% (1)	36% (5)	14% (2)	0% (0)	0% (0)	14% (2)	29% (4)	14
26.5 Information on product	0% (0)	41% (7)	47% (8)	6% (1)	0% (0)	6% (1)	0% (0)	17
26.6 Information on packaging	6% (1)	29% (5)	29% (5)	0% (0)	0% (0)	6% (1)	29% (5)	17
26.7 Manufacturers' training	0% (0)	7% (1)	7% (1)	60% (9)	7% (1)	7% (1)	13% (2)	15

Source: RPA targeted survey analysis (2022)

Table 11-30 Question 27. Do you receive the same type and format of information from all of your suppliers? (N=19)

Option	**Results (percentage (n))**
Yes	63% (12)
No, it varies	26% (5)
Don't know	11% (2)

Source: RPA targeted survey analysis (2022)

Table 11-31 Question 28. Does your company have any processes in place to ensure flow [of] information from your suppliers? (N=18)

Option	**Results (percentage (n))**
Yes	50% (9)
No	33% (6)
Don't know	17% (3)

Source: RPA targeted survey analysis (2022)

Table 11-32 Question 29. In your professional opinion, to what extent are the manufacturers guidelines/instructions complete? (N=19)

Option	Results (percentage (n))
Fully	37% (7)
Not at all	11% (2)
They vary	53% (10)
Don't know	0% (0)

*Source: RPA targeted survey analysis (2022) *Percentages may not sum to 100 due to rounding.*

Table 11-33 Questions 32-35. In your professional opinion, to what extent… (N given in table for each question)

	Results (percentage (n))				
Statement	**Fully**	**Partly**	**Not at all**	**Don't know**	**N**
32. In your professional opinion, to what extent are your suppliers of cladding compliant with Construction Products Regulations Directive?	37% (7)	47% (9)	0% (0)	16% (3)	19
33. In your professional opinion, to what extent your suppliers of cladding compliant with industry standards?	47% (9)	47% (9)	0% (0)	5% (1)	19
34. In your professional opinion, to what extent is the rest of the sector for cladding compliant with Construction Products Regulations Directive?	21% (4)	53% (10)	0% (0)	26% (5)	19
35. In your professional opinion, to what extent is the rest of the sector for cladding compliant with industry standards?	21% (4)	63% (12)	0% (0)	16% (3)	19

Source: RPA targeted survey analysis (2022)

11.10.4 Relationships with buyers

This section contains questions that were asked in the surveys for A, B/C and D/E/F. Not all questions were asked for all surveys.

Table 11-34 Question 46. To what extent do you agree with the following statements relating to cladding? (N=3)

	Results (percentage (n))		
Statement	**Yes**	**No**	**Don't know**
46.1 We have mapped the geographical location of our customers.	100% (3)	0% (0)	0% (0)
46.2 We can visualise the flow of goods from our company to customers.	100% (3)	0% (0)	0% (0)
46.3 We get information from our customers about their demand.	100% (3)	0% (0)	0% (0)

	Results (percentage (n))		
46.4 We have mapped the flow of products in the downstream supply chain.	33% (1)	0% (0)	67% (2)
46.5 We can visualise the flow of goods from our company to our customers' customers.	33% (1)	33% (1)	33% (1)
46.6 The mapping of our downstream supply chain processes permits our company to identify areas for further analysis.	0% (0)	0% (0)	100% (3)
46.7 We have documented processes for dealing with buyers.	100% (3)	0% (0)	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-35 Question 49. In what format is the following information provided? (N=3)

	Results (percentage (n))						
Information type	**paper format**	**online / digital format**	**both paper and online / digital format**	**face-to-face training**	**online training**	**supplied**	**not supplied**
49.1 Data safety sheet	0% (0)	0% (0)	67% (2)	0% (0)	0% (0)	33% (1)	0% (0)
49.2 Technical manuals	0% (0)	0% (0)	67% (2)	0% (0)	0% (0)	33% (1)	0% (0)
49.3 Brochure/leaflet	0% (0)	0% (0)	33% (1)	0% (0)	0% (0)	0% (0)	67% (2)
49.4 Unique ID on product giving access online to info	0% (0)	0% (0)	33% (1)	0% (0)	0% (0)	0% (0)	67% (2)
49.5 Information on product	0% (0)	0% (0)	33% (1)	0% (0)	0% (0)	33% (1)	33% (1)
49.6 Information on packaging	0% (0)	0% (0)	33% (1)	0% (0)	0% (0)	0% (0)	67% (2)
49.7 Manufacturers' training	0% (0)	0% (0)	33% (1)	67% (2)	0% (0)	0% (0)	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-36 Question 51. Do you share the same type and format of information with all your buyers of cladding? (N=2)

Option	Results (percentage (n))
Yes	100% (2)
No, it varies	0% (0)
Don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-37 Question 52. Does your company have in place any processes to ensure flow of information to your buyers of materials for cladding? (N=1)

Option	Results (percentage (n))
Yes	100% (2)
No	0% (0)
Don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-38 Question 53. Does your company have in place any processes to ensure flow of information to your buyers of cladding? (N=2)

Option	Results (percentage (n))
Yes	50% (1)
No	0% (0)
Don't know	50% (1)

Source: RPA targeted survey analysis (2022)

Table 11-39 Question 54. To what extent is your company compliant with existing legislation and/or industry standards related to information provision requirements? (N=3)

Option	Results (percentage (n))
Fully	100% (3)
Partly	0% (0)
Not at all	0% (0)

Source: RPA targeted survey analysis (2022)

11.10.5 Trade associations

This section contains questions that were asked only in the survey for trade associations. Not all questions received a response.

