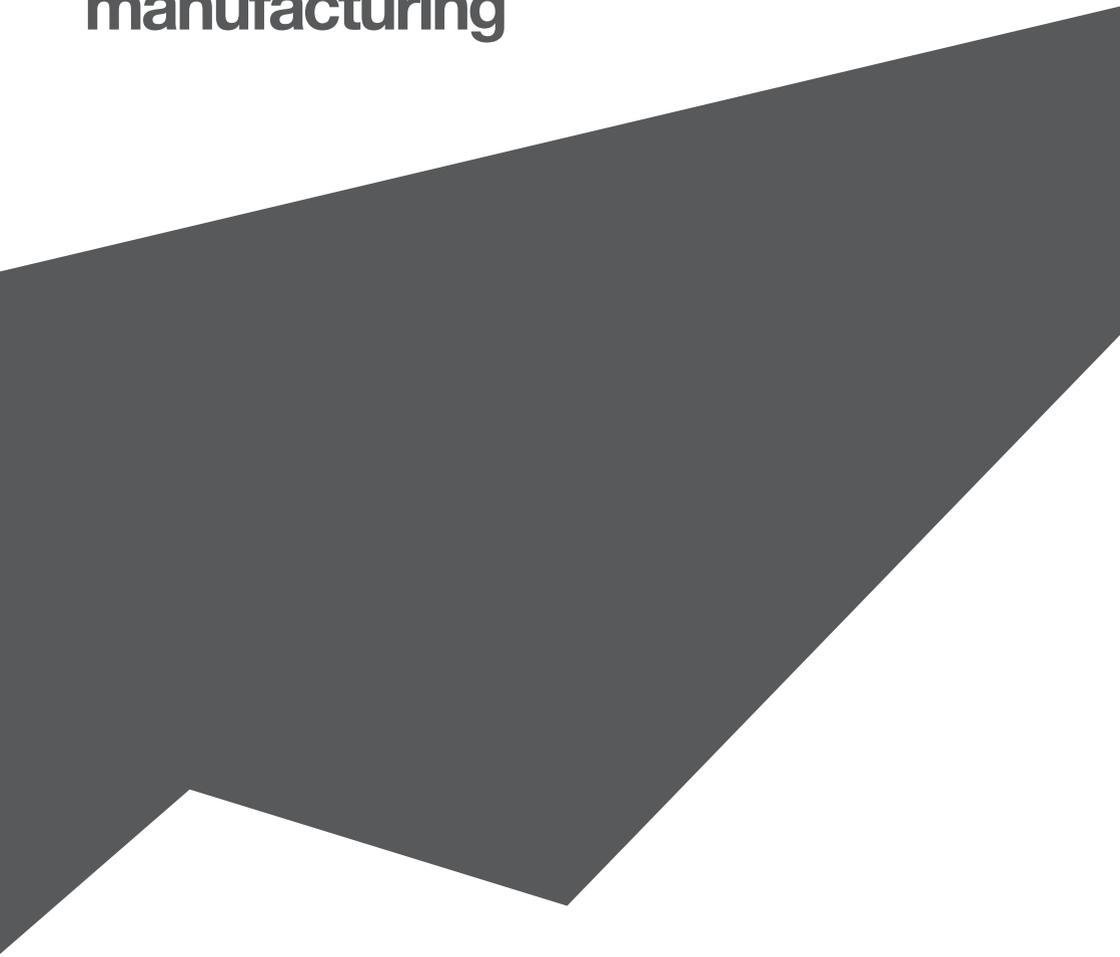


Leading Business by Design: High value manufacturing



eef

**The
manufacturers'
organisation**



70 years
Designing our future

About Design Council

Design Council is an enterprising charity which improves people's lives through the use of design. Our work places design at the heart of stimulating business growth, helps to transform our public services and enhances places and cities to ensure a sustainable future for everyone. We advance new design thinking, encourage debate and inform government policy. Our vision is to create a better world by design.

Contact us at: info@designcouncil.org.uk

Global demand has been challenging and uncertain in recent years, but manufacturers have retained a strong focus on activities that support their growth and that of the economy.

Continuous investment in people, innovation and technology have become hardwired across the sector and a focus on design is becoming ever more important.

Design isn't a bolt on or a 'nice to have'. It is becoming integral to producing goods and services that meet regulatory requirements, enhance user experience, capture the benefits of new technologies and differentiate businesses.

