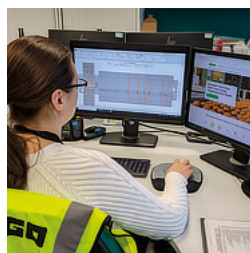
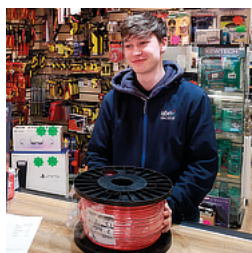
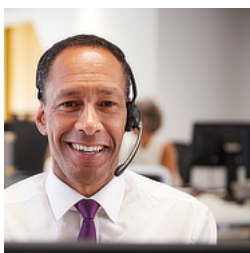


POWER IT UP

A career in the electrotechnical supply chain



Careers in
electrotechnical
are diverse,
with many
opportunities
for advancement.



Publishing information

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Version 3, published November 2023

Electrical Distributors’ Association
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ISBN: 978-1-3999-1855-8

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FROM THE PRESIDENT

The electrotechnical sector is a major player in the UK’s construction industry, worth billions to the economy. The products sold by businesses in this supply chain give us access to electricity: from lighting our homes to floodlighting a football match, from recharging a mobile phone to recharging an electric vehicle.

As a sector we need to attract talented and hard-working individuals looking for satisfying careers with great prospects. This guide explains how the sector works and will inform your career decisions.

If you are enthusiastic, keen to learn and forward thinking, you are just what businesses in this sector are looking for. Once you’re in, the opportunities for advancement will keep you motivated. Many of today’s leaders started in entry level roles and worked their way up.

I hope this *Power It Up* guide helps launch your career, and many others besides.

Charlie Lacey
EDA President
Managing Director, Stearn Electric Co Ltd



ACKNOWLEDGEMENTS

Working group

Electrical Distributors' Association (EDA)
Aico Ltd
CEF
Channel Safety Systems
Robus

Illustrations

The EDA would like to thank these organisations for allowing us to feature their photography in *Power It Up*.
In alphabetical order:

- ABM Electrical Wholesale Ltd
- Aico Ltd
- CEF
- Channel Safety Systems
- CQR
- Eaton
- ECA
- Edmundson Electrical Ltd
- Elite Security Products Ltd
- Glen Dimplex Heating & Ventilation
- Grant & Stone Ltd
- Heat Mat Ltd
- IET
- Itron Metering Systems
- Jaguar Land Rover
- Legrand Electric Ltd
- Lutron EA Ltd
- Marshall-Tufflex Ltd
- Prysmian Cables & Systems Ltd
- Robus
- Schneider Electric Ltd
- Signify (Philips Lighting)
- Solis Inverters
- Stearn Electric Co Ltd
- Specialised Wiring Accessories Ltd
- Texecom
- WAGO Limited

ABOUT THIS INTRODUCTORY GUIDE

This document has been compiled by the Electrical Distributors' Association (EDA) as an introduction to the electrotechnical supply chain in the UK construction industry, and the role of the electrical wholesaler in particular.

Electrotechnical products are installed by a qualified electrician and should not be confused with electrical appliances.

It describes the supply of electrotechnical products and is a guide for anyone considering a career in the sector. For those who already work in the sector, it will serve as an introduction to the EDA's City & Guilds-accredited Product Knowledge Modules, most of which are summarised in Part 3.

Contents

The first section sets out the size of the construction sector in the UK and its importance to the economy. Electrotechnical products are an essential part of any construction project – from the smallest home to massive infrastructure projects such as HS2 or the Elizabeth Line.

A supply chain of manufacturers, wholesalers and installers ensures that these products are bought and fitted in good time.

Supply chain

The second section describes the links in this supply chain, and the additional role of the 'influencers' – clients, architects, system specialists and end users – that influence decision-making at all stages in a project.

In the third section, we describe products in nine product categories, along with a warning about the dangers posed by counterfeit equipment.

Career

Finally, we discuss working in electrical wholesaling, and how the EDA can help you further your career with education and training.

If you'd like to find out more about what the EDA can offer, visit www.eda.org.uk, or phone 020 3141 7350.



ABOUT THE EDA

This book is published by the Electrical Distributors' Association, a trade body that represents electrical wholesalers and has been adding value to the electrotechnical supply chain for over 100 years



Worth over £4 billion each year to the UK economy, electrical wholesaling is big business. Operating in our wider construction sector, wholesalers are that crucial link in the supply chain between the manufacturers who design and produce increasingly hi-tech electrotechnical products, and the electricians and contractors who install them.

Wholesalers are multi-skilled business professionals. They need the technical know-how to understand the thousands of products passing through their business daily, as well as a breadth and depth of knowledge across purchasing and procurement, warehousing and logistics, data management, financial management, sales and marketing, merchandising and HR.

The EDA's 250 wholesaler member companies come in all shapes and sizes: from local family-run enterprises to global businesses with hundreds of branches, but they all enjoy the same level of EDA support including:

- training and development;
- business networking opportunities;
- business support services;
- product data services;
- market information; and
- publications and digital communications, including *Taking Stock*, our regular newsletter.

To support and enhance the manufacturer-wholesaler relationship even further, the EDA invites leading manufacturers, solution and service providers to become affiliated members of the association. There are about 100 affiliated members today, with more joining each year.

Led by a president and board formed of highly skilled and respected members of the sector, the EDA team in London is ready to help you with any questions you may have about training or becoming more involved in the EDA's activities.

Call 020 3141 7350, visit www.eda.org.uk, contact us at info@eda.org.uk, or via our social media channels on Twitter, Facebook or LinkedIn.



INDUSTRY OVERVIEW

INDUSTRY OVERVIEW



1 Industry overview

1.1 Structure of the electrotechnical industry

Construction is big business. According to figures from the Office for National Statistics, it represents **8% of gross domestic product** and **10% of the UK workforce**. Ninety per cent of the industry is made up of small and medium-sized companies.

A quarter of construction work is for the public sector – that's government or local authorities – including infrastructure, and the rest is for private companies or individuals.

The construction industry is made up of almost 40 different supply chains – bricklayers, carpenters, plumbers, and so on. This book is about the supply chain for electricians. The supply chain is the channel for the flow of products from manufacture to use. The market for electrotechnical products for construction in the UK is worth about **£4bn**.

8%
construction sector
represents 8% of
GDP

An essential part of construction is the **electrotechnical supply chain** because electrotechnical products bring a modern building to life.

These products include the **cables** that bring electricity to the building and conduct it to different areas, and accessories that contain and protect them. **Switchgear and distribution products** control the flow of electricity, and **wiring accessories** help electricians connect cables to each other and to other products.

Lighting includes light sources – such as LEDs and fluorescent tubes – and light fittings – which are sometimes called fixtures. Modern lighting systems also demand sophisticated control systems.

Heating and ventilation products can be standalone plug-in appliances or built-in equipment, and can be controlled by an electronic system in response to signals from sensors.

Complete systems are available for **closed-circuit TV, fire protection** and **security**. A modern 'smart home' may require specialised devices and controls.



▲ Going up: the construction sector depends on electrotechnical products distributed by wholesalers

John Cameron, Unsplash

As well as all these products, a wholesaler may also stock **industrial controls**, components for **IT and data infrastructure** projects, **tools and fixings**, **workwear** and **personal protective equipment**.

You will learn more about these products in Part 3 of this book, starting on page 27.

1.1.1 The supply chain

In the electrotechnical sector, the supply chain has three principal links: the **manufacturer**, the **wholesaler** and the **contractor/installer**. There is also another important group: **specifiers** – people who design building systems and may specify products with particular characteristics. They will have a huge influence on the products chosen.

£4bn
annual market
for electrical
products

Manufacturers make the products; wholesalers (or distributors) buy them in large quantities at a discount and sell them on to contractors (or installers) at a higher price than they paid to purchase them.

A wholesaler sells products at a trade counter or on an e-commerce site on the internet. They also need to store these goods between the time they are bought and the time they are sold, so most will have a warehouse. Often this warehouse will be on the same site as the trade counter, so electrical contractors can buy what they want without waiting for stock to become available.

The wholesaler is the essential link in the chain between the manufacturer and the electrical contractor that fits the equipment for the end user.



▲ Face-to-face: the trade counter is where most contractors still buy the products they need

ABM Electrical Wholesale Ltd

Trade associations

Each of the links in the supply chain is represented by one or more trade associations. These bodies are funded by businesses in the electrotechnical sector, and encourage collaboration between member companies; promote education and training; lobby governments, regulators and standards bodies; publish newsletters, websites and technical documents; hold events and present awards.

There are four principal manufacturers' associations. For makers of insulated metallic and fibre optic cables and accessories there is the **British Cables Association** (BCA). It encompasses four product sectors: energy cables, supertension cables, communication cables and power accessories. It 'represents its members on relevant major policy issues to promote the interests of UK cables and associated businesses throughout Europe and the worldwide markets' and to provide services to contribute to the success of the UK cable systems industry.

BEAMA represents manufacturers of electrical infrastructure products and

systems, from electricity transmission and distribution to environmental systems and services in buildings. That description covers four sectors: heating and ventilation, building electrical systems, flexible energy systems and networks. The association has about 200 members.

GAMBICA is a trade association for instrumentation, control, automation and laboratory technology in the UK. Wholesalers are unlikely to encounter products from some of the more specialist manufacturers under the GAMBICA umbrella, but they will certainly encounter test and measurement tools and some industrial control products (see page 42).

For makers of lighting equipment, there is the **Lighting Industry Association** (the LIA). Members benefit from the associations' work with legislators and access to market intelligence.

Recent developments in lighting technology mean there is a need for ongoing training of those in the sector, and the LIA has established the

LIA Academy. It also runs the LIA Laboratory for testing products.

Wholesalers in the UK are represented by the **Electrical Distributors' Association** (EDA). Members can be wholesalers or affiliated manufacturers, solutions and service providers. Wholesaler members include large companies with a network of branches to single branch operations. The EDA organises networking events, training and apprenticeships, digital data services and publicity. It represents the sector in Europe.

Contractors and installers in England, Wales and Northern Ireland are represented by the **Electrical Contractors' Association** (ECA). Its 3,000 members and associates include designers, consultants, specifiers, manufacturers, distributors and training providers.

In Scotland, contractors can join **Select**. It has 1,250 members and offers technical advice, health and safety guidance and employment information. It lobbies government and runs training services.

WHAT THE INDUSTRY HAS TO OFFER

Monkey Business Images, shutterstock.com



▲ Knowledgeable: Nicole Wallis works for Lockwell in Middlewich; she has completed nine EDA Product Knowledge Modules and is working on her 10th

1.2 What the industry has to offer

When you get a job in the electrotechnical sector, you are joining an industry that can change the world for the better. Energy-efficient equipment, smart buildings, renewable energy and electric vehicle infrastructure are just some of the areas that you will be involved in.

Not only that, you will be working in a friendly industry with many opportunities for career advancement – whatever your ability.

The sector deals with thousands of products in categories such as fire and security, lighting, heating and ventilation, renewables, data and networking, wiring accessories, cables and cable management, switchgear and distribution, and industrial controls. Most manufacturers specialise in producing equipment in one or two of these categories, but many electrical wholesalers stock or supply all of them to installers and end users.



1.2.1 What we are doing to save the planet

By joining the electrotechnical sector, you are becoming part of an industry that will design, supply, install and maintain the products that will help the UK meet its ambitions to reduce carbon emissions to zero by 2050 – **Net Zero**.

Your skills will be instrumental in the successful rollout of most low-carbon technologies such as **solar panels, heat pumps, battery storage and electric vehicle charging**.

The sector is crying out for people with the skills to help it deliver Net Zero by 2050. In 2020, the Electrical Contractors' Association, working with other industry bodies, produced the *Skills4Climate* industry report, examining ways to ensure the electrotechnical sector has the skills base it needs.



▲ Sales: working for a manufacturer may offer sales opportunities

Marshall-Tuffex Ltd



Solis Inverters



▲ Hitting carbon targets: solar photovoltaic panels (top), battery storage (middle) and AC electric vehicle chargers (bottom)

The report revealed that 88% of engineering services employers support a green recovery, yet a quarter (25%) said they would not be able to find competent workers to meet an increase in demand for net zero technologies.

1.2.2 Technology

Using electricity efficiently to supply power and heat has never been more relevant. Everyone in the supply chain must understand the knowledge and progress, and the electrotechnical industry will be critical if the UK is to meet its Net Zero ambitions.

Internet of things technology has become widely accepted for many devices in the home, and more recently has been used by landlords and property management companies to monitor and improve living conditions for residents. Installers in the electrotechnical industry have spotted that this is a growth area and are investing in training to develop the skill sets of their staff to provide these products and services.

The electrical wholesaler is the link between the product and the customer.

Most manufacturers rely on market feedback through the wholesaler to inform them of customer needs so they can improve their products.

For more about electrotechnical technology, turn to section 3 starting on page 27.

1.2.3 Training

Training is essential to keep abreast of the rapid changes in technology. The electrotechnical industry is a leader in **training**, which comes in many forms: mandatory training for installers and operatives to ensure they provide a service that is safe for themselves and customers, product and standards training from manufacturers to ensure operatives keep up to date with new developments, personal development training to help people upskill, and learning to work in a team.

Many charities also support people working in the sector with awareness courses. An example is the Electrical Industries Charity, which holds regular mental health awareness sessions.

Personal development opportunities are rife in the electrotechnical sector. It is one of the few industries where you can still start with few qualifications – or even none. Jobs are available to match many skills sets – in technical, sales and management roles.

You can enter the sector as a **graduate**, an **apprentice** or with no formal qualifications. Knowledge is borne from experience and training, both widely available in this diverse community. All you need is the right attitude.

For more about training and career development, turn to page 47.