Table 11-40 Question 63. How important are imports of cladding for your members? (N=3)

Option	Results (percentage (n))
Very important	33% (1)
Important	33% (1)
Neutral	33% (1)
Not important	0% (0)
Not important at all	0% (0)
I don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-41 Question 65. What share of cladding made in the UK are exported and sold in other countries? (N=1)

Option	Results (percentage (n))
<20%	0% (0)
21-40%	0% (0)
41-60%	0% (0)
61-80%	0% (0)
81-100%	0% (0)
I don't know	100% (1)

Source: RPA targeted survey analysis (2022)

Table 11-42 Questions 66 and 67. (N=3)

	Results (percentage (n))		
Statement	**Yes**	**No**	**Don't know**
66. Are there any regulations and/or industry standards related to cladding information provision in the supply chain?	33% (1)	0% (0)	67% (2)
67. Does your organisation have any processes to check whether and how your members comply with those regulations and/or industry standards related to information provision in the supply chain?	0% (0)	67% (2)	33% (1)

Source: RPA targeted survey analysis (2022)

11.11 Survey analysis – fire barriers

11.11.1 Survey respondent statistics

For the product of fire barriers, there were Thirteen survey respondents.

Table 11-43 Type of organisation (N=13)

Survey	Number of respondents (percentage (n))	Type of organisation	Number of respondents (percentage (n))
A	0% (0)	Raw materials supplier	0% (0)
B/C	23% (3)	Manufacturer of end product(s)	23% (3)
		Manufacturer of component(s)	0% (0)
D/E/F	0% (0)	Distributor	0% (0)
		Retailer	0% (0)
		Wholesaler	0% (0)
G/H/I	69% (9)	Sub-contractor	62% (8)
		Main contractor	8% (1)

Survey	Number of respondents (percentage (n))	Type of organisation	Number of respondents (percentage (n))
A	0% (0)	Raw materials supplier	0% (0)
B/C	23% (3)	Manufacturer of end product(s)	23% (3)
		Manufacturer of component(s)	0% (0)
		Installer	0% (0)
Trade association	8% (1)	Trade association	8% (1)

*Source: RPA targeted survey analysis (2022) *Percentages may not sum to 100 due to rounding.*

Twelve respondents were companies, and one was a trade association with Two-Hundred and seventy five members. This trade association has members in all parts of the UK; England, Wales, Scotland, and Northern Ireland.

Table 11-44 Size of company (N=12)

Size of company	Number of respondents (percentage (n))
Large (>250 employees)	25% (3)
Medium (51-250 employees)	42% (5)
Small (11-50 employees)	33% (4)
Micro (<10 employees)	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-45 Question 8. Where is your company's main location/headquarters in the UK? (N=12)

UK or non-UK	Main location/headquarters	Number of respondents (percentage (n))
UK	England	92% (11)
	Scotland	0% (0)
	Northern Ireland	0% (0)
	Wales	8% (1)

Source: RPA targeted survey analysis (2022)

11.11.2 Relationships with suppliers

This section contains questions that were asked in the surveys for B/C, D/E/F and G/H/I. Not all questions were asked for all surveys.

Table 11-46 Question 20. Where do you source the raw materials and components for your product from? (N=2)

Option	Results (percentage (n))
Predominantly from the UK (over 50% of components and/or products)	100% (2)
Predominantly from outside of the UK	0% (0)
I don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-47 Question 23. To what extent do you have flexibility to substitute alternative product(s)? (N=7)

Option	Results (percentage (n))
Fully	29% (2)
Not at all	43% (3)
It varies	14% (1)
Don't know	14% (1)

Source: RPA targeted survey analysis (2022)

Table 11-48 Question 24. To what extent do you agree with the following statements relating to fire barriers (N given for each sub-question):

	Results (percentage (n))			
Statement	**Yes**	**No**	**Don't know**	**N**
24.1 We have mapped our supply chain processes showing the flow of material coming from suppliers.	56% (5)	33% (3)	11% (1)	9
24.2 Our company is aware of the critical component and raw material suppliers.	89% (8)	0% (0)	11% (1)	9
24.3 Our company is aware of the financial stability of our key suppliers.	67% (6)	11% (1)	22% (2)	9
24.4 We have mapped the geographical location of our critical supplier(s).	78% (7)	11% (1)	11% (1)	9
24.5 We have documented processes for dealing with suppliers.	67% (6)	22% (2)	11% (1)	9
24.6 Your company has visually mapped out the key information about our suppliers in the supply chain.	67% (6)	11% (1)	22% (2)	9

Source: RPA targeted survey analysis (2022)

11.11.3 Information flows

This section contains questions that were asked in the surveys for B/C, D/E/F and G/H/I. Not all questions were asked for all surveys.

Table 11-49 Question 26. In what format is the following information provided? (N given for each sub-question below)

	Results (percentage (n))							
Information type	**paper format**	**online / digital format**	**both paper and online / digital format**	**face-to-face training**	**online training**	**supplied**	**not supplied**	**N**
26.1 Data safety sheet	0% (0)	63% (5)	38% (3)	0% (0)	0% (0)	0% (0)	0% (0)	8
26.2 Technical manuals	0% (0)	50% (4)	25% (2)	0% (0)	13% (1)	0% (0)	13% (1)	8
26.3 Brochure/leaflet	0% (0)	38% (3)	38% (3)	0% (0)	0% (0)	0% (0)	25% (2)	8
26.4 Unique ID on product giving access online to info	0% (0)	50% (4)	13% (1)	0% (0)	13% (1)	13% (1)	13% (1)	8
26.5 Information on product	0% (0)	63% (5)	38% (3)	0% (0)	0% (0)	0% (0)	0% (0)	8
26.6 Information on packaging	0% (0)	25% (2)	63% (5)	0% (0)	0% (0)	0% (0)	13% (1)	8
26.7 Manufacturers' training	0% (0)	13% (1)	13% (1)	50% (4)	13% (1)	0% (0)	13% (1)	8

Source: RPA targeted survey analysis (2022)

Table 11-50 Question 27. Do you receive the same type and format of information from all of your suppliers? (N=8)

Option	**Results (percentage (n))**
Yes	75% (6)
No, it varies	0% (0)
Don't know	25% (2)

Source: RPA targeted survey analysis (2022)

Table 11-51 Question 28. Does your company have any processes in place to ensure flow [of] information from your suppliers? (N=8)

Option	**Results (percentage (n))**
Yes	63% (5)

Option	Results (percentage (n))
No	38% (3)
Don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-52 Question 29. In your professional opinion, to what extent are the manufacturers guidelines/instructions complete? (N=8)

Option	Results (percentage (n))
Fully	88% (7)
Not at all	0% (0)
They vary	13% (1)
Don't know	0% (0)