The sector examples contained in this research highlight the benefits design can bring. They also share some common themes for other advanced manufacturing sectors, such as the potential for greater supply chain collaboration in design and the need to be forward thinking in developing future talent.

If more companies are open to the possibilities of investing in design capabilities, we can be confident about manufacturing's future and the contribution it can make to the UK economy.

Lee Hopley,
Chief Economist
EEF

“ Design is the driving force of the entire manufacturing process. We no longer just design components and products that are easy to manufacture and assemble. Instead, design these days considers the entire lifecycle, from concept to manufacture, to maintenance and repair, right through to end of life processing. ”

Dick Elsy, CEO, High Value Manufacturing Catapult¹



¹ Dick Elsy (2015). Design for life, not just for manufacture. Available at <http://www.designcouncil.org.uk/news-opinion/design-life-not-just-manufacture>

Design is experiencing a golden era, with everyone from management consultancies to manufacturers acquiring design agencies and hiring more designers. This report is about how and why companies in the UK's high value manufacturing sectors are investing in design. These sectors are vital to the UK's economy and are supported by the government's Industrial Strategy.

Design Council's *Leading Business by Design* research series is the result of more than one hundred interviews with individuals from over thirty companies across high value manufacturing from well-known manufacturers such as Bombardier and Aston Martin to their suppliers, including Rolls-Royce, Wipac and design agencies. A broad understanding of design was adopted, covering a continuum from design focused directly on end-user experience to design in a more technical sense – for example, the design of sensors and other fundamental product components.

This short report, which accompanies more detailed accounts of the aerospace, automotive and construction sectors, presents themes relevant across high value manufacturing.

The findings are grouped into four broad areas:

- Innovation and growth
- Collaboration (both within and between companies)
- Designers' skills and competencies
- How design could be affected in the future.

For each area, we provide relevant recommendations for government and businesses.

“ The airline is investing heavily in design. We can't not invest, design is so ingrained. We can't separate design from the business. It is not a function. It is a way of being and doing. ”

Head of Customer Experience, Airline

We found that, amongst other things, businesses invest in design in response to emerging technologies and when faced with regulatory constraints. Manufacturers are taking steps to ensure they get the highest yield from their design investment by creating senior design champions or otherwise embedding design-led approaches in their organisation.

While individual sectors have unique forces impacting them, we noticed that the design-led innovation environment in high value manufacturing is driven by:

- **Proximity to end user:** The further away design takes place from the end user, within the organisation and in the supply chain, the more prescriptive design solutions tend to become. This can restrict scope for radical innovation.

- **Product lifecycle:** The average product lifespan may inhibit design vision. Design tends to be less radical for products that have a long lifespan or lengthy development phases.
- **Technological developments:** New materials, the Internet of Things and advanced manufacturing methods such as additive manufacturing will drive design in manufacturing.
- **Industry regulations:** Design is key to driving innovation within the boundaries of industry-specific regulation and standards.

These factors are interrelated. For example in aerospace, tight regulations and the small number of airframe manufacturers contribute to long manufacturing runs and restrictions on rapid innovation in aeroplane design. This incentivises some airlines to compete on service quality rather than price, resulting in design teams focused on passenger experience.

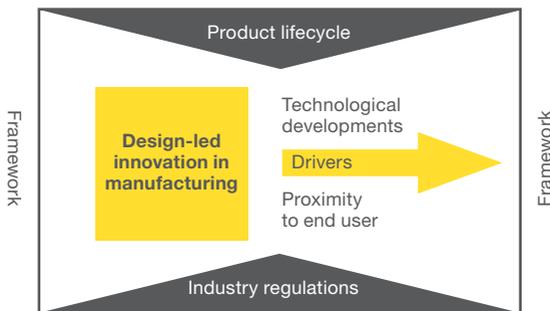


Figure 1: Design-led innovation environment in high value manufacturing

Embedding design strategically

“CEOs of airlines are like gods. If they have the right design vision that works really well, it trickles down the chain.”

Director, Design Agency

Previous *Leading Business by Design* research found that companies that embedded design in their organisation and used it at a strategic level extracted most benefit. High value manufacturers appear to have taken this lesson to heart. Our interviews showed that the manufacturers that had embedded design derived the best return.

One way those manufacturers demonstrated this commitment to design was through a senior leader (such as a Chief Design Officer) who understood and championed design as an asset and approach within the company.