WAGO Limited

▲ Engineering: suitably qualified candidates might land an engineering job with a manufacturer

Apprenticeship level	Wholesaling in branch	Head office roles	Sales and selling	Manufacturing	Electrical contractor
Level 6 (Degree)	Wholesaler (retail) leadership	Chartered manager	Business to business sales professional	Project controls professional	Electrical or electronic support engineer
Level 5 (Foundation degree)	Operations manager	Improvement specialist	Departmental manager	Operations manager	Operations manager
Level 4 (HNC)	Wholesaler (retail) manager	Data protection and information governance	Sales executive	Process leader	Building services engineering technician
Level 3 (A level)	Team leader	Business administration	Digital marketer	Engineering technician	Installation electrician and maintenance electrician
Level 2 (GCSE)	Trade counter/ supply chain warehouse	Finance assistant	Customer service	Supply chain/ warehouse	Highway electrical maintenance and installation operative

▲ Roles in the sector for apprentices: apprenticeship levels and the roles they open up for you in wholesalers, manufacturers and contractors

1.2.4 Variety

A particularly attractive aspect of working in the electrotechnical sector is the variety of work available. Roles in the industry are wide and varied (see box, above): Many other roles are available, providing opportunities for anyone who is looking for a diverse, interesting career with outstanding progression opportunities.

Job security is good. People will always need buildings, and those buildings will need electrotechnical products to bring them to life. They are at the heart of life-safety systems such as fire and security installations, and of lighting control and data networks essential in modern buildings. These systems are essential tools in energy-saving initiatives, ensuring power is only consumed when necessary.

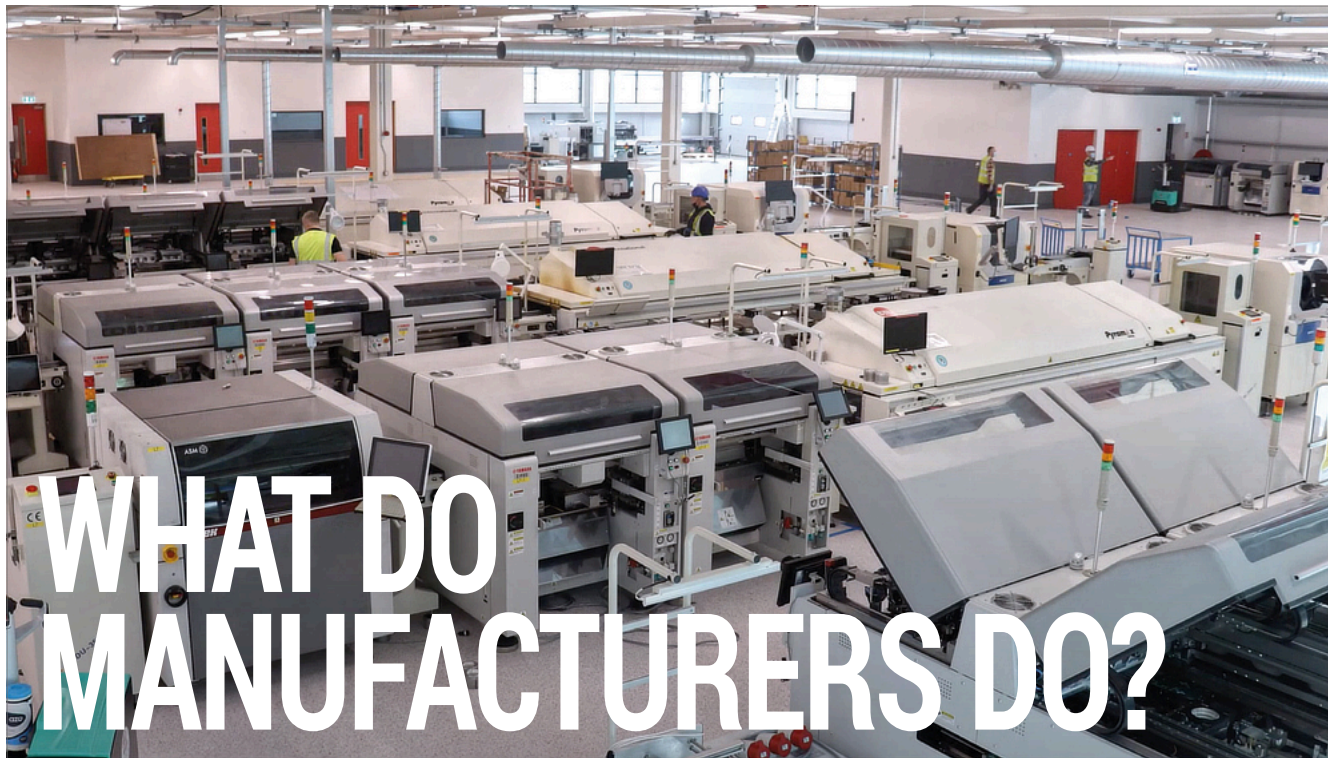
Finally, the electrotechnical business is still very much a **people business**. You will develop close relationships with your colleagues and customers. Industry bodies host a number of social events, annual dinners and awards ceremonies.



▲ People business: the electrotechnical sector holds frequent social events, dinners and awards ceremonies that bring the industry together

2

THE ELECTROTECHNICAL
SUPPLY CHAIN
FROM MANUFACTURER TO END USER



WHAT DO MANUFACTURERS DO?

Alco Ltd

2 The electrotechnical supply chain – from manufacturer to end user

2.1 Activities of the manufacturer

The manufacturer is the first link in the electrotechnical supply chain. The next link in the chain, the wholesaler, would have nothing to sell without the manufacturer.

An electrotechnical manufacturer is a company that designs, develops and manufactures products and sells them through electrical wholesalers – or other channels. They are also involved in product promotion.

2.1.1 The creation of a new product

The inspiration for of a new product can come from many sources. It may be triggered by the launch of a product from a competitor, demand from the market, evolution of an existing product, energy-saving technology, changes to legislation or standards, or simply a great idea. Manufacturers may conduct research to sound out its existing customers or scrutinise competing products in the market.

With this information in hand, the manufacturer can start to define the requirements for its new product.

2.1.2 The design stage

Most manufacturing organisations will hand over this fledgling idea to their research and **development or design** teams to flesh out the concept. Starting in the virtual world, engineers use **design software** to visualise the electrical and physical characteristics of the product.

It is common today to realise the virtual design in the real world using **3D printing**.

Next, it falls to the product development department to review the prototype products. The team may ask for feedback from potential customers. An



Alco Ltd

▲ From virtual to reality: electrotechnical product design usually starts on screen

important part of this process is to ensure the product meets the initial requirements set out earlier in the design process.

This process may be repeated several times, refining the design of the new product over and over until it is right.

2.1.3 The road to manufacturing

With the initial design nailed and the review complete, manufacture of pre-production prototypes can start. In an attempt to assess how the new product will perform in the real world, manufacturers conduct field trials.

The data collected from the trials will help manufacturers iron out any bugs in the design. Once this is done, and nothing else shows up, initial manufacturing of the product can begin. Even then though, the first batches of the products will be closely monitored and tracked to identify any problems that may have been missed and fix them for future production runs.

2.1.4 Information and support

Before the final product can be launched, manufacturers must document its characteristics and operating procedures. Neither wholesalers nor end users will have taken part in the design and testing of the product, and they will expect to have access to **datasheets** and **operating instructions**.

Although the paper catalogue has yet to disappear completely, most product data has migrated from doorstep-sized documents to the internet. Typically, a company will dedicate a page of its website to each product it makes – or has made in the recent past.

Such a page will contain a long list of vital statistics about the product. They may include a basic description, a list of its features, a technical specification, images and perhaps video. More often than not customers can download a datasheet.



Instructions for installing and operating the product are usually accessible from the web, along with other supporting material.

For customers that need more one-to-one support, a company may choose to have live chat on its website, usually with customer services or technical support staff. Other more conventional lines of communication include email, phone and video calls.

Increasingly, the product support team is likely to call on a **product information management (PIM)** system to store and share its data. PIMs output product data in an agreed format that can be imported into a wholesaler's product systems.

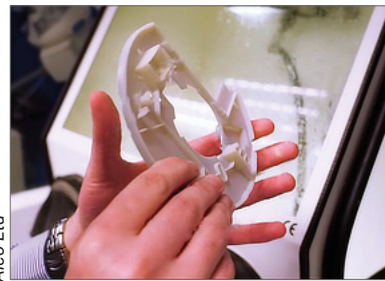
The EDA has been at the forefront of efforts to agree data formats for the electrotechnical industry through its EDATA initiative (see box, right).

2.1.5 Marketing and promotion

Of course, there's little point in launching a new product if you don't tell your potential customers about it. This promotion can take several forms.

One way that manufacturers like to promote their products is to book space at a **trade exhibition**. The largest of these take place at giant exhibition halls such as the NEC in Birmingham or ExCeL in London, although there are smaller, local events, sometimes run by trade associations.

The manufacturer's marketing team will draw up an events programme and



Alco Ltd

▲ Hands on: a product prototype created in a 3D printer

EDA Data Services

Access to rich, high-quality product data is essential. Inconsistencies in the way companies generate data create headaches at all levels of the supply chain, and repeated rekeying of information into proprietary databases inevitably leads to errors.

For this reason, ETIM was created. It is an international product data model – a classification or structure – not a database.

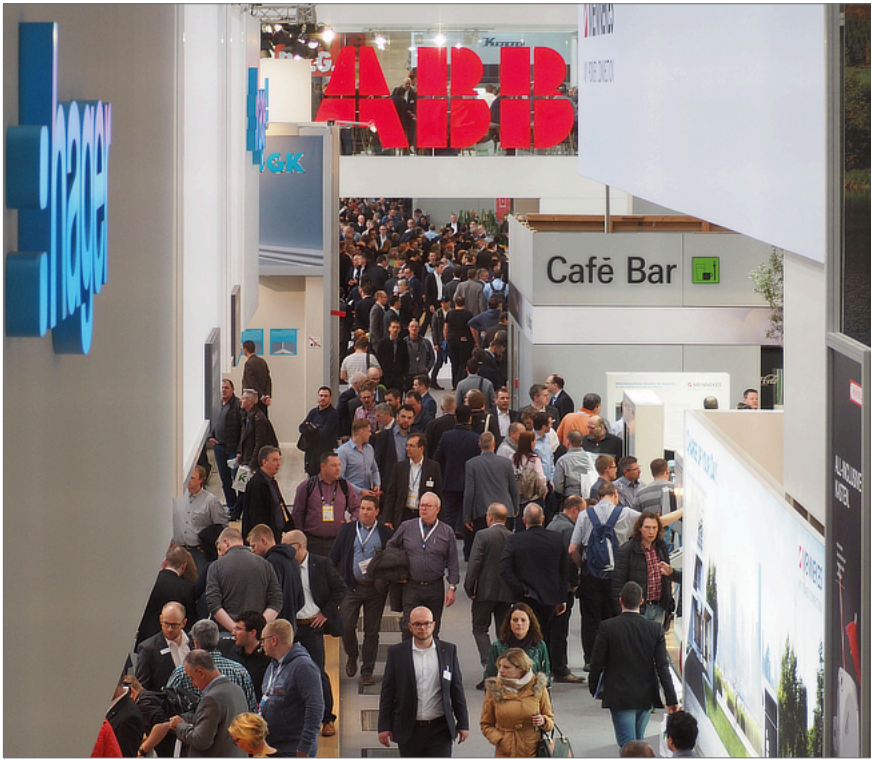
In early 2020, the EDA formed EDA Data Services Ltd, an independent not-for-profit business, to drive the adoption and development of ETIM across the UK.

It also educates, supports and advises businesses on data and digitalisation issues.

Manufacturers and wholesalers do not have to be Members or Affiliated Members of the EDA to have access to the work of EDA Data Services.

Roles at the manufacturer

- **Research and development**
Determining the products to develop
- **Purchasing** Buying raw materials and consumables
- **Manufacturing**
Production of products
- **Quality** Ensure products meet standards
- **Warehouse**
Receiving deliveries and storing stock, picking and dispatching wholesaler orders
- **Internal sales**
Phone calls, inputting orders, raising quotations, dealing with queries from wholesalers
- **Technical**
Answering technical phone calls, offering a design service
- **External Sales/ Specification**
Visiting customers, discuss projects, networking
- **Accounts** Ensuring payments are received on time, raising invoices, opening and closing accounts
- **Marketing**
Designing literature and point of sale, running campaigns to promote products



▲ The exhibition hall is a familiar haunt of marketing staff, wholesalers and end users

design a stand, often with the help of a design company, to attract exhibition visitors to see the latest products. Staff from other departments will be drafted in to work on the stand, explaining the product’s features and unique points – and perhaps setting out the legislative background to the product’s launch.

Alternatively, a manufacturer may opt for a more intimate gathering at its own premises. Here, it will have the potential customer’s undivided attention. Marketing staff will schedule such events, prepare presentations and book hotels for customers.

Beyond the exhibition hall, sales and marketing will be working on an overall marketing strategy. This will cover the four Ps of marketing: product, place, price and promotion.

Product The product must meet the needs of the customer, either by having all the features they are likely to need or by offering variants for different customers. Also the product should be well branded – it must have a distinctive design used throughout all advertising and other promotion.

Place This is where customers can get their hands on the product. A manufacturer will use multiple distributors to help it cover a large geographical area, and its commercial and sales teams will work with those wholesalers to get stock on the wholesaler’s shelf to fulfil installers’ immediate needs. Some customers may prefer to buy online, so online sales and e-commerce channels should be provided.

Price How does a manufacturer work out an appropriate price for its product? Usually it will consider the prices of competing products and set a price based on its desired positioning in the market. It must also take into account any discount that may be offered to trade customers and the profit they need to realise to continue investing in their growth.