*Source: RPA targeted survey analysis (2022) *Percentages may not sum to 100 due to rounding.*

Table 11-53 Questions 32-35. In your professional opinion, to what extent… (N given in table for each question)

	Results (percentage (n))				
Statement	**Fully**	**Partly**	**Not at all**	**Don't know**	**N**
32. In your professional opinion, to what extent are your suppliers of fire barriers compliant with Construction Products Regulations Directive?	75% (6)	13% (1)	0% (0)	13% (1)	8
33. In your professional opinion, to what extent your suppliers of fire barriers compliant with industry standards?	75% (6)	0% (0)	13% (1)	13% (1)	8
34. In your professional opinion, to what extent is the rest of the sector for fire barriers compliant with Construction Products Regulations Directive?	25% (2)	38% (3)	0% (0)	38% (3)	8
35. In your professional opinion, to what extent is the rest of the sector for fire barriers compliant with industry standards?	38% (3)	38% (3)	0% (0)	25% (2)	8

Source: RPA targeted survey analysis (2022)

11.11.4 Relationships with buyers

This section contains questions that were asked in the surveys for A, B/C and D/E/F. Not all questions were asked for all surveys.

Table 11-54 Question 46. To what extent do you agree with the following statements relating to fire barriers? (N=1)

	Results (percentage (n))		
Statement	**Yes**	**No**	**Don't know**
46.1 We have mapped the geographical location of our customers.	100% (1)	0% (0)	0% (0)
46.2 We can visualise the flow of goods from our company to customers.	100% (1)	0% (0)	0% (0)
46.3 We get information from our customers about their demand.	100% (1)	0% (0)	0% (0)
46.4 We have mapped the flow of products in the downstream supply chain.	100% (1)	0% (0)	0% (0)
46.5 We can visualise the flow of goods from our company to our customers' customers.	100% (1)	0% (0)	0% (0)
46.6 The mapping of our downstream supply chain processes permits our company to identify areas for further analysis.	100% (1)	0% (0)	0% (0)
46.7 We have documented processes for dealing with buyers.	100% (1)	0% (0)	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-55 Question 49. In what format is the following information provided? (N=1)

	Results (percentage (n))						
Information type	**paper format**	**online / digital format**	**both paper and online / digital format**	**face-to-face training**	**online training**	**supplied**	**not supplied**
49.1 Data safety sheet	0% (0)	0% (0)	100% (1)	0% (0)	0% (0)	0% (0)	0% (0)
49.2 Technical manuals	0% (0)	0% (0)	100% (1)	0% (0)	0% (0)	0% (0)	0% (0)
49.3 Brochure/leaflet	0% (0)	0% (0)	100% (1)	0% (0)	0% (0)	0% (0)	0% (0)
49.4 Unique ID on product giving access online to info	0% (0)	0% (0)	100% (1)	0% (0)	0% (0)	0% (0)	0% (0)
49.5 Information on product	0% (0)	0% (0)	100% (1)	0% (0)	0% (0)	0% (0)	0% (0)
49.6 Information on packaging	0% (0)	0% (0)	100% (1)	0% (0)	0% (0)	0% (0)	0% (0)
49.7 Manufacturers' training	0% (0)	0% (0)	0% (0)	100% (1)	0% (0)	0% (0)	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-56 Question 51. Do you share the same type and format of information with all your buyers of fire barriers? (N=1)

Option	Results (percentage (n))
Yes	100% (1)
No, it varies	0% (0)
Don't know	0% (0)

Source: RPA targeted survey analysis (2022)

No responses were received for question 52: "Does your company have in place any processes to ensure flow of information to your buyers of materials for fire barriers?"

Table 11-57 Question 53. Does your company have in place any processes to ensure flow of information to your buyers of fire barriers? (N=1)

Option	Results (percentage (n))
Yes	100% (1)
No	0% (0)
Don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-58 Question 54. To what extent is your company compliant with existing legislation and/or industry standards related to information provision requirements? (N=1)

Option	Results (percentage (n))
Fully	100% (1)
Partly	0% (0)
Not at all	0% (0)

Source: RPA targeted survey analysis (2022)

11.11.5 Trade associations

This section contains questions that were asked only in the survey for trade associations. Not all questions received a response.

Table 11-59 Question 63. How important are imports of fire barriers for your members? (N=1)

Option	Results (percentage (n))
Very important	100% (1)
Important	0% (0)
Neutral	0% (0)
Not important	0% (0)
Not important at all	0% (0)
I don't know	0% (0)

Source: RPA targeted survey analysis (2022)

No responses were received for Questions 65, 66 and 67.

11.12 Survey analysis – fire doors

11.12.1 Survey respondent statistics

For the product of fire doors, there were Fifty-four survey respondents.

Table 11-60 Type of organisation (N=44)

Survey	Number of respondents (percentage (n))	Type of organisation	Number of respondents (percentage (n))
A	2% (1)	Raw materials supplier	2% (1)
B/C	45% (20)	Manufacturer of end product(s)	39% (17)
		Manufacturer of component(s)	11% (5)
D/E/F	18% (8)	Distributor	14% (6)
		Retailer	5% (2)
		Wholesaler	0% (0)
G/H/I	30% (13)	Sub-contractor	20% (9)
		Main contractor	7% (3)
		Installer	2% (1)
Trade association	5% (2)	Trade association	5% (2)

*Source: RPA targeted survey analysis (2022) *Some respondents of B/C survey were manufacturers of both components and end-products. **Percentages may not sum to 100 due to rounding.*

Forty respondents were companies, and two were trade associations, one with Five-hundred members (the other did not share this information). They both have members across all areas of the UK: England, Scotland, Wales and Northern Ireland.

Table 11-61 Size of company (N=42)

Size of company	Number of respondents (percentage (n))
Large (>250 employees)	19% (8)
Medium (51-250 employees)	38% (16)
Small (11-50 employees)	12% (5)
Micro (<10 employees)	31% (13)

Source: RPA targeted survey analysis (2022)

Table 11-62 Question 8. Where is your company's main location/headquarters in the UK? (N=47)

UK or non-UK	Main location/headquarters	Number of respondents (percentage (n))
UK	England	90% (38)
	Scotland	5% (2)
	Northern Ireland	2% (1)
	Wales	2% (1)
Non-UK	Belgium	2% (1)

Source: RPA targeted survey analysis (2022)

11.12.2 Relationships with suppliers

This section contains questions that were asked in the surveys for B/C, D/E/F and G/H/I. Not all questions were asked for all surveys.