Chris Bangle, former Chief of Design at BMW, said of his CEO: “He could use me to strengthen his vision for the company and the product ... and I could clarify with him what it was we were trying to do in Design ... without that type of very personal relationship many things wouldn’t have happened.”

Tapping into new technology

“With electric engines you can fundamentally change the shape of a car... if we had the opportunity to.”

Senior Manager, Automotive OEM

Whether one is talking about carbon fibre, information systems or cost-effective microgeneration, technology opens up new business possibilities. It is the designers’ role to convert such inventions into useful products: carbon fibre aeroplane parts, digitally connected cars and homes that farm their own energy.

High value manufacturers are employing design and designers to develop such technologies into propositions that excite and attract customers, ultimately giving them an advantage over their competitors.

Automotive companies, for example, are exploiting advances in information technology to meet customer preferences for greater mobile connectivity and harnessing artificial intelligence to create self-driving cars. Meanwhile, advances in electric engines and batteries are fundamentally changing automobiles’ physical shape.

Innovation within constraints

“It is inevitable in this sector that certification requirements, timelines or weight and balance considerations will impact upon delivery to some extent. The important thing is to retain the ambition and the vision.”

Design Manager, Airline

Some high value manufacturers have turned to design when faced with regulatory constraints. Construction is increasingly driven by the need to deliver low-carbon and energy-efficient housing, while automotive and aerospace are tightly regulated for safety.

Aeroplanes take years to develop and, once certified, scope for alteration is limited. But constraints needn't mean conservative design. Airlines have responded to them by hiring designers who carefully research passengers' needs, desires and behaviour. They can thereby craft experiences unique to each airline, focusing on cabin ambience, lighting, airflow and digital connectivity to personalise the customer experience.

Business recommendation

Use design strategically to differentiate your business from the competition. Embed it in your organisational culture and use it to inform strategic choices.

Policy recommendation

Design is a vital enabler of innovation and growth in high value manufacturing. Government programmes that foster innovation in high value manufacturing should embed initiatives that support design.

“ [Good design is] about getting people on board and making them share a vision... if you can produce a sketch, or a design, or a theory ... that is compelling enough to move that mountain, then you're doing a pretty good job. ”

Design Manager, Automotive OEM

In the same way that design teams should operate not from an ivory tower but embedded within their organisation, high value manufacturing companies do not exist in splendid isolation within their sector. Manufacturers' supply chains are large, complex and critically important to their business.

Airbus, for example, has over 2,000 suppliers across over 20 countries, while Bombardier's Belfast facility has a European supply chain of 900 companies.

Design works best when there is a complementary relationship between companies at the top of the chain and their suppliers.

Rather than simply fulfilling a brief, suppliers are a source of design and innovation.

Designers fall on a broad continuum. People-centric design is more prevalent for companies closer to the end users, while technical design engineering increases further down the supply chain. The end user focus drops dramatically just a few steps down the chain, with designers typically working to fulfil technical requirements.

Early dialogue and close collaboration on design is essential to avoid supply chain tensions.

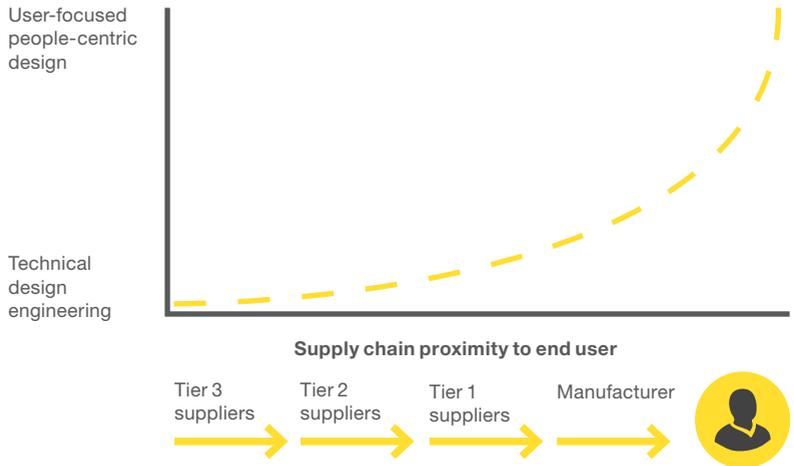


Figure 2: The design continuum in high value manufacturing

Mining the supply chain

“Usually innovations and technology are not created by the car companies by themselves, they are also generated by the suppliers.”

