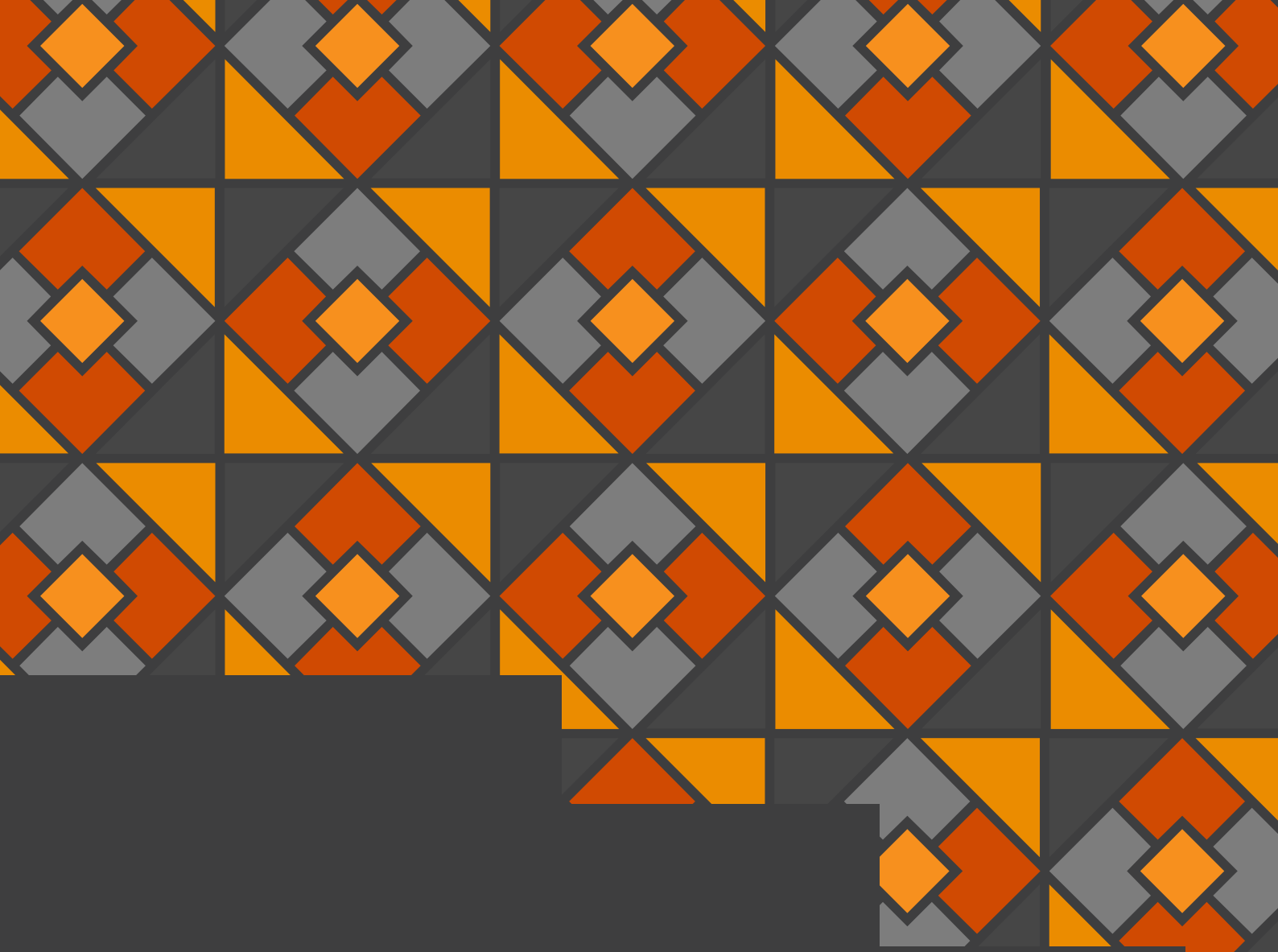

Smart Manufacturing:

Future-proofing your business

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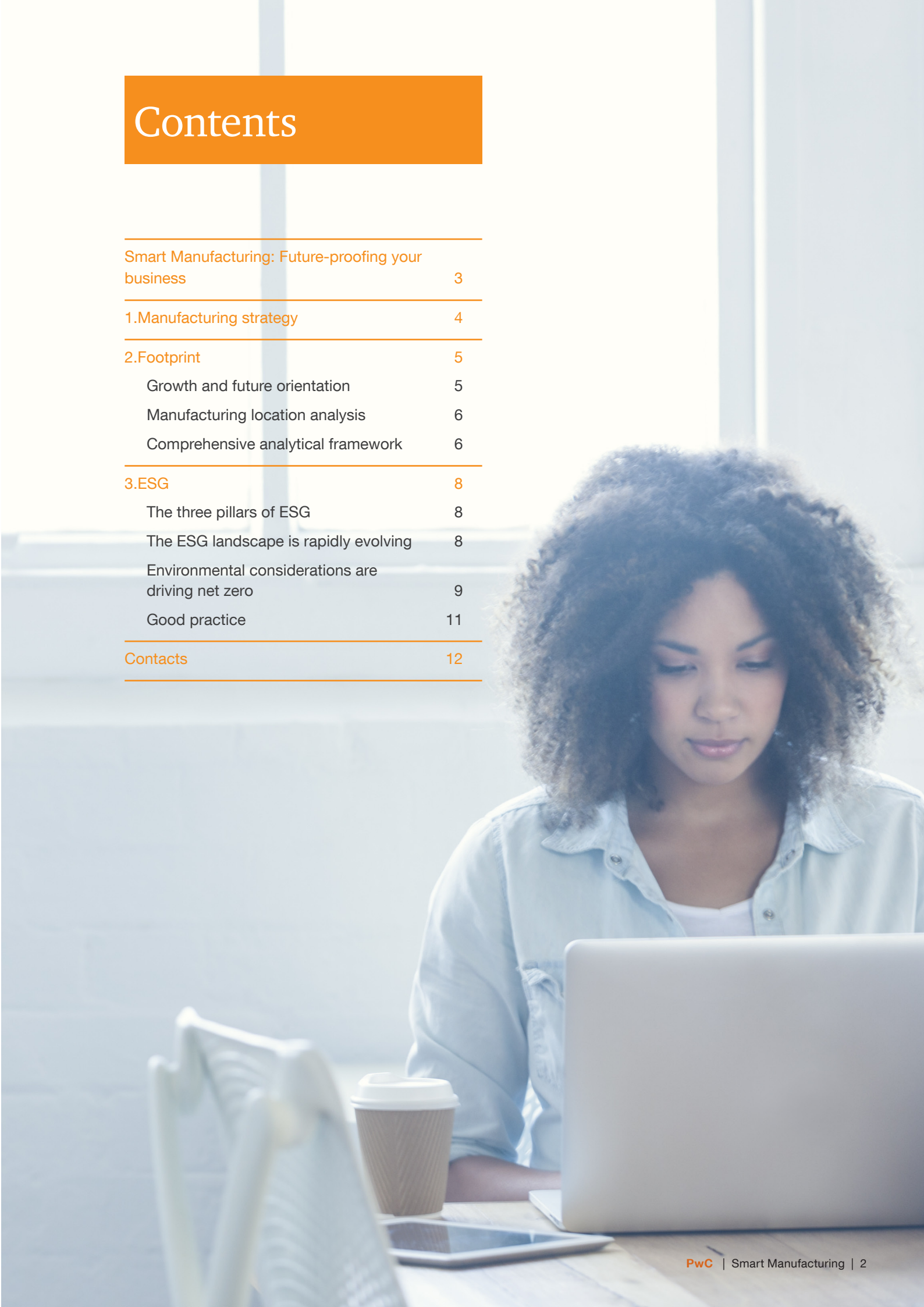


Smart Manufacturing:

Future-proofing your business

Today's manufacturers are operating in a very dynamic and complex environment as depicted in figure 1 below. On the one hand there is a lot of pressure from changing customer expectations with regards to producing smaller lot sizes, even down to a lot size of one, reduction in lead times where customers expect delivery in 24 hours or less, even for custom orders.

End-to-End Traceability is no longer a nice to have, with customers wanting to know the conditions the product was exposed to (e.g. high temperatures, vibration/shock) before they received it, particularly for food and whether it was sourced sustainably etc. Traceability also becomes important in product recalls to make the process efficient and effective in addition to various other benefits.

Another customer driver issue is the volatility in demand due to the current COVID-19 pandemic. Economies are experiencing multiple waves of infections which are not easy to predict and lead to the sudden lockdowns which disrupts economic activity and hence supply and demand patterns. Traditional systems use historical data for supply/demand predictions, but this is no longer valid. Lastly, there is the evergreen issue of cost pressure. There is an expectation by customers that the real cost of manufacturing a product should become less over time due to the recovery of R&D costs, economies of scale and more efficient manufacturing methods.