Table 11-63 Question 20. Where do you source the raw materials and components for your product from? (N=13)

Option	Results (percentage (n))
Predominantly from the UK (over 50% of components and/or products)	54% (7)
Predominantly from outside of the UK	46% (6)
I don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-64 Question 23. To what extent do you have flexibility to substitute alternative product(s)? (N=11)

Option	Results (percentage (n))
Fully	9% (1)
Not at all	36% (4)
It varies	55% (6)
Don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-65 Question 24. To what extent do you agree with the following statements relating to fire doors: (N given for each sub-question)

	Results (percentage (n))			
Statement	**Yes**	**No**	**Don't know**	**N**
24.1 We have mapped our supply chain processes showing the flow of material coming from suppliers.	69% (20)	21% (6)	10% (3)	29
24.2 Our company is aware of the critical component and raw material suppliers.	86% (25)	3% (1)	10% (3)	29
24.3 Our company is aware of the financial stability of our key suppliers.	90% (26)	3% (1)	7% (2)	29
24.4 We have mapped the geographical location of our critical supplier(s).	82% (23)	11% (3)	7% (2)	28
24.5 We have documented processes for dealing with suppliers.	76% (22)	14% (4)	10% (3)	29
24.6 Your company has visually mapped out the key information about our suppliers in the supply chain.	55% (16)	28% (8)	17% (5)	29

Source: RPA targeted survey analysis (2022)

11.12.3 Information flows

This section contains questions that were asked in the surveys for B/C, D/E/F and G/H/I. Not all questions were asked for all surveys.

Table 11-66 Question 26. In what format is the following information provided? (N given for each sub-question below)

	Results (percentage (n))							
Information type	**paper format**	**online / digital format**	**both paper and online / digital format**	**face-to-face training**	**online training**	**supplied**	**not supplied**	**N**
26.1 Data safety sheet	0% (0)	48% (11)	52% (12)	0% (0)	0% (0)	0% (0)	0% (0)	23
26.2 Technical manuals	0% (0)	59% (13)	41% (9)	0% (0)	0% (0)	0% (0)	0% (0)	22
26.3 Brochure/leaflet	14% (3)	41% (9)	41% (9)	0% (0)	0% (0)	0% (0)	5% (1)	22
26.4 Unique ID on product giving access online to info	0% (0)	42% (8)	16% (3)	0% (0)	0% (0)	5% (1)	37% (7)	19

	Results (percentage (n))							
Information type	**paper format**	**online / digital format**	**both paper and online / digital format**	**face-to-face training**	**online training**	**supplied**	**not supplied**	**N**
26.5 Information on product	0% (0)	45% (10)	41% (9)	5% (1)	0% (0)	9% (2)	0% (0)	22
26.6 Information on packaging	15% (3)	25% (5)	10% (2)	0% (0)	5% (1)	20% (4)	25% (5)	20
26.7 Manufacturers' training	0% (0)	9% (2)	14% (3)	41% (9)	0% (0)	14% (3)	23% (5)	22

Source: RPA targeted survey analysis (2022)

Table 11-67 Question 27. Do you receive the same type and format of information from all of your suppliers? (N=24)

Option	Results (percentage (n))
Yes	63% (15)
No, it varies	25% (6)
Don't know	13% (3)

Source: RPA targeted survey analysis (2022)

Table 11-68 Question 28. Does your company have any processes in place to ensure flow [of] information from your suppliers? (N=24)

Option	Results (percentage (n))
Yes	63% (15)
No	25% (6)
Don't know	13% (3)

Source: RPA targeted survey analysis (2022)

Table 11-69 Question 29. In your professional opinion, to what extent are the manufacturers guidelines/instructions complete? (N=24)

Option	Results (percentage (n))
Fully	58% (14)
Not at all	0% (0)

Option	Results (percentage (n))
They vary	29% (7)
Don't know	13% (3)

*Source: RPA targeted survey analysis (2022) *Percentages may not sum to 100 due to rounding.*

Table 11-70 Questions 32-35. In your professional opinion, to what extent… (N given in table for each question)

	Results (percentage (n))				
Statement	**Fully**	**Partly**	**Not at all**	**Don't know**	**N**
32. In your professional opinion, to what extent are your suppliers of fire doors compliant with Construction Products Regulations Directive?	64% (14)	14% (3)	0% (0)	23% (5)	22
33. In your professional opinion, to what extent your suppliers of fire doors compliant with industry standards?	91% (21)	4% (1)	0% (0)	4% (1)	23
34. In your professional opinion, to what extent is the rest of the sector for fire doors compliant with Construction Products Regulations Directive?	22% (5)	52% (12)	0% (0)	26% (6)	23
35. In your professional opinion, to what extent is the rest of the sector for fire doors compliant with industry standards?	30% (7)	52% (12)	0% (0)	17% (4)	23

Source: RPA targeted survey analysis (2022)

11.12.4 Relationships with buyers

This section contains questions that were asked in the surveys for A, B/C and D/E/F. Not all questions were asked for all surveys.

Table 11-71 Question 46. To what extent do you agree with the following statements relating to fire doors? (N given for each sub-question)

	Results (percentage (n))			
Statement	**Yes**	**No**	**Don't know**	**N**
46.1 We have mapped the geographical location of our customers.	75% (9)	25% (3)	0% (0)	12
46.2 We can visualise the flow of goods from our company to customers.	91% (10)	9% (1)	0% (0)	11
46.3 We get information from our customers about their demand.	100% (12)	0% (0)	0% (0)	12
46.4 We have mapped the flow of products in the downstream supply chain.	33% (4)	58% (7)	8% (1)	12

	Results (percentage (n))			
Statement	**Yes**	**No**	**Don't know**	**N**
46.5 We can visualise the flow of goods from our company to our customers' customers.	75% (9)	25% (3)	0% (0)	12
46.6 The mapping of our downstream supply chain processes permits our company to identify areas for further analysis.	17% (2)	50% (6)	33% (4)	12
46.7 We have documented processes for dealing with buyers.	83% (10)	17% (2)	0% (0)	12