Global Marketing Manager,
Automotive OEM

Design is not just the user-facing company’s prerogative. Design and designers exist at all supply chain levels. Technological innovations and new ideas are as likely to emerge from suppliers as from manufacturers at the top of the chain.

Suppliers’ design teams and technological capabilities can put them in a powerful position in relation to their customer. Wipac are a specialist supplier of LED headlights to high-end automotive companies. They pioneered development of compact high-beam LEDs, enabling dramatic changes to their customers’ designs, freeing designers from traditional round headlamps. As Wipac’s Director of Design said: “I don’t even think that [the customer] at the time of the project would have known it was possible to produce an LED high beam. This was still very new then. But we built, demonstrated and modelled a very compact LED high beam.”

The supply chain allows ideas to spread between sectors. Design consultancies may seed ideas from the hotel sector into airlines, while car companies have partnered with high-end audio companies that usually design products for the home.

For design to be most effective, it must be embedded across the whole supply chain, not concentrated at a particular level.

Design through dialogue

“The best projects for us have probably happened with clients... with whom, over time, we have developed a good relationship and have been more open. We have tried to enter their internal mechanisms to anticipate their problems and tried to have solutions ready even before they realised they needed them.”

Global Marketing Manager,
Automotive OEM

When functioning well, supply chains can be hotbeds of innovation, but when things go wrong, relationships can quickly become frosty. Interviewees stressed the importance of close design collaboration between suppliers and customers, and early dialogue on design changes.

In aerospace, the big airframe manufacturers' suppliers are subject to detailed technical design requirements that leave little room for innovation. The problem is exacerbated at lower levels of the chain, where engineers are further removed from airframe makers and have few opportunities for dialogue.

In construction, Building Information Modelling (BIM) is a unified digital platform that aims to enable more seamless collaboration across supply chains between developers, planners, surveyors, designers and builders. Such platforms could be applied to other manufacturing sectors. In fact, Industry 4.0² may drive the creation and uptake of such a platform across all manufacturing sectors.

Business recommendation

Design is most effective when used collaboratively across the supply chain. Build strategic design relationships with smaller suppliers to allow innovation to come up through the supply chain as much as design requirements are pushed down. Consider developing a common design platform so that designers throughout your supply chain can collaborate by facilitating exchange of design information among multiple partners using a common language.

Policy recommendation

SMEs in supply chains often lack the ability to invest in design, yet are vital sources of innovation. A new supply chain approach should be rolled out across manufacturing, enabling SMEs to collaborate with their larger customers and drive design-led innovation in the supply chain.



² See page 19 for a broad description of Industry 4.0

“ Educational systems at university are split into two parts: The arts, which are about how to think, write and critique, are more non-vocational; then there are the professional subjects, which are exactly the opposite ... We should want engineers who are curious, who can think, who can have creativity, who can communicate, who are well-rounded. ”

Tristram Carfrae, Deputy Chairman of Arup³



While high value manufacturers are extracting design-led innovation from their supply chains, they are also investing in their internal design teams' skills. However, we found that they are concerned about shortages of key skills. As they seek to embed design within their organisations, some designers' roles are becoming strategic as well as technical,

creating demand for collaborative and interdisciplinary skills.

Designers in manufacturing are most effective when they find the right balance between people-centric and technical engineering approaches, while still producing a product or service that is financially viable.

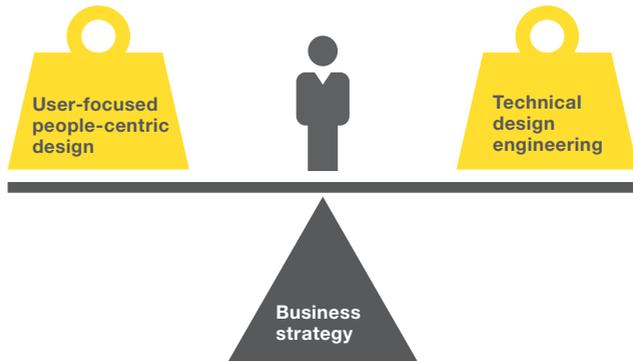


Figure 3: Designer skills in high value manufacturing

Shortage of designers

“Every industry right now wants people in interaction design and data analysis and even just data aggregation ... Frankly we can’t get good people ... The reality is that [innovation] is going to come from Google and Apple and Amazon and Facebook, even if we don’t want it to. They’re where people are going anyway.”