Promotion It is the job of marketing to work out the best way to get the company’s message about the product to potential customers. Many advertising channels

are available, online, TV, press and magazine (including specialist trade press) and direct marketing through ‘e-shots’. A manufacturer’s marketing department may prepare advertisements itself, or hire an external marketing agency.

In the wake of all this promotional activity, the company will analyse the results to identify the channels that will be most effective for future product launches.

2.1.6 Education and training

Many of the products on an electrical wholesaler’s shelves are extremely complex, and it may pay dividends for the manufacturers of those products to offer **training** to wholesalers and end users.

One option is for the manufacturer’s external sales team or its technical team to offer traditional ‘classroom’ lessons, usually at the customer’s premises. Trade counter promotion mornings offer a great way to introduce new products to the installer and educate the wholesaler.

Another way to deliver product training is online. Similar, classroom-style sessions are delivered using videoconferencing platforms such as Zoom or Teams.

More ambitious manufacturers – or those with particularly complex products – may choose to invest in a dedicated **online training** platform. This might include a set of more formal training modules that cover not only the product but relevant legislation and standards.

The technical and marketing teams will work together to prepare the training material – presentations, graphics and perhaps video.

2.1.7 Standards

Any reputable manufacturer will be committed to maintaining **standards**. Standards apply to most business operations, not just the products themselves. There are standards covering product and manufacturing quality, the environment, health and safety and product safety.



Manufacturers must review all the applicable standards and develop their business functions and procedures in line with them. These functions must be set out in written documents. Companies must report regularly on their efforts and conduct audits of their factories to ensure compliance with standards is maintained. All of this work is conducted under the auspices of an operations or dedicated quality team.

2.1.8 Logistics

Logistics is about more than the shipping of finished products. It starts with an analysis that will help the manufacturer forecast demand for its products. Then it can ensure that there is enough manufacturing capacity to meet that demand.

Orders are received at the manufacturer’s distribution site, and warehouse staff will – with the help of software systems – pick, pack and load products onto vehicles. The software helps maintain stock levels and pinpoints the location of products in the warehouse.

Distribution software scans and weighs the packages, matches them to the order, prints labels and sends the data to the carrier’s software systems.

When it comes to shipping products to wholesalers, the manufacturer works with logistics companies to ensure products are delivered on time and that the wholesaler has enough stock to meet customer demand.

Quality control

Quality control (QC) is an essential part of the manufacturing process.

There are three aspects, set out in standards such as ISO 9001:

- Controls, management, well defined and managed processes, and effective record keeping throughout manufacturing.
- Competence, which covers the knowledge, skills, experience and qualifications of staff.
- Less tangible things such as motivation, confidence and team spirit.

An important part of QC is visual inspection of products.



▲ On the road: products are picked, packed and loaded on to vehicles



▲ Checkup: quality assurance tests on wiring accessories



2.2 Activities of the wholesaler

Procurement

An essential role of the wholesaler is procurement. Without products to sell, a wholesaler would not have a business.

The procurement department ensures that stock is brought at the right price, and that the wholesaler has stock available for delivery to its customers on time.

Another crucial role of the procurement department is to ensure that suppliers meet all relevant quality standards – suppliers with poor standards will be avoided.

In the electrotechnical supply chain, the electrical wholesaler – or distributor – is the vital link between the product manufacturer and the contractor/installer or the user.

Wholesalers ensure the visibility of manufacturers by offering thousands of products from hundreds of companies at branches all over the country. Not only do wholesalers have branches where customers can buy products in person over the trade counter, they will also have an extensive delivery network.

Wholesalers are staffed by knowledgeable experts that can advise customers. They can even play a role in stimulating the introduction of new technologies by offering advice and promoting particular products.

They help their customers stay on the right side of the law by informing them of changes to standards and legislation, and steering them towards compliant products – that is, products that have been certified as complying with government standards.

Stock awareness is a vital part of the wholesaler's job, ensuring that products are available by monitoring sales and planning purchases from manufacturers.

In addition to their lines of supply from manufacturers, most wholesalers will also purchase some product from distributors. **Distributors** provide a fast delivery service, often next day, when the product lead time is critical and getting the product direct from the manufacturer is less practical.

Distributors can be specific to a particular product type – or group of product types – or have a more diverse product portfolio to cater for the wholesaler's needs.



The primary role of the wholesaler is to support its customers. This support can take many forms.

2.2.1 Product knowledge

Customers expect wholesalers to have a comprehensive knowledge of the products they sell. It gives them confidence that working with the wholesaler will add value to their businesses.

Wholesaler staff that understand their products will more easily understand what their customers need, and help them choose the right products for the job. If a particular product is in short supply, they can help them choose an alternative with confidence. Knowledgeable staff can also

offer extra products that the customer may not have thought of – or better or cheaper alternatives.

Trade counter staff should know about the latest changes to standards and legislation, and how they affect the products they sell. By staying abreast of these changes in the wider industry, the wholesaler will promote confidence among its customers, and potentially secure more sales.

2.2.2 Getting products to customers – logistics

Putting products in the hands of customers isn't always simply a matter of handing them over at the **trade counter**. A rapid and reliable **delivery** service is an essential part of a wholesaler's job. Alongside routine deliveries – often on the same day – wholesalers will often offer an **emergency service** if the absence of a product would delay a project.

££

Credit helps a project run smoothly

Working closely on a project with the customer helps develop trust and strengthen the relationship between the two parties. On larger projects, the wholesaler will often be familiar with the schedule, and ensure that products are delivered to site on time. They may hold stock specific to a project, ready to supply when it is needed.

The key to this is communication. A good relationship between wholesaler and customer will ensure a successful project outcome for the customer, and repeat business for the wholesaler. Contractors and installers depend on reliable suppliers for their businesses to thrive.

Many wholesalers have implemented **online systems** to let customers place orders whenever they want. These orders have to be processed and ready for collection or delivery – usually the following day.

2.2.3 Finance and credit

Another important aspect of the wholesaler/customer relationship is credit. Wholesalers will manage finance and extend credit to their customers. Cash flow on a construction project can be complex. The client usually pays its contractors in stages, so those contractors may not have cash at hand for products they will need in the next stage.

Wholesalers, meanwhile, are offered credit from their suppliers, so they are in a position to offer credit to their customers. As a critical link in the supply chain,

Tackling counterfeit products

When a contractor buys products from a reputable electrical wholesaler, they are helping to keep non-compliant and potentially dangerous goods out of the market.

By stocking only products that meet national and international standards and corresponding legislation, the wholesaler is acting as a gatekeeper with an important safety role.

For more about counterfeit products, turn to page 46.



▲ Wise words: giving product advice is one of the wholesaler's key roles

Roles at the wholesaler/distributor

- **Trade counter**
Serve customers face to face, offer advice and recommend training
- **Warehouse/drivers**
Store deliveries from manufacturers, pick customer orders, deliver to site
- **Internal sales**
Answer telephone calls, input orders, raise quotations
- **External sales**
Visit customers, discuss up-and-coming projects, build relationships
- **Buyer**
Raise purchase orders for manufacturers, ensure stock levels are maintained, forecast product sales
- **Admin, finance and IT**
Raise invoices, follow up payments maintain computer systems
- **Branch manager**
Ensure branch runs effectively and efficiently, manage finance and credit
- **Apprentice**
There are many opportunities in wholesaler branches

In smaller branches, individuals may perform multiple roles.

the availability of credit at all stages will help a project run smoothly and finish in time.

Good handling of finances – not just supplying products – strengthens the relationships between everyone in the chain. A wholesaler's purchase and sales ledger staff are critical to this process.

2.2.4 Customer education

Electrotechnical equipment is changing all the time, and a contractor who is an expert on one product may not be just a few months later. Also, the electrotechnical equipment market is constantly changing, as standards and legislation change.

As the central link in the supply chain, wholesalers will often be involved in keeping their customers up to date on the latest developments. Wholesalers have to stay informed about the products they sell, and this puts them in an ideal position to communicate any changes to their customers.

Sometimes, an entirely new category of equipment comes onto the market. An example is electric vehicle chargers (EVCs). In recent years, the number of electric vehicles on the road has rocketed and, along with that, demand for charging equipment. As contractors were asked by their customers to fit charging points for their shiny new vehicles, the education of contractors about the technical and legislative requirements of EVCs became the job of the wholesaler.

Smart wholesalers promote these training activities as a customer resource.

2.2.5 Design services

Similarly, electrical contractors often need more than simply a product. They may need extra support and advice when it comes to fitting something as complex as a lighting, fire alarm or heating and ventilation system.

Wholesalers can work with manufacturers to provide the best possible design services for the contractor. Again, wholesalers are the essential link between the manufacturer and the contractor.

2.2.6 Staff training

If wholesaling staff are to fulfil their role as advisers to their customers, training is essential. The EDA is active in this area. It has a series of a dozen **Product Knowledge Modules** that cover topics from the principles of electricity to customer service through a range of products such as lighting, cables, heating and ventilation, and data infrastructure.



12

Product Knowledge
Modules from
the EDA



Syda Productions, shutterstock.com

▲ Off the shelf: the warehouse team is responsible for picking customer orders for delivery to the customer's site

Armed with the knowledge in these modules, wholesalers who have studied them can better understand the needs of their customers and offer authoritative advice. (Key points from the modules are summarised starting on page 27.)

Apprenticeships are another opportunity to upskill by learning on the job. Apprentices can move into sales, management, marketing or design roles by studying for an apprenticeship and working in the role. Apprenticeships are available from level 2 to level 7 (equivalent to a degree).

2.2.7 Specialist Services

Many electrotechnical wholesalers offer their customers extra services such as the **calibration** of electrical test equipment; the opportunity to **hire** cable jacks, large crimping tools or specialist test instruments; and product **recycling**.

As part of the Waste Electrical and Electronic Equipment (WEEE) Regulations, all electrotechnical wholesalers must:

- Offer free take-back on WEEE.
- Accept, for free, WEEE from customers supplied with like-for-like products, whether this is done in store, online or by mail order.
- Retain a record of all WEEE taken back for at least four years.
- Provide customers access to written information on the service provided and what they should do with their WEEE.

Wholesalers with a sales area for electrical and electronic equipment greater than 400 square metres must also accept small WEEE for free from private household customers at their retail site or close to it without the requirement to purchase new electrical and electronic equipment.



Marshall-Tuffex Ltd

▲ Hitting the road: electrotechnical products are loaded up for delivery to wholesalers

WHAT DO CONTRACTORS DO?



Kaspars Grinvalds, shutterstock.com

2.3 Activities of the contractor/installer

An electrical contractor is a business person or a company that designs, installs and maintains electrical systems in homes and businesses. Without electrical contractors there would be no electricity, no internet and no mobile phone networks.

Electrical contractors are involved in all aspects of electrotechnical design, installation, inspection, maintenance, testing and monitoring. They perform a specialised service that can demand specific skills. The types of work done by a contractor can be diverse, and the places where that work takes place will be very different. Contractors may work in:

- homes,
- commercial buildings,
- industrial buildings,
- infrastructure,
- marine and offshore environments, and
- temporary sites/events.

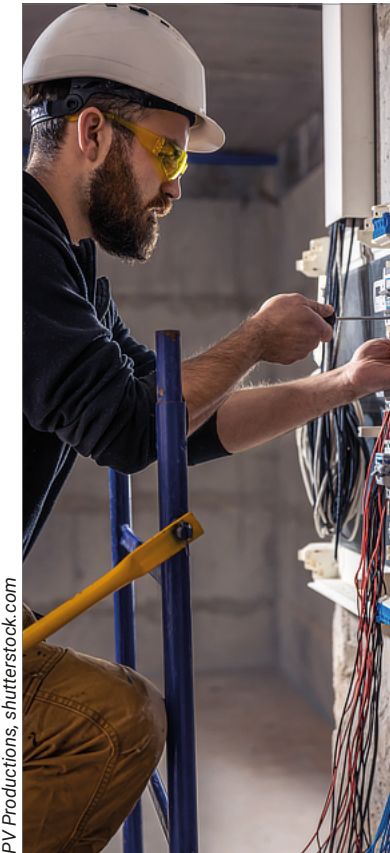
In these settings, an electrical contractor may also provide support for, or undertake, specialist services such as:

- Renewable energy generation;
- smart buildings;
- data and communication;
- building controls and building management systems;
- fire alarms, emergency lighting and security; and
- high-voltage work.



ECA

▲ Going up: a career in contracting means working in many settings



PV Productions, shutterstock.com

2.3.1 Quoting for a project

First of all, a contractor will **quote** to win work on a particular project. On a domestic scheme, this is a fairly straightforward process that may be carried out by the contractor themselves, or by administration staff. For a larger project, the quote may take the form of a standard enquiry on tender.

Once a larger scale job is secured, contract and **project management** staff will be assigned to the project, to make sure that everything runs smoothly – and within budget. As the work progresses these people will attend meetings, ensure the on-site team is hitting all project targets, track spending and prepare progress reports.

Estimators will then work out the cost of the job so the contractor knows how much to charge the client. This will involve the use of estimating software and the preparation of a 'bill of quantities' that will list materials, parts and labour.

2.3.2 Design and installation

Before installation work can start, the electrotechnical system has to be **designed**. This can be carried out in a number of ways. Smaller electrical contractors may have a relationship with an engineering consultancy to do this work. A larger contractor may have an engineer on staff, and the largest could have a fully fledged engineering division.

The engineering function will involve the use of computer-based design software. Engineering staff will specify the types of products to be used and the layout of the installation, and ensure it meets all relevant technical and safety regulations. They will also document the design for installers and the client.

Trade associations

Electrical contractors have a responsibility to provide a service that meets relevant standards, the most important being BS7671, the Wiring Regulations, currently in its 18th edition.

Most contractors will be members of a trade association aimed at maintaining quality standards such as the **Electrical Contractors' Association (ECA)**, which was formed in 1901 and has Members throughout England, Northern Ireland and Wales.