Source: RPA targeted survey analysis (2022)

Table 11-72 Question 49. In what format is the following information provided? (N is given for each sub-question)

	Results (percentage (n))							
Information type	**paper format**	**online / digital format**	**both paper and online / digital format**	**face-to-face training**	**online training**	**supplied**	**not supplied**	**N**
49.1 Data safety sheet	0% (0)	36% (4)	64% (7)	0% (0)	0% (0)	0% (0)	0% (0)	11
49.2 Technical manuals	10% (1)	30% (3)	60% (6)	0% (0)	0% (0)	0% (0)	0% (0)	10
49.3 Brochure/leaflet	11% (1)	33% (3)	56% (5)	0% (0)	0% (0)	0% (0)	0% (0)	9
49.4 Unique ID on product giving access online to info	0% (0)	38% (3)	25% (2)	13% (1)	0% (0)	13% (1)	13% (1)	8
49.5 Information on product	10% (1)	30% (3)	50% (5)	0% (0)	0% (0)	10% (1)	0% (0)	10
49.6 Information on packaging	43% (3)	14% (1)	14% (1)	14% (1)	0% (0)	14% (1)	0% (0)	7
49.7 Manufacturers' training	0% (0)	0% (0)	0% (0)	0% (0)	100% (9)	0% (0)	0% (0)	9

Source: RPA targeted survey analysis (2022)

Table 11-73 Question 51. Do you share the same type and format of information with all your buyers of fire doors? (N=11)

Option	Results (percentage (n))
Yes	45% (5)
No, it varies	55% (6)
Don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-74 Question 52. Does your company have in place any processes to ensure flow of information to your buyers of materials for fire doors? (N=1)

Option	Results (percentage (n))
Yes	100% (1)
No	0% (0)
Don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-75 Question 53. Does your company have in place any processes to ensure flow of information to your buyers of fire doors? (N=11)

Option	Results (percentage (n))
Yes	73% (8)
No	27% (3)
Don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-76 Question 54. To what extent is your company compliant with existing legislation and/or industry standards related to information provision requirements? (N=11)

Option	Results (percentage (n))
Fully	73% (8)
Partly	27% (3)
Not at all	0% (0)

Source: RPA targeted survey analysis (2022)

11.12.5 Trade associations

This section contains questions that were asked only in the survey for trade associations. Not all questions received a response.

Table 11-77 Question 63. How important are imports of fire doors for your members? (N=1)

Option	Results (percentage (n))
Very important	100% (1)

Option	Results (percentage (n))
Important	0% (0)
Neutral	0% (0)
Not important	0% (0)
Not important at all	0% (0)
I don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-78 Question 65. What share of fire doors made in the UK are exported and sold in other countries? (N=1)

Option	Results (percentage (n))
<20%	0% (0)
21-40%	0% (0)
41-60%	0% (0)
61-80%	0% (0)
81-100%	0% (0)
I don't know	100% (1)

Source: RPA targeted survey analysis (2022)

Table 11-79 Questions 66 and 67. (N=1)

	Results (percentage (n))		
Statement	**Yes**	**No**	**Don't know**
66. Are there any regulations and/or industry standards related to fire doors information provision in the supply chain?	100% (1)	0% (0)	0% (0)
67. Does your organisation have any processes to check whether and how your members comply with those regulations and/or industry standards related to information provision in the supply chain?	100% (1)	0% (0)	0% (0)

Source: RPA targeted survey analysis (2022)

11.13 Survey analysis – insulation

11.13.1 Survey respondent statistics

For the product of insulation, there were Thirty-seven survey respondents.

Table 11-80 Type of organisation (N=37)

Survey	Number of respondents (percentage (n))	Type of organisation	Number of respondents (percentage (n))
A	0% (0)	Raw materials supplier	0% (0)
B/C	27% (10)	Manufacturer of end product(s)	24% (9)
		Manufacturer of component(s)	8% (3)
D/E/F	35% (13)	Distributor	22% (8)
		Retailer	0% (0)
		Wholesaler	14% (5)
G/H/I	30% (11)	Sub-contractor	22% (8)
		Main contractor	8% (3)
		Installer	0% (0)
Trade association	8% (3)	Trade association	8% (3)

*Source: RPA targeted survey analysis (2022) *Some respondents of B/C survey were manufacturers of both components and end-products. **Percentages may not sum to 100 due to rounding.*

Thirty-four respondents were companies, and three were trade associations. Two associations gave their number of members. One association has 110 and the other three.

Table 11-81 Size of company (N=34)

Size of company	Number of respondents (percentage (n))
Large (>250 employees)	44% (15)
Medium (51-250 employees)	32% (11)
Small (11-50 employees)	21% (7)
Micro (<10 employees)	3% (1)

Source: RPA targeted survey analysis (2022)

Table 11-82 Question 8. Where is your company's main location/headquarters in the UK? (N=34)

UK or non-UK	Main location/headquarters	Number of respondents (percentage (n))
UK	England	79% (27)
	Scotland	3% (1)
	Northern Ireland	0% (0)
	Wales	15% (5)
Non-UK	Italy	3% (1)

Source: RPA targeted survey analysis (2022)

Table 11-83 Question 12. What is the geographical location of your members? (N=3)

UK or non-UK	Member location	Number of respondents
UK	England	3
	Scotland	2
	Northern Ireland	2
	Wales	1

Source: RPA targeted survey analysis (2022)

11.13.2 Relationships with suppliers

This section contains questions that were asked in the surveys for B/C, D/E/F and G/H/I. Not all questions were asked for all surveys.