Senior Designer, Automotive OEM

Manufacturers are concerned about the supply of designers. In construction, for example, the recession had a profound effect on the whole workforce – including professionals. More generally, the design engineer shortage is causing companies concern for the future. Aerospace, for example, identified significant gaps between cohorts of design engineers in some companies.

While high value manufacturing companies need designers, they also find themselves in competition for them with faster-moving industries. Technology start-ups are increasingly hiring designers and also outright buying design companies.⁴

Collaborative and interdisciplinary skills

Besides this general skills shortage, as emerging technologies find a bigger role in high value manufacturing, they create demand for designers with the skills to develop them into consumer products. Traditionally, an automotive designers’ remit was to synthesise a car’s aesthetics, functionality, usability and manufacturability. As the automotive sector evolves – and particularly as cars develop a digital component – interaction designers are needed as much as physical vehicle designers.

Though collaboration between companies in a supply chain is important, so is internal collaboration between design teams and their own organisation. Design teams’ positions are of great strategic importance for high value manufacturing companies: they act as champions for the user, have product oversight and sit amongst a plethora of other voices and perspectives that they must often integrate.



⁴ Design in Tech Report 2015, KPCB, available at <http://www.kpcb.com/blog/design-in-tech-report-2015>

Designers' need for collaborative and interdisciplinary skills is therefore clear. To be able to integrate sometimes opposing perspectives from marketing, engineering, manufacturing and finance teams while maintaining clear design vision is no mean feat.

Business recommendation

Consider embedding programmes in design apprenticeships that focus on developing collaborative and interdisciplinary skills as well as technical skills. Such apprenticeships can be in partnership with universities to improve recruitment of designers.

Policy recommendation

Young people at all stages of education require exposure to the multidisciplinary mix of science, technology, arts, humanities and enterprise that underpins both creative and manufacturing success in the UK. The government should provide incentives to universities to deliver an increased range of multidisciplinary design courses in partnership with expert bodies.

“ We have to have our eyes on the next thing ... customer, environment, technology. We need a global perspective. ”

Head of Customer Experience, Airline

Manufacturing companies expect the arrival of a new digital industrial technology, known as Industry 4.0, to particularly affect design's future development. In what is being touted as the fourth industrial revolution, machines and systems will be interconnected along supply chains, beyond single companies. These cyber-physical systems will interact with one another to anticipate failure, configure themselves and adapt to change. This could significantly alter the design process in manufacturing, turning it from an isolated top-down approach to something more integrated and seamless, spanning the entire supply chain.

Changing consumer preferences will also play a role as users become more familiar with advances in connectivity.

We also anticipate that more high value manufacturers will supplement the products they currently manufacture with experiences and services.

Connectivity and creativity

"I think that the rules that we develop today are not going to be the rules we develop in ten, 15 years' time, so one eye has to be on what might happen in the future. So, not just making our technology or our interfaces better for the next three or four years but making them compatible beyond that point."

Human Machine Interface Technical Specialist, Automotive OEM

High value manufacturing companies expect pervasive digital connectivity to drive part of the design agenda in the foreseeable future.

For example, cars have evolved into fast-moving computers on wheels, increasingly connected to the internet. This connectivity will lay the foundations for other technological advances, but will also fundamentally affect car design. Car manufacturers expect it to separate into two constituent

parts: the digital and physical car. While continuous upgrades can be made to the former – improving the driving experience – the latter will need to be relatively flexible to accommodate these future features.

This trend's parallel implementation in aerospace could lie in the evolution of in-flight digital experiences where passengers expect the constant high-speed connectivity from their everyday lives to be available in the cabin.

As other sectors such as entertainment, media and leisure evolve, they will increasingly affect home builders, carmakers and airlines, despite seeming completely removed from them.

Servitisation of manufacturing

“We are moving from a vehicle ownership model to mobility service fulfilment, which is a huge change, and I think it's a generational change.”

Director and Head, Automotive OEM

We have already seen how some manufacturers supplement their physical products with less tangible experiences – in effect creating product-service systems. Rolls-Royce has pioneered this model for aircraft engines and many airlines already compete on flight experience details.