On the other hand, manufacturing organisations are faced with a plethora of technological advancements such as AR, VR, AI, IoT etc., that they would like to take advantage of, in order to deal with the customer challenges. However, most manufacturers are not sure what is real and what is hype. Furthermore, they have difficulty justifying these investments with solid business cases. When these technologies are implemented, then they usually fail to scale beyond the initial pilot project.

In part 1 of this 4-part series, we will discuss Manufacturing strategy, Footprint and ESG.

Figure 1: Aspects to consider in Smart Manufacturing Journey

1. Manufacturing strategy

In the current dynamic environment, business strategies are rarely valid for more than 3 years. These business strategies consist of sub-strategies concerning sales and marketing, procurement, technology, manufacturing etc. From a manufacturing point of view, having a strategy that complements the overall business objective and vision is critical as manufacturing sits in the middle of the supply chain. Decisions regarding whether it is best to make a product from raw materials or buy semi-finished goods and assemble become key.

As organisations come under increasing pressure to cut expenses and improve their return on assets, the decision of whether to keep key functions in-house or outsourced have become critical. Manufacturers are faced with 'make or buy' decisions because third-party suppliers in low-cost regions could potentially reduce overall costs. However, other critical activities such as human resources, information technology, maintenance and customer relationships should be carefully considered before such a decision is made.

Business units should conduct detailed analyses that thoroughly evaluate the costs, benefits, risks and rewards of outsourcing and the implications of keeping the activity in-house. Before giving up on in-house operations, a company must objectively assess its core competencies and measure them against world-class standards.

The questions to ask are: If our manufacturing or HR capabilities are below global benchmarks, can they be improved to reach maximum performance and efficiency, and would the benefits of those capabilities surpass the benefits that we would obtain from outsourcing? If so, what resources are required, and how long would it take to reach noticeably improved performance? Are technology innovation and alignment necessary for us to have a competitive edge? Do our customers expect a high level of service and response, much greater than we could offer if we outsourced call centres?

If, after these questions are answered, outsourcing is chosen, then the right partner will need to be found. Important considerations for the partner will be business strategies, manufacturing and engineering capabilities, design and innovation skills, labour costs, staff skills, employee training programmes, the ability to scale, capacity utilisation, and the social policies of the potential partner must be assessed. In addition, the risks associated with outsourcing must be accurately determined, whether they relate to the supply chain or to proprietary technology and intellectual property.

In order to make more objective and informed make-or-buy decisions it is important to ensure that all the right trade-offs have been evaluated and all the possibilities have been considered. To help answering these questions we have developed a model to help in the decision-making process. It is built on three key pillars: business strategy, risks and economic factors[1].

[1] https://www.strategyand.pwc.com/gx/en/insights/2002-2013/make-or-buy/strategyand-make-or-buy-sound-decision-making.pdf

2. Footprint

The decision to reconfigure your manufacturing footprint requires the following questions to be answered: Should we build and operate a new factory, where is the best location for the new factory, what is the best capex plan and how are we going to set up the new factory and finally how do we effectively reduce or exit our existing investments and minimise stranded costs?

In PwC's experience the following are key success factors in the analysis of footprint reconfiguration:

Have a growth and future orientated mind-set	by looking not just at the current consumer demand pattern but importantly at the future demand pattern and service level requirements
Analyse based on a comprehensive framework	to assess all aspects of business performance instead of focusing on just costs (i.e. also on supply chain service levels, CSR and environmental performance)
Use a rapid filtering process	to quickly eliminate options and zero in on a few scenarios for detailed analysis
Review the full operating model implications	including those on tax and customs duty as well as on the broader supply chain as well as the cost of exiting the existing setup
Use insights driven Data & Analytics	paired with a flexible scenario modelling tool to guide decision making. It is important that both the tool and the anlysis adapt as the project proceeds and goes into detail with a few scenarios

Growth and future orientation

A forecast of the demand volumes for the next five to ten years is necessary to evaluate the attractiveness of the various potential locations. This also includes a clear understanding of the trends in customer demand, as well as the different demand segments. As part of the forecast, expected changes in market trends and the corresponding impacts on the supply chain also need to be taken into account.