Its role is 'improving standards, supporting the industry and creating a

sustainable business environment'. It does this by admitting companies that meet industry standards and certifications for electrotechnical design, installation, maintenance, testing and monitoring.

Contractors, engineers and installers join the association as Members, and companies in the wider industry can become Associates. Benefits for Members include free access to technical and business support, information and software, and a range of British Standards – as well as a range of discounts. ECA promotes

Entering the industry

An apprenticeship is the training route preferred by the industry. It is a job with training – you'll earn while you learn, acquiring skills through on-the-job experience and classroom training at a college or other training provider.

Your employer receives funds for the apprenticeship programme, which takes about four years to complete. Apprenticeships are now available for apprentices of any age.

Electricians are assessed at the end of their apprenticeships to test everything they've learned during their training.

There are other training routes into the sector, but you will need to work to gain practical experience.

its Members' capabilities to government, clients, specifiers and main contractors.

In Scotland, **SELECT** – formed in 1900 as the Electrical Contractors' Association of Scotland – performs a similar role. It is authorised by the Scottish Government to assess and register electricians who work in Scotland.

Contractors can also register themselves in a voluntary inspection body such as the **National Inspection Council for Electrical Installation Contracting (NICEIC)** or **NAPIT**.



Physics_Joe, Shutterstock.com

▲ Going green: contractors play a vital role in the installation of renewable technology

Engineering roles include design engineer, principal design engineer and design manager.

According to *Electrical Contractor* magazine's profile of the electrical contractor in 2020, 72% of contracting companies have a significant influence on the electrical design and specification of a project. Larger firms tend to have more sway than smaller ones.

Installation is the next stage. This will include wiring, switchgear, accessories and other equipment specified in the design. Installers must ensure that electrotechnical system is as specified in the technical drawings supplied by the engineer, and that they are working correctly – and safely.

The products for the installation are likely to be supplied by an electrotechnical wholesaler, although for very large projects they may come direct from the manufacturer.

Installers working on a job may have a number of job titles. Some may be apprentice electricians, at the start of their careers. Then there are electricians, technicians and test engineers.

On-site management has a supervisory role, monitoring progress and feeding information backwards and forwards between staff working on site and the client. They ensure the work is performed by the installers to a good and safe standard that meets the regulations relevant to the work being done. They may then need to provide certification for the installation.

72%
of contractors
influence project
design

Roles at the contractor

- **Contract manager**
Focus on delivering the job and meeting client's needs
- **Estimator**
Calculates the cost of the job
- **Electrical engineer**
Designs the electrical systems
- **Electrician** Works on the installation of the components – may be an apprentice
- **On-site management**
Supervises on-site staff including electricians
- **Senior management**
Responsible for all aspects of a contracting firm's operations

In smaller companies, individuals may perform multiple roles.

2.3.3 Safety

Safety is essential in any electrical installation, and it is a key role of the contracting company to check the installation and to certify that it meets the demands of all technical and safety standards.

In the UK the most important standard for electrical installations is *BS 7671, Requirements for Electrical Installations, IET Wiring Regulations*, which are published by the Institution of Engineering and Technology. The regulations are often simply referred to as 'the regs' in the electrotechnical sector.

Surprisingly, the wiring regs themselves are non-statutory, but they have the force of law because they are mentioned in other, statutory regulations such as the Electricity at Work Regulations.

In homes, electrical safety requirements are set out in Part P of the Building Regulations (see box, below).

Maintenance of electrical installations is essential to ensure safety, or simply to improve or extend an existing system. This work includes inspections and the repair or replacement of components.

2.3.4 Management

An electrical contracting company – whether it has a handful of staff or has a national presence and hundreds of staff – will have **senior management**. The management is responsible for finance, customer services, sales, staff welfare, health and safety, legal and environmental matters throughout the company.

Many senior managers in the electrotechnical contracting sector started in other roles in the business – sometimes as apprentices. Then they worked their way up into roles that may include Director, Managing Director and Chief Executive.



▲ Installation: just one of the tasks a contracting firm does

Electrical installations in homes – Part P

Some domestic electrical work must be carried out by an electrical contractor who is registered with a Part P self-certification scheme, or notified to the local authority building control department before work begins.

Several scheme operators approve contractors for Part P self-certification, including the following for England and Wales: BSI, ELECSA, NAPIT, Certsure, STROMA, BECSA, Benchmark Certification; and OFTEC.

Organisations registered with these schemes often advertise their certification on their vehicles, stationery, website, and advertisements. Consumers can check the registration status of a contractor with their certification body.

The schemes have minimum requirements for training, knowledge and ex-

perience, and carry out regular audits or inspections to check that the contractors appear to be conforming to the scheme requirements, as well as the required standards and legislation.

The **Construction Skills Certification Scheme (CSCS)** was introduced so those working in the construction industry could have cards to demonstrate their craft skills. This was also adopted for those working in construction management. Applicants have to demonstrate:

- relevant knowledge and experience at the right level,
- appropriate qualifications, and
- knowledge of relevant construction health and safety practices and legislation.

Some large building firms demand that those working on their sites – and

managing the work – have appropriate cards for the work they are doing.

Skills cards for electrotechnical trades are managed by the **Electrotechnical Certification Scheme (ECS)**, which is associated with the CSCS.

The **Joint Industry Board (JIB)** administers the ECS scheme. It has for many years had an associated grading scheme for those working in the electrical industry, called 'JIB Grades'. If you qualify for a JIB Grade you can obtain an ECS card for that grade.

ECS cards are available for other electrical-related occupations:

- security and CCTV systems,
- audiovisual systems,
- mobile portable buildings, and
- management of electrotechnical projects.

WHO ARE THE SPECIFIERS?



Borko Manigoda, Pixabay



▲ Looking good: the aesthetic importance of lighting means lighting designers will be keen to specify particular products



Thirdman, Pexels

▲ On the drawing board: architects are important influencers on the electrotechnical supply chain

2.4 Specifiers

There is another group that, although it is not a link in the supply chain, can have a profound impact on electrotechnical wholesalers and the products they are called on to supply: the **specifiers**.

The decisions of influencers can affect the supply chain throughout the life of a project, even if it is simply to emphasise the need to meet the demands of relevant legislation, or to meet the particular look and feel, or technical, demands of the client or their designer.

As a result of these decisions, the choice of products may change, and so might the time they must be delivered to site.

So who are these influential people? At the very top of the pecking order is the **client**, which may be a public sector body like a council, a private company such as a housebuilder, or an individual. From the very start of a project, they will have a very clear idea of what is required for their building.

The **architect** is charged with making the client's ideas a reality. They will set out the essential demands for the electrotechnical systems in the building. A number of specialist consultants are likely to be involved at an early stage.

Building services engineers have a direct influence on the specification of electrotechnical products for a project. They include **mechanical and electrical engineers**, **heating and ventilation engineers**, and **building automation engineers**.

Lighting designers are specialists that will be keen to specify particular products because of the important role of lighting in achieving the look of the interior and exterior of the building.

Similarly, the **interior designer** can affect the choice of wiring accessories and other parts of the installation visible to the occupants of the building.

There are also many other **specialist consultants** and subcontractors for fire and security, CCTV, computer networking and other systems in a modern building.

3

PRODUCTS IN THE SUPPLY CHAIN

Find out more...

This is just a taste of what's inside the EDA's Product Knowledge Module:

- Distribution, Switchgear and Protection

Visit www.eda.org.uk for more.



3 Products in the supply chain

3.1 Distribution, switchgear and protection

An electrical wholesaler sells products that help ensure the safe use of electricity. But before we look at those, how is electricity generated and how is it distributed to customers?

3.1.1 Generation, transmission and distribution

First, electricity must be generated. In the UK, in the first quarter of 2020, just over half of the electricity was the result of thermal generation – the conversion of heat or thermal energy into mechanical energy that, for example, can turn a turbine connected to a generator.

The heat required for thermal generation can come from several sources: **fossil fuels**, nearly a third of the UK's generating capacity came from this source in Q1 2020; **non-fossil fuels** such as nuclear. Fossil fuels are simply burnt to generate heat; in nuclear, atoms are split.

Fossil fuels include gas, coal and oil, but North Sea oil and gas production has declined and renewable energy sources are replacing them.

Renewables, which represented about a half of UK capacity in Q1 2020, include wind, solar, tidal, shoreline wave and bioenergy (*turn to page 30 for more about renewables*).

To balance the UK's energy needs, the UK **imports** (and exports) electricity to the networks in France, the Netherlands and Ireland through efficient high-voltage direct current interconnectors.

3.1.2 Power to the home

Once generated, electricity cannot easily be stored, so it is transmitted and distributed to customers throughout the UK. Electricity system operators move

50%

of UK generating capacity is renewable



▲ Generation game: the turbine hall in a power station

electricity – at extra high voltage, 275-400kV – from the generators to bulk supply substations. The three system operators in the UK own and maintain the HV transmission system, and a single National Grid Electricity System Operator balances demand and supply.

From the substations, **distribution network operators** (DNOs) distribute electricity to consumers. Six operators hold 14 regional distribution licences between them. There are also **independent distribution network operators** (IDNOs) that build, own and operate networks for housing estates, business parks, data centres and other areas.

The final link in the chain is supply. **Electricity suppliers** are the retail arm of the electricity business. They buy energy on the wholesale market or direct from the generators and have it delivered by DNOs or IDNOs. They set the price to the consumer and the consumer chooses their supplier.

3.1.3 Electricity meters

Electricity **intake arrangements** vary for different kinds of premises. Most homes are connected to the low-voltage network. The DNO's supply ends at a service head which contains a protective fuse sized for the expected load of the premises – about 100A for a home. The service head is connected to the customer meter by the 'meter tails'. The **meter** may be a traditional electromechanical model (*below, left*) or a 'smart' meter (*below, right*). It is owned by the meter operator and has a seal to prevent tampering.



More modern installations have an **isolation switch** after the meter so the supply can be interrupted without calling out the DNO to isolate the supply at the service head.

The meter – or isolation switch – is connected to the consumer unit by 'consumer's tails'.

3.1.4 Consumer units and distribution boards

The purpose of a **consumer unit** – sometimes called **fuseboxes** or **switchboards** – is to split the supply to feed separate circuits in the premises for power, lighting, cooker, immersion heater and so on. Each circuit has protective device – a **fuse**, a **circuit breaker** or **residual current circuit breaker**.

There is also a **main switch** to isolate the entire installation.

Each of these devices are triggered by excess current flow in the line conductor, and has a breaking capacity – the current it can safely interrupt, measured in kA (thousands of amps).

Residual current circuit breakers monitor current in both line and neutral conductors. If they are not balanced there is likely to be an earth fault in the circuit. Once this imbalance exceeds the residual current setting of the device, it trips.

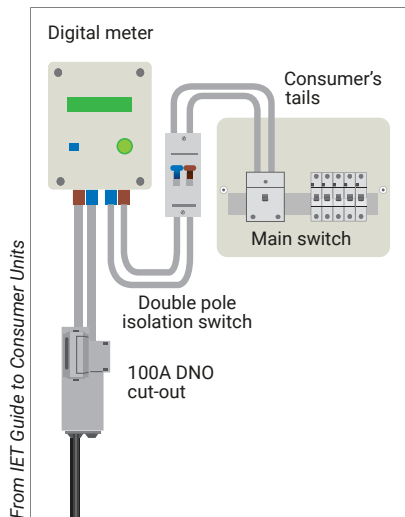
Industrial intake

Low-voltage commercial and small industrial premises have different intake arrangements. They may be connected to a three phase supply at 230 or 400V. The cutout fuse in the service head may be rated at 200-600A.

A larger industrial installation would need an air circuit breaker rated at 2,000A, and may need a dedicated switch room.



▲ Split supply: modern consumer unit with two RCDs



▲ Making the right connections: modern service installation showing smart meter and DNO isolation

RENEWABLES



Find out more...

This is just a taste of what's inside the EDA's Product Knowledge Module:

■ Renewables

Visit www.eda.org.uk for more.

3.2 Renewables

Renewable energy systems, once a specialist technology, are becoming more popular. Components for such systems represent an increasing proportion of sales at a wholesaler branch.

The Government is keen to encourage the UK to abandon environmentally damaging – and increasingly scarce – fossil fuels in favour of renewable energy sources. Small-scale generators can export electricity to the grid, or use it on site.

Some of the most popular small-scale generation technologies are solar photovoltaic modules, heat pumps and wind turbines.

3.2.1 Renewable energy technologies

Solar photovoltaic (PV) panels convert sunlight into electricity. They generate direct current that is used as is or stored in batteries, or an inverter can convert it to alternating current. In this form, it can be used in the home or exported to the electricity grid.

Typical system components are a photovoltaic cell made from a semiconducting material. When photons, particles of energy from the sun, hit it, electrons in the semiconductor break free and generate a voltage. PV cells have an output of 0.5V but, when linked in series, produce higher voltages and power output.

An inverter converts the DC output from the cells to 230V AC at 50Hz, and synchronises with the mains supply.

Sites for PV installations include roofs, open ground, a building façade or glazing. Obviously, they must face the sun for as large a part of the day as possible, and tilt so the sun's rays are close to perpendicular to the panel. Installers must avoid sources of shade such as trees and buildings.



▲ Slated for success: a roof-integrated PV system

0
greenhouse gas
emission target for
2050

All installations must have a loss of mains protective relay. This device protects network operator repair crews who may have isolated part of the grid to work on cables, but may not be aware that embedded generators could be live on the grid.

Wind turbines have become something of an icon for renewable technology. They come in two flavours: horizontal and vertical axis. Horizontal axis turbines are common in large installations. They must face into the wind, and have a tail fin to ensure this happens. Vertical axis wind turbines will work whatever way the wind is blowing, and they are more common in smaller installations.