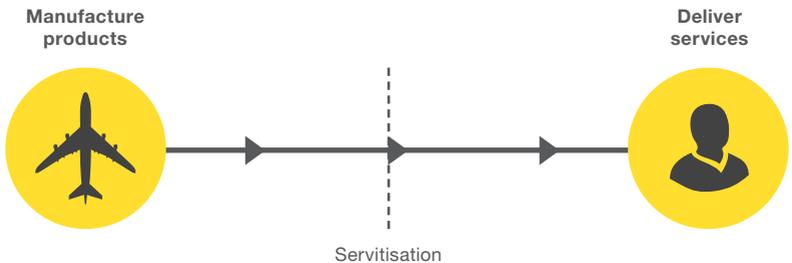


Figure 4: Servitisation of manufacturing

In addition, automotive manufacturers appear to be thinking carefully about the rapid growth of car-sharing services such as Liftshare and ZipCar. The trend from car purchasing to mobility purchasing could have big implications for automotive manufacturers – and the designers they employ.

A little further into the future, we anticipate that other manufacturers will follow this path towards servitisation of manufacturing.

Business recommendation

Invest in your capabilities for service design, an area that will increasingly become important in manufacturing industries that have been predominantly focused on product design.

Policy recommendation

As research into new manufacturing technology advances, design will be increasingly important in commercialising findings and making them work for the user. In order to maximise value from our publicly-funded research base, government spend must be complemented by access to design support for commercialisation.

Background

Design Council's 2014 *Leading Business by Design* research explored how UK companies are using design to do business better: listening more deeply to customers and creating more effective solutions, thereby improving their competitiveness and, ultimately, profitability.

Leading Business by Design showed that when design is user-centred it can add value to any organisation and is most powerful when it is culturally embedded within an organisation.

In 2015, Design Council has followed up the original 2014 *Leading Business by Design* with research projects that take a deep-dive into three high value manufacturing sectors: civil aerospace, passenger automotive and housing construction. Each one is critical to the UK economy's health and future growth, as laid out in the government's Industrial Strategy.

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High value manufacturing**

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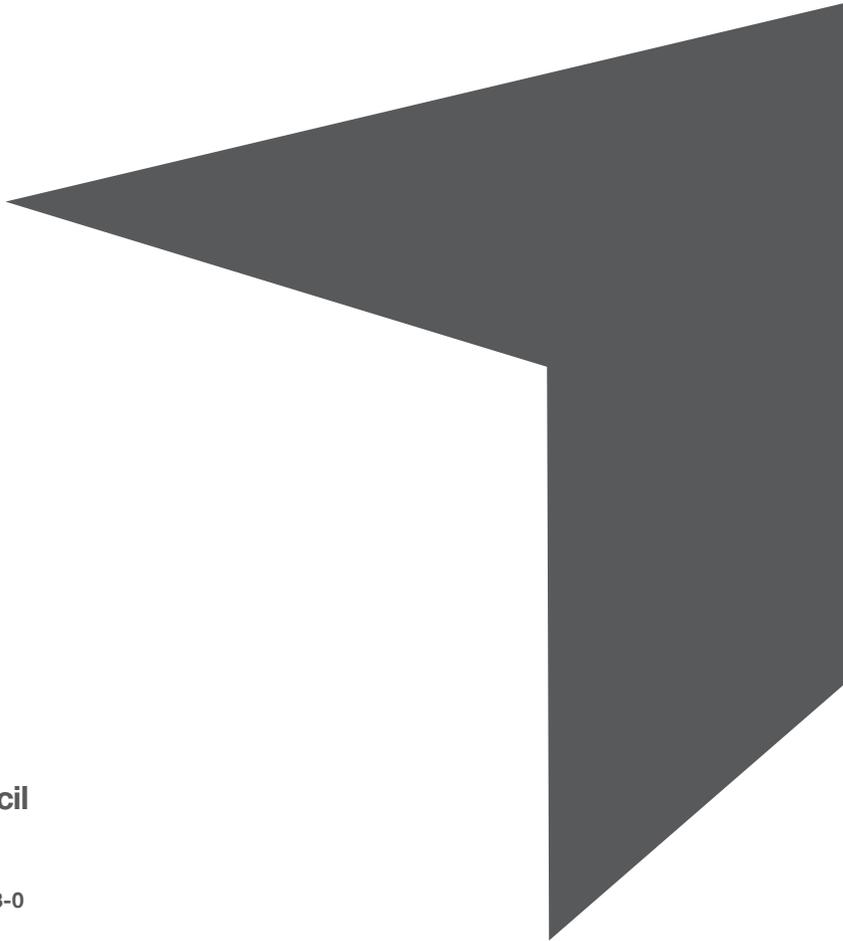
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