Table 11-84 Question 20. Where do you source the raw materials and components for your product from? (N=10)

Option	Results (percentage (n))
Predominantly from the UK (over 50% of components and/or products)	40% (4)
Predominantly from outside of the UK	60% (6)
I don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-85 Question 23. To what extent do you have flexibility to substitute alternative product(s)? (N=7)

Option	Results (percentage (n))
Fully	29% (2)
Not at all	29% (2)
It varies	43% (3)
Don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-86 Question 24. To what extent do you agree with the following statements relating to insulation:

	Results (percentage (n))			
Statement	**Yes**	**No**	**Don't know**	**N**
24.1 We have mapped our supply chain processes showing the flow of material coming from suppliers.	63% (12)	26% (5)	11% (2)	19

	Results (percentage (n))			
Statement	**Yes**	**No**	**Don't know**	**N**
24.2 Our company is aware of the critical component and raw material suppliers.	79% (15)	5% (1)	16% (3)	19
24.3 Our company is aware of the financial stability of our key suppliers.	68% (13)	11% (2)	21% (4)	19
24.4 We have mapped the geographical location of our critical supplier(s).	58% (11)	26% (5)	16% (3)	19
24.5 We have documented processes for dealing with suppliers.	89% (17)	5% (1)	5% (1)	19
24.6 Your company has visually mapped out the key information about our suppliers in the supply chain.	47% (9)	21% (4)	32% (6)	19

Source: RPA targeted survey analysis (2022)

11.13.3 Information flows

This section contains questions that were asked in the surveys for B/C, D/E/F and G/H/I. Not all questions were asked for all surveys.

Table 11-87 Question 26. In what format is the following information provided? (N given for each sub-question below)

	Results (percentage (n))							
Information type	**paper format**	**online / digital format**	**both paper and online / digital format**	**face-to-face training**	**online training**	**supplied**	**not supplied**	**N**
26.1 Data safety sheet	13% (2)	67% (10)	13% (2)	0% (0)	7% (1)	0% (0)	0% (0)	15
26.2 Technical manuals	0% (0)	67% (10)	20% (3)	7% (1)	7% (1)	0% (0)	0% (0)	15
26.3 Brochure/leaflet	15% (2)	38% (5)	31% (4)	8% (1)	0% (0)	0% (0)	8% (1)	13
26.4 Unique ID on product giving access online to info	0% (0)	50% (7)	0% (0)	7% (1)	0% (0)	29% (4)	14% (2)	14
26.5 Information on product	7% (1)	53% (8)	27% (4)	0% (0)	7% (1)	7% (1)	0% (0)	15

	Results (percentage (n))							
Information type	**paper format**	**online / digital format**	**both paper and online / digital format**	**face-to-face training**	**online training**	**supplied**	**not supplied**	**N**
26.6 Information on packaging	0% (0)	23% (3)	23% (3)	0% (0)	0% (0)	15% (2)	38% (5)	13
26.7 Manufacturers' training	0% (0)	15% (2)	0% (0)	46% (6)	8% (1)	8% (1)	23% (3)	13

Source: RPA targeted survey analysis (2022)

Table 11-88 Question 27. Do you receive the same type and format of information from all of your suppliers? (N=14)

Option	Results (percentage (n))
Yes	64% (9)
No, it varies	29% (4)
Don't know	7% (1)

Source: RPA targeted survey analysis (2022)

Table 11-89 Question 28. Does your company have any processes in place to ensure flow [of] information from your suppliers? (N=14)

Option	Results (percentage (n))
Yes	36% (5)
No	43% (6)
Don't know	21% (3)

Source: RPA targeted survey analysis (2022)

Table 11-90 Question 29. In your professional opinion, to what extent are the manufacturers guidelines/instructions complete? (N=14)

Option	Results (percentage (n))
Fully	86% (12)
Not at all	0% (0)
They vary	7% (1)
Don't know	7% (1)

*Source: RPA targeted survey analysis (2022) *Percentages may not sum to 100 due to rounding.*

Table 11-91 Questions 32-35. In your professional opinion, to what extent… (N given in table for each question)

	Results (percentage (n))				
Statement	**Fully**	**Partly**	**Not at all**	**Don't know**	**N**
32. In your professional opinion, to what extent are your suppliers of insulation compliant with Construction Products Regulations Directive?	71% (10)	7% (1)	0% (0)	21% (3)	14
33. In your professional opinion, to what extent your suppliers of insulation compliant with industry standards?	79% (11)	7% (1)	0% (0)	14% (2)	14
34. In your professional opinion, to what extent is the rest of the sector for insulation compliant with Construction Products Regulations Directive?	21% (3)	21% (3)	0% (0)	57% (8)	14
35. In your professional opinion, to what extent is the rest of the sector for insulation compliant with industry standards?	21% (3)	29% (4)	0% (0)	50% (7)	14

Source: RPA targeted survey analysis (2022)

11.13.4 Relationships with buyers

This section contains questions that were asked in the surveys for A, B/C and D/E/F. Not all questions were asked for all surveys.

Table 11-92 Question 46. To what extent do you agree with the following statements relating to insulation? (N=7)

	Results (percentage (n))		
Statement	**Yes**	**No**	**Don't know**
46.1 We have mapped the geographical location of our customers.	71% (5)	29% (2)	0% (0)
46.2 We can visualise the flow of goods from our company to customers.	86% (6)	0% (0)	14% (1)
46.3 We get information from our customers about their demand.	86% (6)	14% (1)	0% (0)
46.4 We have mapped the flow of products in the downstream supply chain.	29% (2)	57% (4)	14% (1)
46.5 We can visualise the flow of goods from our company to our customers' customers.	29% (2)	71% (5)	0% (0)
46.6 The mapping of our downstream supply chain processes permits our company to identify areas for further analysis.	43% (3)	57% (4)	0% (0)
46.7 We have documented processes for dealing with buyers.	57% (4)	29% (2)	14% (1)

Source: RPA targeted survey analysis (2022)

Table 11-93 Question 49. In what format is the following information provided? (N=7)

	Results (percentage (n))						
Information type	**paper format**	**online / digital format**	**both paper and online / digital format**	**face-to-face training**	**online training**	**supplied**	**not supplied**
49.1 Data safety sheet	0% (0)	71% (5)	29% (2)	0% (0)	0% (0)	0% (0)	0% (0)
49.2 Technical manuals	14% (1)	71% (5)	14% (1)	0% (0)	0% (0)	0% (0)	0% (0)
49.3 Brochure/leaflet	14% (1)	71% (5)	14% (1)	0% (0)	0% (0)	0% (0)	0% (0)
49.4 Unique ID on product giving access online to info	0% (0)	43% (3)	29% (2)	0% (0)	0% (0)	0% (0)	29% (2)
49.5 Information on product	14% (1)	57% (4)	29% (2)	0% (0)	0% (0)	0% (0)	0% (0)
49.6 Information on packaging	14% (1)	29% (2)	14% (1)	0% (0)	0% (0)	14% (1)	29% (2)
49.7 Manufacturers' training	0% (0)	0% (0)	0% (0)	43% (3)	14% (1)	14% (1)	29% (2)

Source: RPA targeted survey analysis (2022)

Table 11-94 Question 51. Do you share the same type and format of information with all your buyers of insulation? (N=7)

Option	Results (percentage (n))
Yes	57% (4)
No, it varies	43% (3)
Don't know	0% (0)

Source: RPA targeted survey analysis (2022)

No responses for question 52.