Both types work in the same way. A shaft from the turbine links to a gearbox and then a generator.

A micro wind generator can be off grid – energy generated is stored in a battery for later use. Alternatively, an on-grid generator is connected through an inverter to the electricity grid.

Turbines can be freestanding or mounted on poles. The roof of a building is also a good spot for a turbine.

A **heat pump**, at its most basic, is a device that moves energy from one place to another. In practice, this means from the air of the ground to a building, where it can heat either a space or water. Equally, heat can be removed from a building for air conditioning.

A heat pump works in a similar way to a fridge. External air or the ground releases its heat energy to a refrigerant that absorbs heat and turns into a gas. A compressor in the heat pump compresses the gas and it heats up. Inside the building, the refrigerant is hotter than its surroundings and releases heat into the space. The heat pump itself contains a heat exchanger, compressor and expansion valve.

A **ground source heat pump** extracts heat at low temperature from the ground. Buried heat collection loops, containing a mix of water and anti-freeze, collect the heat. The loops may be vertical, horizontal or in flattened overlapping loops.

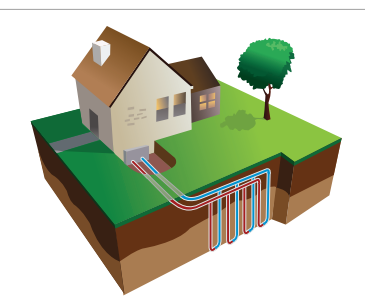
3.2.2 Energy storage

Often, energy from on-site generation schemes has to be stored. This helps increase 'self-consumption' by ensuring power is available when needed rather than simply when generation is high. Some with generators may want to generate electricity but sell it to the grid when demand, and prices, are high. Technologies include **batteries**, **fuel cells** and, on a larger scale, **flywheels** and **pumped hydro**.

Metering

Small-scale generation installations must be fitted with a meter to record the number of units generated in kilowatt-hours.

It is recommended that the meter should also display the instantaneous power output in kilowatts.



▲ Heat from the earth: horizontal and vertical loop ground source heat pump installations

Electric vehicles hit the road

Electric vehicles (EVs) are now a common sight on the road. For the electrical wholesaler, charging systems are a potentially lucrative market.

In the early days of EVs, owners used a 'non-dedicated outlet', a simple direct power cable between the outlet and the vehicle. There was no communication between them. Later systems incorporated an RCD in the cable, and the cable had power supply

and protection conductors. Such systems are limited to 10A and can take up to 12 hours to fully charge an EV battery.

A dedicated socket-outlet connects the vehicle through a wall-mounted or freestanding connector. Control and protection functions are built in. Charging times are 1.2 to 8 hours.

In rapid DC charging the vehicle is connected to the main AC distribution



Jaguar Land Rover

network through an external charger. Control and protection functions and the charging cable are permanent parts of the installation. These systems are built to a specification.



3.3 Lighting

Over the past few decades, lighting technology has arguably advanced more than any other in the electrotechnical sector. LEDs have all but replaced more traditional light sources such as incandescent and fluorescent lamps, and lighting controls have become increasingly sophisticated.

The result is that finding the right replacement lamp for a customer can be quite a minefield for the electrical wholesaler. The range of lamps and light fittings – or luminaires – on the market is enormous, but both lamps and fittings will fail, and replacements have to be found.

3.3.1 Energy efficiency

Many of the changes in lighting technology of recent years have been driven by a relentless quest for greater energy efficiency – about a fifth of the energy used in the UK is consumed by lighting installations. So solid state light sources, LEDs, have displaced less efficient sources, many of which are no longer available.

A working knowledge of the theory and practice of lamps, and lighting, will make specification easier.

3.3.2 Lamps and luminaires

Lamps are often referred to as light bulbs. An older, incandescent-type lamp should last between one and five years in normal use. An LED lamp should last significantly longer. (Beware that some manufacturers claim lifetimes of 50,000 hours or more, but this is often for the light-emitting component only, not the other components in the lamp.)

Luminaire is the technical term for what is often called a fitting or fixture. A commercial luminaire should also last about 50,000 hours – with lamp changes at more frequent intervals.

In both cases, the lifetime of lighting equipment depends on the quality of the components used in the lamp or luminaire and the operating environment.

20%
of UK energy
consumption is for
lighting



▲ Taking over: LED lamps are available to replace many conventional types



▲ More possibilities: LED light sources have made new form factors for luminaires possible

Find out more...

This is just a taste of what's inside the EDA's Product Knowledge Modules:

- Lighting (Introduction)
- Lighting (Systems and Controls)

Visit www.eda.org.uk for more.

Environmental factors include how frequently the lamp is switched on and off, how long it is left on, and the operating temperature.



▲ It takes all types: a parade of lamps that use different technologies

The most common lamp type was once the **general lighting standard** (GLS) lamp. The traditional household 'light bulb' had tightly wound coil of thin wire encased in a glass enclosure. The wire heated up and emitted light (and a good deal of heat). Its life was around 1,000 hours. Most GLS lamps have been withdrawn from the market.

A **linear fluorescent lamp** consists of a glass tube lined on the inside with a fluorescent coating and filled with a low-pressure inert gas. A coil at each end heats the gas and electrons flow from one end to the other, emitting light. The fluorescent gas evens out the light emission along the tube. They come in different diameters and lengths. The lamp could last 7,000 to 10,000 hours, but the control gear may fail before then.

Compact fluorescent lamps (CFLs) use the same technology as linear tubes, with a tube bent or coiled into a form factor that more closely resembles a GLS lamp. Non-integrated versions are for commercial use and the control gear is in the luminaire. For household use, integrated versions have control gear that lives in the lamp base. Life is 8,000 to 10,000 hours.

For more intense, localised pools of light, a halogen spot might be a good choice. These lamps are often recessed in ceilings or track-mounted, and the shape of the built-in reflector determines the beam angle. Mains voltage and 12V versions are available. Lamp life is 2,000 to 3,000 hours.

A **high-intensity discharge** (HID) lamp has a life of about 20,000 hours. There are various types: low pressure sodium (SOX), high-pressure sodium (SON), ceramic metal halide (CMH), and Mercury. All of them require control gear. Most are used for floodlighting and exterior versions are rated from 70 to 400W. Indoor versions are rated from 20 to 70W. They have good colour rendering and are used in retail applications.

Many small floodlights incorporate **double ended linear halogen lamps**. Latest of a halogen filter tube containing a filament that glows when current passes through it. Lifetime is 1,000 to 2,000 hours.

3.3.3 Light output

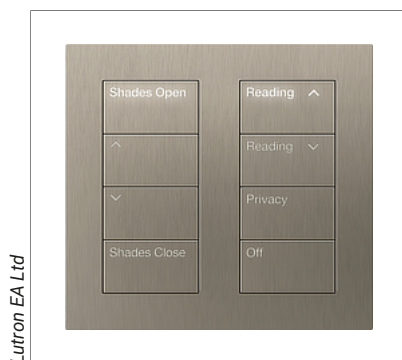
In the past, when almost all lamps were incandescent, it was a simple matter to indicate a lamp's brightness by quoting its wattage. A 100W lamp was brighter than a 40W lamp, for example. With the advent of different lighting technologies, such simple comparisons are no longer possible.

A unit of actual light output, rather than power consumption, is the lumen. An incandescent light source would produce 13-15 lumens per watt (lm/W), but a modern LED emits 80 lm/W or more. You can see how specifying a replacement for an old lamp can be a challenge if brightness is to be maintained.

Lighting controls

Another area where technological advances have affected lighting is in controls – such as dimmers, sensors and switches.

Controls – like light sources – have a role in ensuring more efficient use of energy. For example, they can turn off lights automatically when they are not needed. However, they can also improve the aesthetic appearance of a lighting scheme and improve the health of building occupants by reducing their exposure to artificial light that is often of a colour temperature that is at odds with that of daylight.



Lutron EA Ltd

▲ In control: a keypad for a modern lighting system, which also controls window shades



Find out more...

This is just a taste of what's inside the EDA's Product Knowledge Module:

- Fire Safety and Security Systems

Visit www.eda.org.uk for more.



▲ Hands off, hands on: an automatic detector and a manual call point



▲ In control: the fire alarm panel indicates the system's status

3.4 Fire safety and security systems

There is an array of legislation that covers fire safety. Also, insurers often demand that buildings have fire safety systems installed by professionals. So fire safety and security systems are a sales opportunity for electrical wholesalers.

3.4.1 Fire detection and alarm systems

Fire detection systems include several kinds of automatic sensors to detect smoke and heat – sometimes both.

Smoke detectors, for example, use optical or ionisation techniques. In an optical detector, any smoke particles refract an infrared beam. In an ionisation device, the smoke particles help a current flow between two electrodes.

Other detector types include high-level beam devices that detect smoke, and carbon dioxide sensors.

People too can spot the signs of a fire, so a system will also include **break-glass units**, or manual call points.

To alert building occupants, protected buildings will have **sounders**. In noisy environments – and for the hard of hearing – visual alarm devices.

Other products such as **sprinklers** will tackle the fire. Magnetic **automatic door closers** help stop it spreading. The system may also be able to shut down lifts and escalators. **Video cameras** may be fitted so operators can check the fire is real without having to check the building in person.

The **fire alarm panel** marshals all these functions. It processes the fire alarm system's functions and indicates its status. There will also be a test button to perform system checks.

Wiring is an essential part of the system. In a conventional system, a number of call points and detectors are wired to the control panel in zones. Each zone is typically

a circuit, so it shows approximately where a fire is. The system is also wired to at least two sounders. All circuits have an end-of-line device for monitoring.

In a twin-wire system, there are two twin-wire circuits, with detection and alarm devices connected on the same supply wires.

An **addressable system**, the detection circuit is wired as a loop and each detector has an electronic address built in. As a result, it is possible to pinpoint the position of fire from the control panel.

More popular in recent years are **wireless systems**, which are easy to install and work in a similar way to addressable systems. They use radio frequencies for communication. Devices have batteries that must be monitored.

3.4.2 Emergency lighting

Fire alarm systems work together with **emergency lighting** to ensure safe evacuation of a building if the mains power supply fails.

Emergency escape lighting helps people find escape routes from the building. It ensures those routes have at least some lighting. Emergency lights are compulsory near stairs, changes in floor level, changes of direction and corridor intersections. They are fitted close to firefighting equipment, call points and first aid points.

Open area or anti-panic lighting makes sure there is enough light for people to find their way to an escape route.

Finally, for some activities, **high-risk task lighting** can help people shut down hazardous processes before evacuating the building.

Power for emergency lights can come from several sources. Luminaires may be self-contained with an **on-board battery**. The installer wires them into the system through a test switch. Products from different manufacturers are interchangeable.

For a medium-sized or large installation, a **central battery system** is more suitable. Batteries are in a cabinet connected to the emergency lighting fittings by fire-resistant cables. A central battery detects a loss of supply and turns on the fittings. These kinds of systems are easier to maintain and test.

3.4.3 Intruder alarm systems

These systems are similar in some ways to fire alarm systems. They consist of **detection devices**, **sounders** and a **control unit**. Again, wireless systems are becoming more popular.

Detection devices have two purposes. **Perimeter devices** protect the perimeter or the fabric of the building. **Space protection** devices monitor an area.

The simplest example of perimeter protection is a **switch contact** on a door, window or roller shutter. **Vibration** and **impact sensors** detect vibration caused by forced entry. **Break-glass detectors**, once easy to spot as foil strips on window glass, are now microphones that 'listen' for the sound of breaking glass. Space protection devices, such as **passive infrared detectors**, detect thermal radiation from intruders.

Warning devices such as **sounders** and **strobes** raise the alarm.

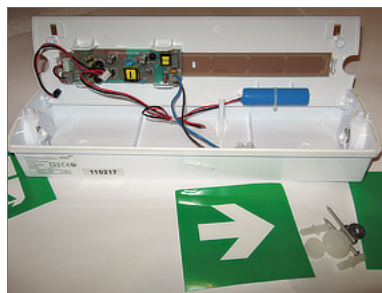
A **central control unit** has a keyboard so an authorised operator can turn the system on and off. It includes a power supply unit to maintain protection if the mains fails. It can send a message to a remote monitoring point.

Access control and building intercoms

In these systems, a visitor to a building speaks to a remote operator who can grant or deny access through a door, gate, barrier, turnstile or other obstruction. Some such systems include a **videophone**.

Alternatively, an **electronic reader** checks a visitor's credentials. Those credentials could be a PIN number, a card or fob, a fingerprint or other biometric characteristic.

In a **standalone** system, all the electronics are in the reader. In a more secure, **networked**, system, the complex electronics are inside the protected area.



▲ Working together: self-contained emergency fittings from different manufacturers are compatible



▲ Listening in: electronic break-glass detectors 'hear' breaking glass

WIRING DEVICES AND CONTROLS



Legrand Electric Ltd

3.5 Wiring devices and controls

Wiring devices and controls are big business for electrical wholesalers – they represent about 10% of any given branch's sales.

Domestic and small commercial installations can be arranged in several ways. The first is a **radial circuit** in which wiring takes a path from the consumer unit (fuse box) and feeds one connection after the next. A radial circuit can also have branches.

Alternatively, an installation can have a **ring circuit**, in which wiring leaves the consumer unit and feeds each outlet and accessory before returning to the consumer unit.

Both kinds of circuit can have a 'spur' that takes power to extra socket-outlets or towel rails. They operate at a lower current than the main circuit and often have to be protected by a fused connection unit.

Wiring devices terminate the wiring when it reaches current-using equipment such as electrical appliances and luminaires. Controls, as the name implies, also control the flow of power to that equipment. They include light switches, pull cords and cooker controls.