Comprehensive analytical framework

To assess advantages and disadvantages of different locations, we recommend that a comprehensive analytical assessment framework that covers six categories of analysis is used:

Manufacturing location analysis

Demand fit
Assessment of the expected performance in fulfilling customer demand (e.g. average lead time from the potential manufacturing locations to the customers) and the service level (e.g. reliability and on-time-delivery))

Supply fit
Evaluation of the local supplier base, material lead time and labour availability and quality. Such as unemployment rate, educational attainment rate or unionisation rate

Setup and transition costs
Estimation of land price and construction costs as well as company registration fees. Costs related to reducing or exiting investments and/or shifting production as well as related stranded costs

Operational environment and risk
Estimation of infrastructure availability and quality (e.g. public roads, railroads, ports cargo) and assessment of local policies related to the specific industry

Tax Impact
Evaluation of FTAs, applicable import/export tariffs at the different locations as well as analysis of tax rates, tax credits and other tax incentive programmes such as property tax abatements or discretionary grants

Operating costs
Estimations of labour costs (e.g. manufacturing workers, technicians and management), utility & facility costs (e.g. electricity, water and gas, depending on the industry) as well as logistics costs (e.g. material transportation from manufacturing site to distribution centres)

A number of supply chain factors are affected by the location choice. Traditional experts use the SCOR model to evaluate five interlinked performance metrics to assess supply chain performance at each location. However, we advocate also taking into account the disruption risk and external impact of the supply chain reconfiguration in order to provide a more holistic supply chain assessment.

Traditional approach

- Flexibility
- Reliability
- Speed
- Costs (operational)
- Assets (capital expenditure)

New approach

- Flexibility
- Reliability
- Speed
- Costs (operational)
- Assets (capital expenditure)
- Disruption risks
- Social and environmental impacts

Rapid filtering process

Analysing different locations for a potential expansion is a very time intensive process, therefore, a rapid filtering process is crucial to shortlist the best suited locations as far as possible. PwC typically facilitates interactive workshops leveraging its experience in order to help its clients eliminate the less interesting locations early in the process. In addition, the workshops offer a good platform to align all stakeholders.

Review of operating model implications

Any change to the supply chain and manufacturing footprint will have broader implications on business operating, legal, tax and financing models. Some questions that must be answered are: what taxes and tariffs will apply to the produced goods? How will processes such as production allocation and procurement be managed? What will the inter-company transfer pricing, trade and physical goods flows look like?

If not considered properly, then other factors such as inefficiencies, taxes and duties can negatively impact the competitiveness of new facilities despite other cost advantages such as labour. In addition, the cost to exit existing investments or reduce the volume of production at existing facilities must be considered, along with an evaluation of ways to minimise the stranded costs from the shift of production. In the case of a full exit, potential material legal and regulatory hurdles to exit must also be evaluated.

Use insights driven data and analytics

The usage of data analytics is essential to evaluate the right locations. It gives the possibility to discover insights that profoundly impact your decision-making process. In addition, the findings can be used for a flexible modelling tool for scenario analysis. The model should be able to handle progressively more detail and data points as the process evolves as well as be able to compare different scenarios quantitatively.

The complexity of footprint is apparent in the above discussion and more information can be found at: https://www.pwccn.com/en/deals/publications/reconfiguring-your-manufacturing-footprint-for-growth.pdf

3. ESG

In recent years we've seen dramatic changes in our world. As impacts of the climate crisis and resource scarcity, large-scale urbanisation, accelerating technological development and other megatrends become increasingly clear, manufacturing organisations need to adapt with new strategies to help them continue to succeed. Sustainability is the capacity to create long-term value through a comprehensive focus on environmental, social and governmental (ESG) factors which are explained in figure 2 below.

The three pillars of ESG

Environmental			
Climate change	Natural resources	Pollution & waste	Environmental opportunities
Carbon emissions	Water stress	Toxic emissions & waste	Opportunities in clean tech
Product carbon footprint	Biodiversity & land use	Packaging material & waste	Opportunities in green building
Financing environmental impact	Raw material sourcing	Electronic waste	Opportunities in renewable energy
Climate change vulnerability			

Social			
Human Capital	Product liability	Stakeholder opposition	Social opportunities
Labour management	Product safety & quality	Controversial sourcing	Access to communication
Health & safety	Chemical safety		Access to finance
Human capital development	Financial product safety		Access to health care
Supply chain labour standards	Privacy & data security		Opportunities in nutrition & health
	Responsible investment		Technology disruptions
	Health & Demo. Risk		

Governance	
Corporate Governance	Corporate behaviour
Board diversity	Business ethics
Executive pay	Anti-competitive practices
Ownership	Corruption & instability
Accounting	Financial system instability
	Tax transparency

Source: MSCI

Figure 2: ESG Components

Sustainability can no longer be managed in a silo, nor can organisations focus only on mitigating negative impacts on society and the planet. Instead, climate and sustainability are increasingly being built into the core of organisations, reflected in purposes and missions, managed across operations and crucial to engagement with investors and policymakers alike.