Table 11-95 Question 53. Does your company have in place any processes to ensure flow of information to your buyers of insulation? (N=7)

Option	Results (percentage (n))
Yes	43% (3)
No	57% (4)
Don't know	0% (0)

Source: RPA targeted survey analysis (2022)

Table 11-96 Question 54. To what extent is your company compliant with existing legislation and/or industry standards related to information provision requirements? (N=7)

Option	Results (percentage (n))
Fully	71% (5)
Partly	29% (2)
Not at all	0% (0)

Source: RPA targeted survey analysis (2022)

11.13.5 Trade associations

This section contains questions that were asked only in the survey for trade associations. Not all questions received a response.

Table 11-97 Question 63. How important are imports of insulation for your members? (N=2)

Option	Results (percentage (n))
Very important	50% (1)
Important	0% (0)
Neutral	50% (1)
Not important	0% (0)
Not important at all	0% (0)
I don't know	0% (0)

Source: RPA targeted survey analysis (2022)

No responses received for question 65.

Table 11-98 Questions 66 and 67. (N=3)

	Results (percentage (n))		
Statement	**Yes**	**No**	**Don't know**
66. Are there any regulations and/or industry standards related to insulation information provision in the supply chain?	100% (1)	0% (0)	0% (0)
67. Does your organisation have any processes to check whether and how your members comply with those regulations and/or industry standards related to information provision in the supply chain?	0% (0)	100% (1)	0% (0)

Source: RPA targeted survey analysis (2022)

11.14 Imports and exports – trade balances

11.14.1 Cables

Table 11-99 Trade balance for coaxial cable, low and high voltage and fibre optic cables – 10 lowest and 10 highest shown

Coaxial cable		Low voltage cable		High voltage cable		Fibre optic cables	
Country	**Trade balance**	**Country**	**Trade balance**	**Country**	**Trade balance**	**Country**	**Trade balance**
China	-£34,888,966	Turkey	-£323,359,333	Poland	-£51,367,744	Poland	-£40,617,287
Turkey	-£13,745,635	Egypt	-£82,975,111	Turkey	-£50,266,088	China	-£14,275,332
Vietnam	-£13,553,848	China	-£68,104,467	United States	-£38,799,897	Hong Kong	-£11,624,108
United States	-£11,997,390	Greece	-£43,051,228	Finland	-£34,380,906	Romania	-£9,504,078
Germany	-£4,334,483	Poland	-£34,739,931	Germany	-£26,177,014	India	-£9,084,261
Philippines	-£3,413,561	Germany	-£20,531,324	Norway	-£16,104,223	Belgium	-£7,106,061
Belgium	-£1,365,015	India	-£19,561,750	Vietnam	-£10,829,315	Morocco	-£6,729,269
Costa Rica	-£1,322,801	Portugal	-£18,741,965	Denmark	-£9,896,801	Norway	-£6,045,091
Denmark	-£1,186,900	Taiwan	-£18,551,677	Italy	-£6,946,651	Japan	-£5,811,848
Taiwan	-£1,082,230	Italy	-£15,183,501	France	-£5,796,034	United States	-£5,623,788
Sweden	£1,011,092	France	£3,666,032	Cyprus	£915,533	Brazil	£906,895
Spain	£1,020,598	Morocco	£3,698,032	Ireland	£1,624,877	Spain	£1,503,960
Russia	£1,070,137	Netherlands	£3,834,796	Indonesia	£1,764,796	Denmark	£1,629,734
Ireland	£1,325,334	Finland	£3,886,478	Brazil	£1,784,341	South Africa	£1,711,219
Oman	£1,436,559	Saudi Arabia	£5,281,409	UAE	£1,949,181	Saudi Arabia	£1,987,130
Italy	£1,518,624	South Africa	£6,481,642	Australia	£1,956,371	UAE	£2,099,775
Hong Kong	£1,570,544	Qatar	£8,627,707	Nigeria	£2,249,441	Qatar	£2,640,213
UAE	£1,582,667	UAE	£23,606,751	Iraq	£2,267,853	Italy	£3,519,798
Japan	£2,001,550	Ireland	£46,012,711	Qatar	£3,739,652	France	£4,150,849
France	£4,197,773	Hong Kong	£54,617,726	Singapore	£8,704,410	Ireland	£5,359,613
Total imports	**-£122,332,415**	**Total imports**	**-£905,078,388**	**Total imports**	**-£307,890,955**	**Total imports**	**-£203,031,049**
Total exports	**£58,025,862**	**Total exports**	**£434,586,901**	**Total exports**	**£71,164,239**	**Total exports**	**£104,856,255**
Trade Balance	**-£64,306,553**	**Trade Balance**	**-£470,491,487**	**Trade Balance**	**-£236,726,716**	**Trade Balance**	**-£98,174,794**

Note: red break line shows that other countries have trade balances between those displayed
Source: UK Trade Info (2019)

11.14.2 Cladding

This information is not available, see section 4.3.3.

11.14.3 Fire barriers

This information is not available, see section 5.3.4.