3.5.1 The products

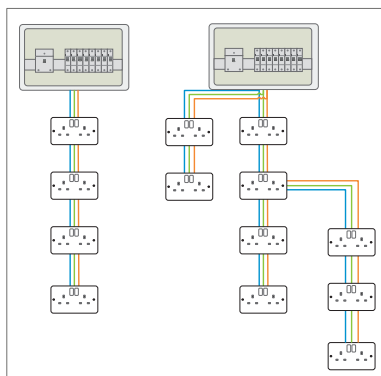
What kind of products on the wholesaler's shelves are considered wiring devices and accessories? Perhaps the most familiar is the socket-outlet. Behind the visible plate with sockets is a metal or plastic **backbox** that is fixed to the building structure.

Wiring accessories also include products for support and containment. The most basic kind is metal or plastic **cable clips** that fix cables directly to a surface.

More robust cable support can be provided by **cable tray** (*overleaf*), a length of plastic or metal in the form of a ladder that supports heavy cables; **cable ladder**, a perforated metal or plastic sheet with turned up edges, usually seen in commercial and industrial applications; or **cable basket**.

IP

ratings show how well an enclosure is sealed



From the IET's Student's Guide to the IET Wiring Regulations

▲ Radial final circuits, with and without branches (top), and a ring final circuit (above)

Find out more...

This is just a taste of what's inside the EDA's Product Knowledge Module:

- Wiring Devices and Controls

Visit www.eda.org.uk for more.



For the most hostile environments, cable containment products completely surround cables and ensure protection from impacts. **Conduit** is a metal or plastic pipe in 3m lengths. It is usually 16-32mm in diameter, although some large installations may include conduit up to 63mm in diameter.

Alternatively, **cable trunking** (*right*) is a metal or plastic compartment with a U-shaped cross-section and removable lid. Trunking is available in several sizes with different number of internal compartments.

When a cable enters an enclosure such as a backbox, it needs mechanical support and protection so it does not become loose or damaged if it is pulled or twisted. The product that prevents this is a **cable gland** (*right*). Common sizes for glands are 20, 25 and 32mm – although there are larger versions for industrial applications – and they are available in metal or plastic.

Once the wiring is inside the enclosure, electrical connections have to be made – at **terminals**. The most common type is a screw terminal. The installer strips back the insulation from the wiring, inserts the conductor and tightens a screw to hold it in place.



There are **screwless terminals** (*above*), and the most common of these is the compression type. Rather than a screw holding the conductor in place, the pressure of a spring retains the conductor after it has been pushed in.

Terminal capacity is the number and size of conductors that fit into a terminal.

3.5.2 IP ratings

An **IP** (ingress protection) rating is an essential indication of an enclosure's ability to withstand solid objects and water. It consists of the letters IP followed by two or three further characters.

The first digit indicates the ability of the equipment to withstand solid objects – on a scale from 0-6, where 1 is solid bodies larger than 50mm and 6 is complete protection against dust.

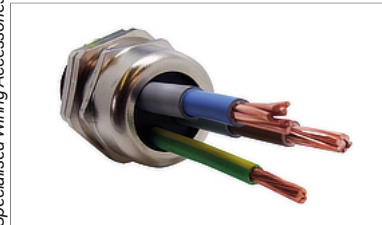
The second digit is a measure of the equipment to prevent the ingress of liquid – this time on a scale from 0-8, where 1 is protection from vertically falling drops and 8 is prolonged protection of immersion under pressure.

An X in place of either digit indicates that the protection is not specified for solids and/or liquids.

An additional letter – A, B, C or D – indicates protection against direct contact with hazardous current-carrying parts, from the back of hand on the enclosure to the introduction of a wire.



▲ In the box: cable trunking carries power to the user's desktop



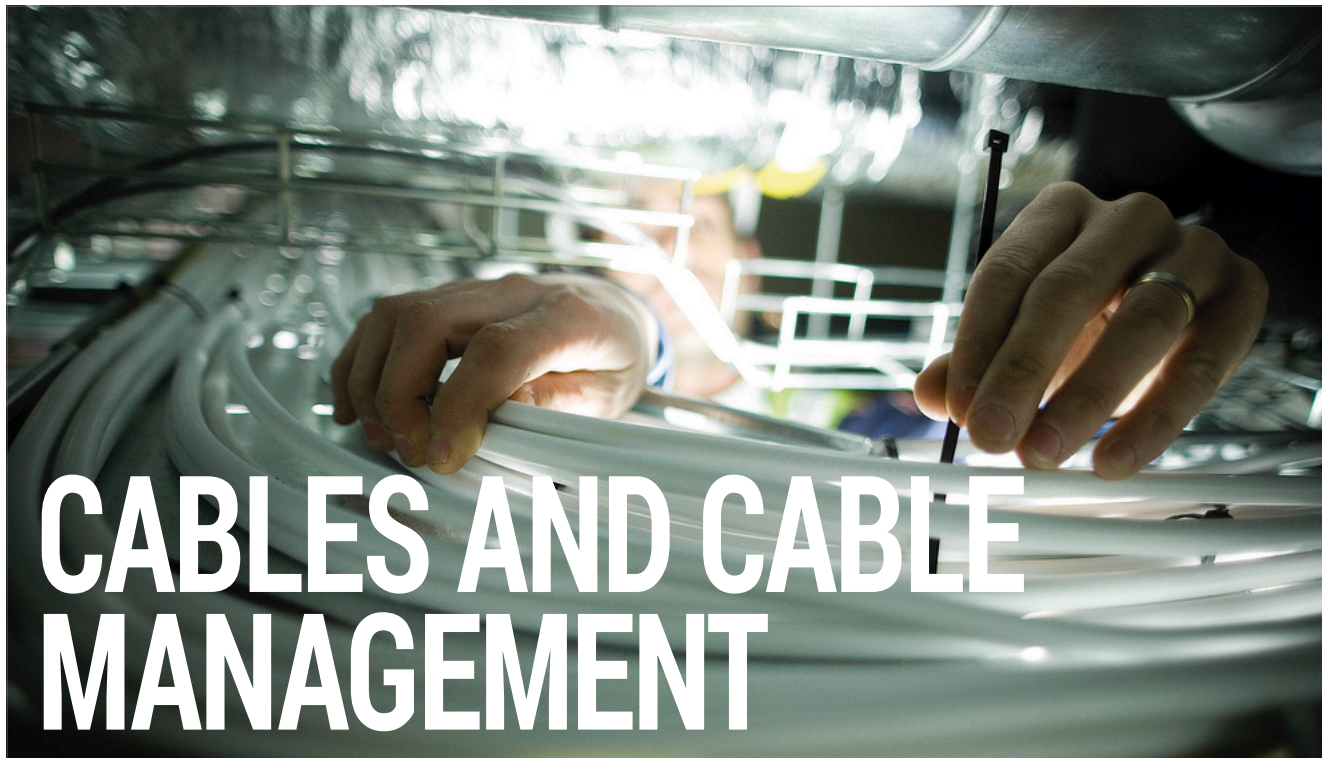
▲ Secured cable: a metal cable gland

Specialised Wiring Accessories Ltd

BS 1363 plugs and socket-outlets

Plugs and socket-outlets must comply with BS 1363, and have a number of safety features:

- Built-in shutters that open when the plug is inserted and close when the plug is removed. This prevents access to live parts.
- The earth pin makes contact before the line and neutral connect.
- The plug contains a fuse to protect the appliance and prevent fires from damaged cables.



CABLES AND CABLE MANAGEMENT

Find out more...

This is just a taste of what's inside the EDA's Product Knowledge Module:

- Cables and Cable Management

Visit www.eda.org.uk for more.

3.6 Cables and cable management

All of the devices and appliances that the modern home or workplace depends on need electricity. This is supplied by a connection to the mains supply – either directly, or to charge a portable device.

Also, cables are necessary to transmit data from one place to another, either to control building systems or to connect to online services.

Wholesalers sell low-voltage power cables, data cables and control cables. Less frequently, they may stock high-voltage power cables, fibre optic and other specialist cable types.

Most low-voltage power supply cables are rated up to 1,000V AC or 1,500V DC.

3.6.1 Cable construction

An electrical cable has several components. First, a **conductor** with a cross-section large enough to carry the current without overheating. This conductor is most likely to be copper, although some low-voltage cables have aluminium conductors. The conductor may be a single solid wire, or a more flexible collection of thinner copper strands. Either of these could be coated to prevent corrosion.

Around the conductor is **insulation**, and a **sheath** provides mechanical protection.

A **single-core cable** is generally unsheathed and must be fitted in some kind of containment to protect it from damage.

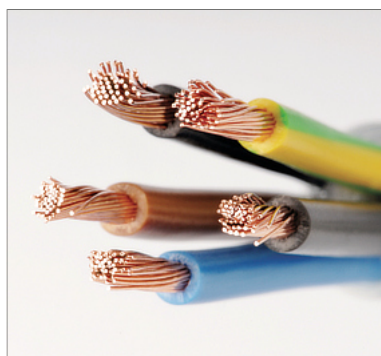
Multicore cables fall into several categories.

Cables can be mounted on any surface with simple clips, embedded in the fabric of a building or installed in conduit or trunking (see box, right).

More robust SWA (steel wire armour) cables consist of stranded conductors

MI

mineral insulated
cables are fire
resistant



▲ Five-cores or more: a multicore cable with PVC insulation and sheath

covered with colour-coded PVC insulation and a PVC sheath. Steel wires spiral around the cable for mechanical protection. This kind of cable is so well protected that it can be used in exposed installations or even buried.

Flexible multicore cables have two or three separately insulated cores made of many thin strands of copper wire. They connect appliances to the installation through wiring accessories.

Mineral insulated (MI) cables have copper conductors inside a seamless copper tube filled with magnesium oxide powder. They are fire resistant.

Fire performance cables are an alternative to MI cables. They have a sheath that makes them easier to connect than MI cables, but it will not emit smoke in a fire. They help maintain supplies to power and lighting circuits, and to protect alarm and sprinkler systems.

Finally, **communications** and **computer networking cables** may contain one or more optical fibres rather than copper conductors.

3.6.2 Cable vital statistics

With so many kinds of cable in use, they can be described in many ways. The class of a cable is a measure of its flexibility.

Class 1 has a rigid, solid conductor and is typically used in fixed wiring. A **Class 2** cable has instead a stranded conductor, usually seven or more wires, making it more flexible. It too is for fixed installations.

Class 5 cables incorporate multiple fine stranded wires, making them much more flexible. **Class 6** has even finer wires and is more flexible still.

The **size** of a cable is the nominal cross-sectional area of the conductor. Although the unit used is mm², only the electrical resistance of the cable is measured, not the actual cross-section of the conductor.

Common sizes are 1-25mm² for final circuit wiring, 16-400mm² for distribution inside a building and up to 800mm² for supply cables coming into a building.

The **resistance** of a cable can be stated in two ways: continuity resistance and insulation resistance. Continuity resistance is the resistance from one end of a conductor in a circuit to the other and should be as low as possible.

In contrast, insulation resistance is measured from the outside of the cable to the conductor inside, or across the insulation that separates the conductors. It should be high to prevent current leakage or a short circuit between nearby conductors.

Current-carrying capacity is the current a cable can carry without overheating. The system designer – not the wholesaler – determines the size needed.

The **moisture resistance** of a cable depends on the sheath material, and most cables have a thermal performance rating that indicates how hot they can get before the life of the insulation will be shortened.

A key measurement for a cable is its **voltage rating**. It is usually expressed in the form xxx/yyy V, where xxx is the maximum voltage allowed between any of the insulated conductors and any metallic covering, and yyy is the maximum voltage between any pair of live conductors.

The rating is for cable use in AC power systems, and typical values in low-voltage systems are 300/500, 450/750 and 600/1,000 V.

Schneider Electric Ltd



▲ In control: KNX provides control of lighting, air conditioning, blinds, heating and audio



▲ Good optics: data cables may have fibre optic cores

Cable management

Cable management products include steel wire cable tray, which can support many types of cables with more than basic insulation. They are supplied in straight lengths that are easy to cut and shape to form bends, tees and other shapes. They are suspended using trapeze hangers, threaded rods or cantilever brackets.

In commercial and industrial applications cable tray and cable ladder may be used together.

Cables can be laid in trunking or drawn through ducting. Both can be mounted on walls, ceilings, floors, inside cabinets or in floor-to-ceiling service poles.



HEATING AND VENTILATION

Glen Dimplex Heating & Ventilation



Glen Dimplex Heating & Ventilation

▲ Warmer washing: a downflow heater in a bathroom



Glen Dimplex Heating & Ventilation

▲ On target: a quartz heater warms objects, not the intervening air

3.7 Heating and ventilation

3.7.1 Principles of heating

Heating and ventilation are concerned with the creation and movement of heat – by conduction, radiation or convection.

In **conduction**, heat energy moves directly between objects as hot, vibrating molecules in one object make the molecules in another vibrate. An example is the transfer of heat from an electric hob to a frying pan and the bacon and eggs inside. In **radiation**, heat is transferred by electromagnetic waves. The hotter the object, the higher the frequency. The surface material affects an object's ability to radiate. Finally, **convection** occurs when heat is transferred by the movement of fluids – liquids, such as water or oil, and gases, such as air. Such fluids are less dense when hot and tend to rise, and tend to sink when colder. This circulates heat.

3.7.2 Elements and controls

To create heat, a **heating element** is necessary. The most basic kind is a **metal element** made from nichrome wire – a mixture of 80% nickel and 20% chromium. This wire has a high resistance to the passage of electricity and heats up when a voltage is applied. A protective layer forms on the wire when it is first used and no further oxidation will take place.

A **ceramic heating element** operates at temperatures as high as 2,030°C. Not only does the ceramic material conduct electricity, it is also self-regulating – as when it reaches a certain temperature, electrical consumption stops.

In an **earth sheathed heat element**, the resistance wire is covered by an earthed aluminium sheath. These elements are common in underfloor heating.

The most basic control for a heater is a simple **on/off switch**. A more complex arrangement has three terminals for the control of multiple heating elements.

A **mechanical thermostat** switches an element on and off in response to the ambient temperature. A strip comprising two metal strips bonded together bends as the temperature changes and one strip expands faster than the other. This

W

watt, the metric unit for power or heat

Find out more...

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■ Heating and Ventilation

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operates a microswitch to turn off the heating. As the strip cools, it will turn the heating back on.

A **digital thermostat** is more accurate. It contains thermistors – electronic components whose resistance changes with temperature.

A **thermal cut-out** is a small safety device, most commonly incorporating a bimetallic strip that closes the circuit when a preset temperature is reached.

There are also analogue and digital **timing devices** and **smart controls**. Smart controls allow the remote control of a heating system connected to the internet. The user can adjust heating using an app on a phone or tablet.

3.7.3 Heaters

Heaters are appliances that contain heating elements. A **convection heater** uses the circulation of warm air to heat a space. An example is a panel heater. It contains a finned, sheathed heating element typically rated between 0.5 and 3kW.

Fan heaters transfer heat to a space faster than a convection heater because they incorporate fans. However, they are more noisy and use more electricity. Portable models have either electric or ceramic elements.

For the kitchen, a **plinth heater** may be a good choice. It may have dual elements, and be controlled by a switch, a mechanical thermostat or a thermal cutout. Some have remote controls for making adjustments without having to reach to the floor.

Downflow heaters are suitable for bathrooms, and force heated air downwards. They are typically rated between 1 and 2kW and have electrical wire elements in a finned aluminium case. Control is by pull-cord or mechanical thermostat.

Ceiling fan units are usually used in commercial applications such as offices. They fit in standard suspended ceiling panels and are rated from 3 to 6kW.

Curtain heater units create a fast-moving airstream that blocks air movement through an open door. They are popular for shop entrances and warehouses, and can be rated up to 24kW. They may require a three-phase electrical supply.

Beyond fan heaters, there are many other heater types. **Storage heaters** collect heat during the night – using cheap off-peak electricity – and release it during the day. A wire heating element heats up bricks inside the cabinet, and they release the heat during the day when it's needed.

Radiant space heaters emit infrared radiation. There are several kinds. A **halogen heater** users short-wave infrared energy from a halogen lamp with a tungsten filament. It heats objects, but not the air between the heater and those objects, so it is good for large or open air spaces.

A **quartz heater** is a variant that has a quartz tube heating element.

A **ceramic heater** operates at the lowest temperature of the radiant heaters, and incorporates a wound electrical wire in a ceramic bulb.

Oil-filled heaters contain a sealed element that heats oil inside. They can be mobile or wall mounted, or a towel rail that operates independently of any other heating system. Tubular heaters are ideal for smaller areas and for frost protection in greenhouses, lofts or conservatories.

Fires are more decorative, and may or may not actually emit heat. Some simply create a fire effect using coloured light bulbs, LEDs or even an LED screen.

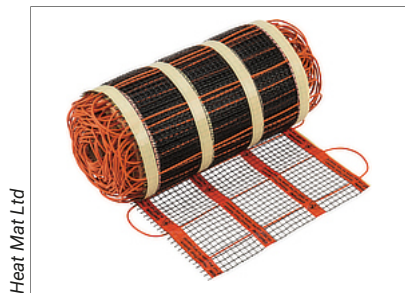
Ventilation

Ventilation is necessary to remove moisture, volatile organic compounds, smells and carbon dioxide and monoxide from a space. Fans fitted in the ceiling, through a wall or in a window can be installed in bathrooms, kitchens and cloakrooms.

A centralised mechanical extraction ventilation system consists of a single large fan, usually in the loft. Signals from a humidity sensor switch between trickle and full ventilation mode. Installation involves fitting ducts from the bathroom and kitchen to the loft.

A decentralised mechanical extraction ventilation system includes extractor fans in the bathroom and kitchen that run continuously with boosts triggered by a timer, a humidity sensor, a pull cord or a movement detector.

To prevent the ventilation of heat from a building, a heat recovery system may be necessary.



Heat Mat Ltd

▲ Heat underfoot: the floor itself is the radiator in underfloor heating



▲ Pole position: a collection of industrial switches and bezels



▲ In isolation: a rotary switch disconnecter can break the full rated load of the connected circuit

3.8 Industrial controls

Industrial equipment often has a domestic equivalent – a blast furnace is simply a large oven, the valves in water works are just larger taps. The principal difference is that industrial kit is expected to work more reliably for much longer hours than domestic equipment. The same goes for the controls.

3.8.1 Switches and indicators

Industrial switches can have a number of poles – the number of circuits they can control – and throws – the number of positions. They come in many flavours.

A **pushbutton** can be momentary or latched. That is, it can return to its initial state or remain switched until pressed again. The buttons are available in many colours and are inserted through a hole in a control panel and fixed with a threaded bezel.

A **selector switch** has an actuator handle that indicates the position of the switch. It can have more than two positions (throws), or a spring that returns it to the central position.

For safety and security applications, a **keyswitch** may be a better choice. A lock barrel is built into the switch actuator and the switch is locked in position until the key is inserted.

Isolators and disconnectors cut off the supply for safety. A rotary switch disconnecter used as a 'main switch' is an example – it can break the full rated load.

Emergency stop switches are a familiar sight on escalators or luggage belts. Once pressed, they remain open until reset by either pulling or twisting the button, or using a key.

Once a switch is operated, an **indicator** or **pilot lamp** is a useful indication of what the connected equipment is doing.

3.8.2 Relays and contactors

Relays are automated switches. They use control or signalling circuit to switch as second circuit carrying a larger current. They are separate and isolated from the 'power' circuit.

£7bn

approximate turnover
of the controls
sector

They apply a voltage to a coil that generates a magnetic field and switches the contacts of the power circuit. An example of a relay is a car starter switch.

In larger scale industrial applications – such as switching three-phase motors or heaters, or switching power as part of a distribution circuit in a building – a **contactor** will be used.

A contactor has spring-loaded contacts to prevent welding and arc suppression devices to stop arcing on switching which could damage or weld the contacts.

3.8.3 Fuses and breakers

An **industrial fuse** is similar to a domestic one. When excess current flows, the wire in the fuse melts, breaking the circuit. They are mounted in fuse holders that are similar to electricity company cut-outs in homes.

Of course, fuses cannot be reset or repaired, so **miniature circuit breakers** (MCBs) may be a better choice in many applications. If a high current flows, the magnetic field it generates opens the breaker's contacts. For overload protection the heating effect of the current flow makes the device disconnect the supply. MCBs and **moulded case circuit breakers** (MCCBs) are common in industrial control.

3.8.4 Motors and motor control

Many industrial processes incorporate motors. The most common type is the **squirrel cage motor**, in which an AC current flows in the stationary stator windings. This induces a current flow in the rotor and the two electromagnetic fields interact turning the rotor at a speed governed by the supply frequency.

Starting such a motor is not a simple matter of switching the electricity supply because there is an initial 'inrush' current – four to ten times the steady state current – when it starts. **Starters** consist of an isolator, short circuit protection, overload protection and a switch.

A **variable speed drive** (VSD) incorporates complex electronics to drive a motor at speeds other than that governed by the supply frequency. VSDs enable controlled acceleration and deceleration, reverse control, controlled braking and advanced protection.

3.8.5 Power supplies

There are two kinds of supplies in industry: three-phase or single-phase power circuits and 24V DC control circuits for, for example, a contactor coil circuit in a motor starter.

Each electronic device could have its own power supply, but it is more efficient to use a single DC power supply for multiple devices. Most industrial supplies are **switch mode supplies**, a term that refers to the electronics that generate the supply output from the input voltage.

3.8.6 Enclosures and panel layout

The term **enclosures** refers to panels, cabinets and boxes in industrial applications. Most are assembled from off-the-shelf components – the enclosures, mounting plates, rails, busbars and terminals. Rails are for mounting equipment, but busbars may be used at higher currents.

An enclosure may include fans or air conditioning if convection is insufficient to prevent overheating.



▲ In good repair: a miniature circuit breaker can be reset or repaired



▲ Cast in the same mould: moulded case circuit breakers are often used in industrial control

Programmable control

As in all aspects of life, computers have made their mark on industry. Programmable controllers are, however, very different beasts from the computers we use every day. They are more reliable, built to withstand harsh environments and programmed in a different way.

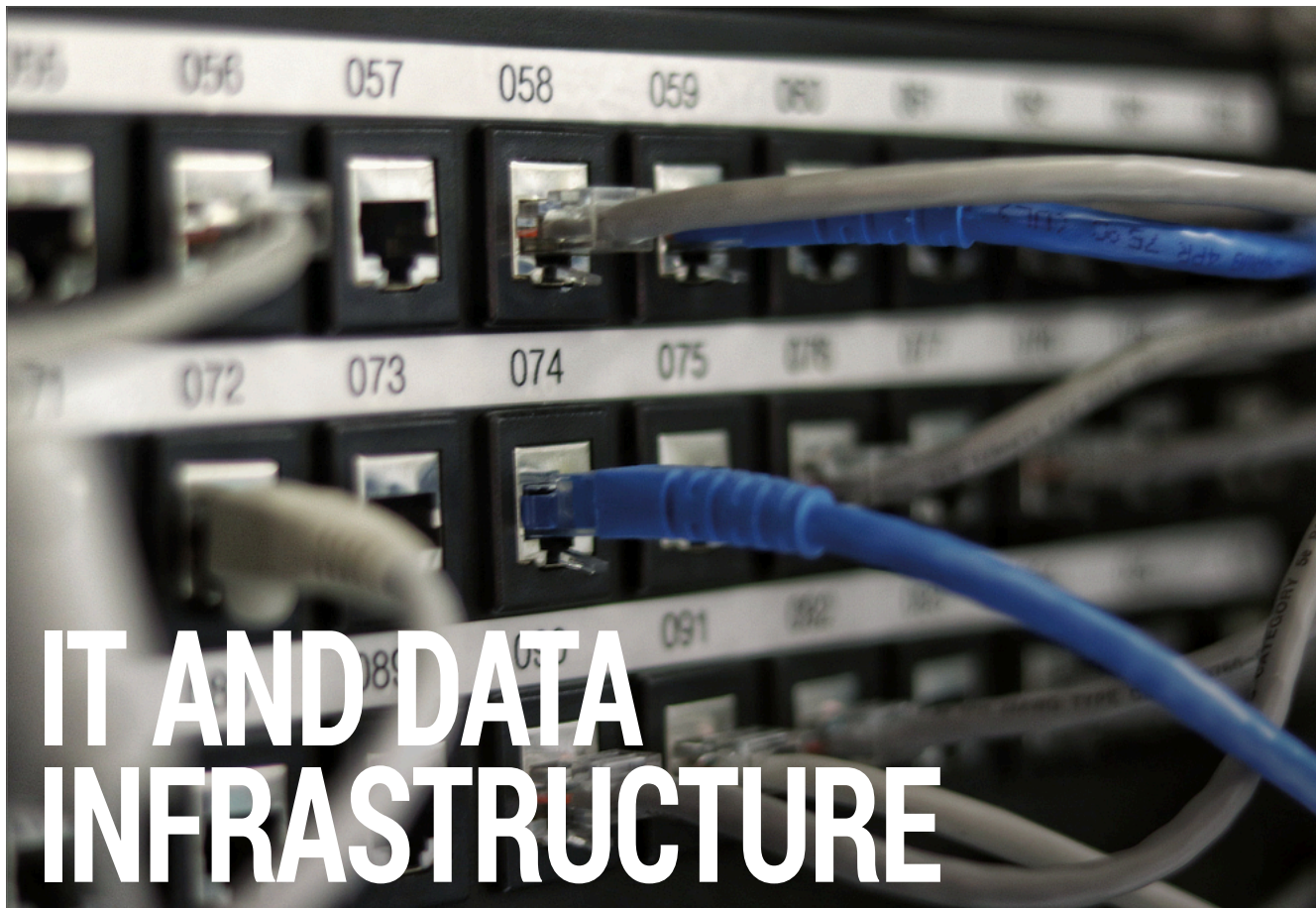
Most controllers share the following components. Input/output hardware that interfaces with physical devices, a central processing unit that contains memory to store data and programs, a serial or Ethernet connection to other PLCs or computers and a human-machine interface. This interface may simply be buttons and a small LCD display or a bank of high-definition monitors in a central control room.

Find out more...

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■ Industrial Controls

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3.9 IT and data infrastructure

IT and data infrastructure is concerned with the creation and transport of digital data. The physical infrastructure for data transport includes local and much larger networks.

A **local area network**, or LAN, connects a group of devices in single building or group of buildings. A wireless local area network is similar, but the devices are connected using radio signals rather than cables. A virtual local area network reduces network congestion for a group of devices on a LAN.

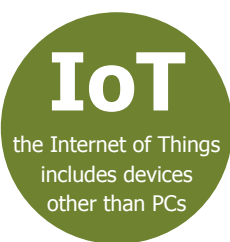
On a larger scale, a **wide area network** covers a larger geographical area and can incorporate many LANs. Larger still is a **metropolitan area network** that, as the name suggests, could be city-scale.

An **internet service provider** is an organisation that provides access to the internet, and the cloud is the use of third party resources to store and share data.

Rules are necessary to make communication between devices on a network possible. These rules, or networking protocols, include **Internet Protocol** (IP), **Transport Control Protocol** (TCP) and **Ethernet**. Ethernet controls how data is transmitted over a LAN and defines the wiring and signalling standards of the physical network.

3.9.1 Structured cabling

Structured cabling is single or multiple building telecommunications cabling with a number of smaller elements. Initially, it consists of the **work area cabling** for network devices.