11.14.4 Fire doors

Table 11-100 Overall trade balance of timber, plastic and iron or steel doors and frames – 10 lowest and 10 highest shown

Country	Balance of Payments £	Country	Balance of payments £	Country	Balance of payments £
Wood doors, thresholds, and frames		**Plastic doors, windows and their frames and thresholds**		**Iron or steel doors, thresholds, and frames**	
Indonesia	-£75,665,104	South Korea	-£24,295,922	Germany	-£20,6Z66,067
China	-£37,591,069	Taiwan	-£22,342,946	China	-£15,516,846
Malaysia	-£31,801,994	Sweden	-£9,265,516	Netherlands	-£4,724,510
Portugal	-£21,727,119	China	-£9,244,153	Poland	-£4,368,870
Italy	-£17,638,452	Poland	-£4,669,999	Lithuania	-£3,207,498
Poland	-£14,594,732	Slovakia	-£3,832,186	Switzerland	-£2,116,095
South Africa	-£9,646,001	Germany	-£3,346,971	Italy	-£1,582,695
Brazil	-£8,181,588	Austria	-£2,900,520	India	-£1,080,766
Vietnam	-£6,348,890	Netherlands	-£2,663,572	Denmark	-£892,269
Spain	-£5,529,763	Turkey	-£1,892,935	Canada	-£858,302
St Helena	£19,753	Saudi Arabia	£29,517	Egypt	£566,964
Congo (Republic)	£23,095	Guatemala	£35,870	Thailand	£567,779
Kuwait	£31,456	Japan	£49,338	St Vincent	£665,434
Mongolia	£52,919	Bermuda	£130,302	Norway	£831,740
Falkland Islands	£63,280	Falkland Islands	£183,006	Australia	£992,128
Switzerland	£72,563	New Zealand	£224,123	UAE	£1,036,705
Qatar	£88,824	UAE	£289,393	Qatar	£1,085,191
Gibraltar	£168,626	France	£799,402	France	£1,160,454
United States	£242,037	Australia	£2,140,703	United States	£2,071,183
Ireland	£22,618,937	Ireland	£23,713,337	Ireland	£11,102,686
Total imported	-£254,042,443	Total imported	-£88,544,447	Total imported	-£56,955,646
Total exported	£23,478,122	Total exported	£27,863,269	Total exported	£25,548,611
Total balance	**-£230,564,321**	**Total balance**	**-£60,681,178**	**Total balance**	**-£31,407,035**

Notes: red break line shows that other countries have trade balances between those displayed
Source: UK Trade Info, provided by HMRC (2019)

11.14.5 Insulation

Table 11-101 Overall trade balance of insulation: Polyurethane spray foam, foam board, and nitrile rubber – 10 lowest and 10 highest shown

Country	Balance of Payments	Country	Balance of Payments	Country	Balance of Payments
Polyurethane spray foam		**Foam boards**		**Nitrile rubber**	
Germany	-£37,665,476	United States	-£22,003,606	China	-£3,728,887
Belgium	-£7,381,738	Portugal	-£16,923,977	Germany	-£965,375
Italy	-£7,110,975	Japan	-£15,828,158	Czechia	-£763,100
Netherlands	-£5,440,768	Ireland	-£9,166,608	France	-£677,082
Ireland	-£4,802,329	Belgium	-£5,552,009	Italy	-£549,732
Spain	-£1,990,298	Germany	-£3,288,977	Slovakia	-£401,479
United States	-£1,773,427	France	-£2,043,834	Turkey	-£356,003
Switzerland	-£1,585,978	Romania	-£897,404	Hong Kong	-£244,687
Romania	-£515,393	Switzerland	-£592,674	Japan	-£230,646
Solomon Islands	-£103,502	Lithuania	-£422,353	Taiwan	-£196,853
Canada	£1,233,181	Canada	£1,627,864	Philippines	£135,146
Norway	£1,349,785	Australia	£1,676,222	Singapore	£176,904
UAE	£1,445,993	Vietnam	£2,271,383	UAE	£215,416
Denmark	£1,933,481	Sweden	£2,416,267	Egypt	£231,451
Brazil	£2,242,831	Malaysia	£2,678,296	Ireland	£330,536
Poland	£3,476,641	Italy	£4,528,142	Belgium	£348,198
India	£3,509,620	South Africa	£4,652,861	Australia	£380,703
China	£3,670,638	Czechia	£6,876,393	Norway	£468,048
South Africa	£4,602,572	Poland	£8,914,489	United States	£945,398
Australia	£6,075,684	China	£26,283,116	Russia	£1,111,589
Total imported	**-£124,588,141**	**Total imported**	**-£213,495,887**	**Total imported**	**-£15,111,102**
Total exported	**£107,411,703**	**Total exported**	**£216,055,937**	**Total exported**	**£13,377,113**
Total balance	**-£17,176,438**	**Total balance**	**£2,560,050**	**Total balance**	**-£1,733,989**

Notes: red break line show that other countries have trade balances between those display
Source: UK Trade Info, provided by HMRC

Table 11-102 Overall trade balance of insulation: mineral wool and glass wool – 10 lowest and 10 highest shown

Country	Balance of Payments	Country	Balance of Payments
Mineral wool		**Glass wool**	
Belgium	-£6,069,755	China	-£23,898,281
China	-£2,895,643	United States	-£19,609,283
Netherlands	-£2,711,391	Belgium	-£11,534,230
United States	-£2,528,649	Egypt	-£10,291,082
Slovenia	-£1,323,736	Czechia	-£8,722,012
Denmark	-£1,231,027	Russia	-£7,725,065
Canada	-£1,015,022	Slovakia	-£7,708,916
Thailand	-£991,395	Japan	-£7,085,961
Iceland	-£781,335	Latvia	-£5,693,274
Poland	-£636,181	Sweden	-£3,002,052
Turkey	£3,397,652	Singapore	£5,708,463
Australia	£3,452,218	South Africa	£6,240,952
Sweden	£3,633,531	Spain	£6,576,807
Spain	£4,064,859	Hong Kong	£6,989,090
UAE	£4,845,725	Poland	£9,603,407
South Africa	£6,310,156	New Zealand	£15,978,589
Ireland	£7,028,459	Ireland	£17,166,555
Japan	£10,987,735	Italy	£29,238,064
Germany	£14,536,533	Australia	£33,359,432
France	£14,717,894	Germany	£58,415,096
Total imported	**-£110,471,848**	**Total imported**	**-£265,892,406**
Total exported	**£181,485,654**	**Total exported**	**£404,227,001**
Total balance	**£83,567,576**	**Total balance**	**£138,334,595**

Notes: red break line show that other countries have trade balances between those display
Source: UK Trade Info, provided by HMRC (2019)