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- IT and Data Infrastructure

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Beyond this, there is a **generic cabling system** consisting of a horizontal cabling subsystem of copper or fibre optic cable. The larger **building or campus backbone cabling subsystems** are more likely to be fibre optic networks.

Basic **copper data cables** (U/UTP) consist of four twisted pairs of insulated wires in a plastic outer sheath. Each pair has a different number of twists per metre to reduce interference. As data rates increase, manufacturers have come up with new cable constructions to prevent interference and thermal problems.

F/UTP cables, often called FTP cables, have an overall foil shield. S/FTP cables have an overall braided screen and foil shields on the twisted pairs. SF/UTP cables have an overall foil and braided screen and unshielded twisted pairs.

Optical fibre cables support greater bandwidth over a greater distance and are also immune to electrical interference. Single mode fibres transmit information through a single path of light. Multimode fibres use multiple paths of light. A fibre has a core of pure silica glass that carries the data, surrounded by cladding of less pure glass that protects the core. Then a primary coating, usually plastic protects the core and cladding and makes the cable flexible.

3.9.2 Cabinets and racks

Server racks house servers and storage area network hardware. They are usually separate from other network infrastructure for data security, power and airflow management reasons. **Network cabinets** hold other active network equipment, and **patch racks** are for the termination of horizontal distribution cable and patching circuits. Occasionally, a smaller company may use a **hybrid cabinet** to house all of these things.

The footprint of a cabinet is its width and depth, typically 600 x 600mm for servers. An 800 x 800mm cabinet may house network equipment and patching, and this larger size is becoming common for servers. The depth may even be increased to 1 or even 1.2m.

3.9.3 Connectivity

Data communication is about more than just cables. A range of products is available to complete the communications channel. These include **faceplates** with an RG45 connection. The faceplate's backbox has enough space for cable termination.

To connect work area cables to the active network equipment, installers will need copper or fibre optic **patch panels**. To connect two components to form part of the channel they will need copper or fibre optic **patch leads**. **Floor boxes** provide telecommunications outlets to open plan offices with raised floors. They may be large, but they often contain other services, such as power and telephony.

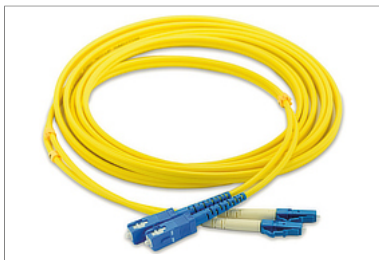
3.9.4 Termination

Terminating copper or fibre data cables is a job for a skilled professional with access to specialist tools. These range from relatively simple **insertion tools** for copper cables to highly complex **fibre splicers** that use an electrical arc to weld optical fibres in cable joints or patch panels.

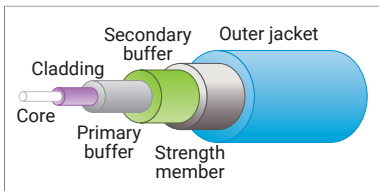
Test equipment is necessary to ensure the best performance of a data network. It can be used to qualify an installation, usually to ensure the existing infrastructure can meet the performance needs of a network upgrade. Cable links are usually certified to prove that an installed component complies with standards. Test equipment is preconfigured with parameters for standard defined tests for links and channels.



▲ True colours: copper cable patch cords, colour coded for different applications



▲ High fibre: an optical cable patch cord



▲ Inside out: the construction of an optical fibre cable

COUNTERFEIT PRODUCTS



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Fighting back

The electrotechnical industry has been at the forefront of efforts to tackle counterfeiting. In 2000, BEAMA formed its Anti-Counterfeit Working Group, which has conducted raids on companies suspected of making counterfeit products.

Distributors of electrotechnical products are on the front line too. They must demand proof of authorisation and compliance claims from suppliers, particularly unfamiliar new entrants to the market.

MSSI Electrical is a European Union initiative – with the UK represented by BEAMA and Gambica, the controls equipment manufacturers' association – that aims to tackle counterfeiting. Members include many familiar names such as Legrand, Hager, ABB, Eaton, Seimens, Schneider Electric and Gewiss.

3.10 Counterfeit products

In the EDA's annual sector survey for 2019/2020, 70% of electrical wholesalers said they were concerned about the increasing number of unfamiliar brands appearing on the market. Their concern was shared by more than half of the contractors who responded to the same survey.

Although the appearance of more brands is not in itself a bad thing, the electrotechnical sector fears that some of the products sold under these brand names are counterfeit.

A counterfeit product is one about which the manufacturer makes false or misleading claims, that does not comply with legislation, or that is not fit for purpose. It may infringe the intellectual property rights of the registered owner of a similar product. Some are direct copies of products from other manufacturers.

3.10.1 A global market

The global market for counterfeit goods is vast, and is thought to be worth about \$509bn. This represents 3.3% of world trade. About 7% of imports into the European Union – and 4% into the UK – are fake.

Profits from the sale of counterfeit goods are linked to organised crime and international terrorism. In fact, selling counterfeit goods is more profitable than trading in class A drugs.

For consumers, counterfeit products are attractive because they are cheaper than products from a legitimate source. But – and this applies to electrotechnical products in particular – they represent a serious safety risk, not only to people and property through fires or electric shock, but to the reputations of the companies that sell them, such as wholesalers.

Most of the counterfeit electrotechnical products that find their way into the UK are made in China. BEAMA, the UK trade association for manufacturers and providers of electrotechnical products and systems, maintains a database of 2,700 companies involved in manufacturing counterfeit electrotechnical products. Some 95% of these companies are in China.

Also, counterfeit products are made in countries including Turkey, India, Thailand and Vietnam.

4%

of UK imports are counterfeit goods

A CAREER IN WHOLESALE



4 A career in wholesaling

4.1 Entering the industry

Congratulations, you have gained a role at an electrotechnical wholesaler.

Probably not the job you dreamt of when you left school. Most people in the industry will say the same, they never woke up one morning and thought 'I want to be an electrotechnical wholesaler'. But interestingly, most have never left the industry. They have worked their way through a range of job roles to be branch or regional managers, directors and/or owners.

3 routes to a career in electrotechnical wholesaling

There are several ways to enter the wholesaling business (see diagram below). First, you can take an apprenticeship, this will open up a number of roles in the company you join, including dealing with customers at the trade counter, working in the warehouse and administration. Alternatively, if you have relevant experience in wholesaling or just in life, you could be directly recruited. The roles open to you will depend on the experience you have. Finally, graduates can join a wholesaler and may be fast-tracked into higher-level roles.

Whatever route you choose, you will have many opportunities to learn your craft and develop a career on the job.

Apprenticeships	Direct recruitment	On-the-job training
<ul style="list-style-type: none">WarehouseTrade counterAdministrationDigital marketingCustomer service	<ul style="list-style-type: none">With life experienceWith wholesaling experienceEntry and higher level roles	<ul style="list-style-type: none">GraduatesFast-track learning to assistant and branch managerIn-house programmesOn-the-job trainingMentoring

▲ Entry to the industry: choose your path to a career in electrotechnical wholesaling



▲ A wholesaler's industry pathway: employee profile by industry experience

4.2 Developing your wholesaling career

As you start to feel more confident in your role, ask your manager about the EDA Product Knowledge Module Learning Programme which will enable you to develop your skills and knowledge to an industry-expected level.

This will make it easier for you to climb the career ladder (or pyramid, as seen in the diagram above). Within five years, you could be running a branch. Read Jack Lynch's story (below) and Olly Thorburn's (overleaf) to see what is possible.

Jack Lynch: apprentice to boss in five years

At just 25, **Jack Lynch** is the newly appointed branch manager in Greenock for wholesalers Holland House Electrical Co Ltd. This job has been his goal from day one when he joined the business as an apprentice from college. Now, Jack is recruiting an apprentice for his branch and he knows what to look for.

in our Middlesbrough and Aberdeen branches along the way. With each move I was learning something new. In Aberdeen I was doing both tele-sales and going out and about to meet clients – being a sales rep. The regional manager and I worked together to develop accounts and acquire new ones, including a major house builder.

'College was OK but I wanted a real job, independence and to earn a wage' says Jack. 'I didn't know anything about electrical wholesaling but Holland House offered me a job as a warehouse apprentice in Glasgow. From day one I was ambitious, and they gave me opportunities because they saw that I was keen and let me work in every department. Once you're serving contractors and electricians over the trade counter, you really start to build up your product knowledge.'

'In November 2020 they called me in to ask if I wanted to lead the Greenock branch, which is fantastic. There are four roles here: driver, storeperson, administrative support and me, as branch manager. Our driver has just left so that opens up an opportunity for an apprentice and I'll be interviewing shortly. I'm looking for someone who can see the career potential in wholesaling, and who's got that extra spark.'

'When given the chance, I was happy to jump on the phone and take on a sales role. You've got to be fearless and open to new things. I've worked

And what is Jack's advice for any new recruit? 'Be patient, thick-skinned, always be on the lookout for something to do. Show that you're hungry for advancement and a career.'



▲ Jack Lynch, Holland House Electrical Co, Greenock



▲ Olly Thorburn, Electric Center, Newbury

Olly Thorburn: leaps and bounds

Meet **Olly Thorburn**, a trade supplier apprentice at Electric Center in Newbury.

'Since I started the trade supplier apprenticeship five months ago, I have learnt so much more in than I anticipated,' says Olly, 'My knowledge of the products we stock has boomed. It is a real confidence booster.'

Olly is full of praise for the trade supplier experience. 'I feel like this apprenticeship is the best thing I could have signed up for. I have learnt so much in a short time and feel really motivated – I've even earned the title of Apprentice of the Month for December 2021 with my training provider. That felt incredible.'

'My days are varied: from picking and packing orders for customers to driving the van and making deliveries. I enjoy working with our contractor customers, ensuring they get the right products, and giving them the best experience possible.'

'An apprenticeship could suit many people because it is a credible alternative to university. This experience has taught me a lot about myself – both learning on the job and with my tutor. My apprenticeship course work is relevant and thought-provoking and has 100% helped me with my role in the branch.'

'I can see my progress and how relevant the trade supplier qualification is to my current job and future roles – I do want to move up the career ladder, and I have a qualification to show that I know what I am doing.'

'I really want to stay in electrical wholesaling. I've come on leaps and bounds since starting this apprenticeship, and I am really enjoying it.'

'There's no doubt that I've grown in confidence. I am looking forward to the next seven months and becoming a fully qualified trade supplier, and working towards other qualifications in the future.'

4.3 What is the Electrical Distributors' Association?

The **EDA** (Electrical Distributors' Association) is the trade association that represents wholesale distributors of electrotechnical products in the UK.

There are two categories of membership:

- Wholesalers join the EDA as **members**.
- Manufacturers, solutions providers and service providers join as **affiliates**.

Wholesaler members include national networks with hundreds of branches through to single branch operations. Membership covers about 2,000 outlets throughout England, Scotland, Wales and Northern Ireland.

The EDA's 250 wholesaler member companies come in all shapes and sizes – from local family-run enterprises to global businesses with hundreds of branches – but they all enjoy the same level of EDA support including:

- training and development,
- business networking opportunities,
- business support services,
- product data services,
- market information,
- publications and digital communications.

To support and enhance the manufacturer-wholesaler relationship, the EDA invites manufacturers and service providers to become affiliates. There are more than 80 affiliated members who can engage regularly with wholesaler members.



Get in touch

Visit www.eda.org.uk/training-apprenticeships/ to learn more about the EDA's activities in training and apprenticeships.



4.4 EDA training awards

One of the principal activities of the EDA is training and education, and every year it acknowledges the efforts of managers who promote training and learners who have worked hard as apprentices or on improving their product knowledge.

The EDA's Training & Apprenticeship Programme is twofold: apprenticeships and the City & Guilds-accredited product knowledge programme of 12 modules.

In 2011 the EDA partnered with EDA Apprenticeships Plus to offer an apprenticeship service for the Associations' members and affiliates. The menu of services includes all recruitment, HR and mentoring support.

Each product knowledge module is a distance-learning training course, comprising a hard-copy textbook and a digital end-of-module assessment.

4.4.1 Investors in training

The EDA Investors in Training Awards acknowledge the support, commitment and leadership of managers in apprenticeships and the product knowledge programme.

The prosperity of the sector depends on the aptitude and performance of its people, so training and apprenticeships are central to the association's work.

4.4.2 Learning achievement

EDA Learning Achievement Awards are presented for outstanding performance in an apprenticeship or product knowledge training.

Winners are chosen based on the grades they achieved in Product Knowledge Module studies or in an apprenticeship.

EDA Learning Achievement Award winners come from the four corners of the UK and represent a broad spectrum of ages and seniorities. Some are already branch managers, though most are youngsters starting out in their careers.

Competition for an EDA Award is intense, with winners chosen from the thousands of employees at EDA member and affiliated member businesses.



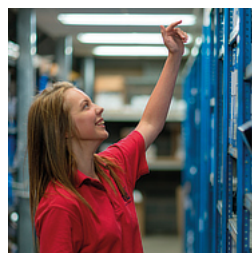
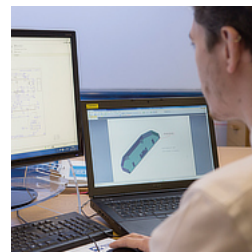
▲ Be a winner: one of these splendid trophies could be yours if you excel as an EDA apprentice or in studying the EDA's Product Knowledge Modules



▲ Sky high: the Learning Achievement Awards winners receive their trophies at the Shangri-La hotel on the 34th floor of the Shard



▲ Winners all: Investors in Training Awards (top) and Learning Achievement Awards (above)



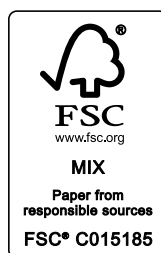
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ISBN 978-1-3999-1855-8