The ESG landscape is rapidly evolving

Investors are driving the ESG agenda very aggressively as per figure 3 below.

The 'responsible investor' has changed and investors are fundamentally rewiring capital markets

89%
of investors say their firm has changed its voting and/or engagement policy to be more attentive to ESG risks

2/3
of institutional investors believe that ESG will become 'industry standard' within five years

$20T
BoA estimate of ESG market demand in the next two decades

20%
of all ETFs will be tied to ESG ratings by 2028. BlackRock forecasts

53
# of companies in 2020 that BlackRock took voting action against for lagging in action and disclosure on ESG issues

67
S&P 100 companies who issued supportive statements on Racial Equality asked to disclose D&I invofmration by NYC competitor

Investors want consistent, high-quality information that outlines a strategic plan for long-term value creation. Other stakeholders, including customers, regulators and NGOs, are also demanding more transparency, and SEC statement on audit committee role now includes ESG KPIs.

"If certain information that happens to fall in any of the ESG categories is material to that company, the company needs to disclose it. We expect management and the board to do that, and we will come after them when they don't."

– Elad Roisman, SEC Commissioner

Figure 3: Investors driving change

Strategy: Organisations who understand the impact and urgency of ESG and are able to, not only act on it, but make it an integral part of their corporate and business strategies have the potential to keep their license to operate. In addition, they can also identify opportunities for growth, enhance reputation, ease access to finance or be competitive in talent acquisition.

Transformation: In order to effectively execute on the ambitions and the set targets, organisations need to change the way they operate – reflecting ESG in their organisation, in processes, incentive schemes and daily operations as well as decision making.

There is growing consensus that organisations, investors and governments can no longer rely solely on traditional financial information for decision making. Progressive organisations are integrating insights about their people, intellectual capital, important relationships and social impacts, as well as about natural capital considerations such as climate.

Many manufacturing companies are sitting on a sustainability time bomb due to the following reasons:

- The bulk of greenhouse gas emissions originates from industrial production, this is approximately 40%.
- Machinery is a key enabler for circularity and reducing resource consumption.
- Low diversity and inclusion in a traditionally male driven industry.
- Skills shortage requires an attractive/sustainable employer brand.
- Health and safety regulations in the global value chain.
- Labour practices and human rights along the entire value chain.
- Regulation exerts pressure for sustainability (e.g., CSR guidelines, EU Taxonomy, Lieferkettengesetz).
- Importance of data protection and cyber security (digital business models).
- Selected customer markets seen as critical (e.g. Defense, Tobacco).

New technologies that support smart manufacturing and smart factories can increase efficiency, reduce errors, and track resources, emissions and energy use. The auto industry is faced with zero-emissions vehicles, innovative mobility concepts and CO2-neutral production. Both auto and A&D industries are developing hydrogen fuelled engines. Manufacturers also need to focus on the impact of ESG efforts on employees. Upskilling, safety, diversity and a living wage are a few of the challenges.

Environmental considerations are driving net zero

Net zero – Explained

- To avoid dangerous climate change **global warming must be limited to 1.5°C**. This means **reaching 'net-zero'** emissions no later than 2050.
- Net zero is the point at which **GHG emissions are reduced as close to zero** as possible with remaining 'hard to reduce emissions' removed by carbon sinks, e.g. forests.
- **Global rate of decarbonisation must rapidly accelerate** to achieve net zero by 2050, from 1.6% a year (now) to 11.3% a year.

Countries and companies have set ambitions

- **Action needs to happen over the next 2-3 business cycles** to have any chance of achieving net zero by 2050.
- Around 120 countries have committed to net zero, including the UK, the EU & other major economies.
- **Over 200 global companies committed to achieve net zero** — a movement that has more than doubled in size since it began in September 2019.
- Achieving these pledges will need **radical enterprise and supply chain transformation**, including identifying and scaling nascent technologies and disruptive business models.

Industrial manufacturing and construction companies often have **high emissions, high energy use, long lived assets** and are **capital intensive**. They are also a key **part of the value chain** for **energy** and **transport** systems and **the built environment**, all of which will disrupt significantly under net zero.

Net zero risks in manufacturing

- **Increased costs** from changes to carbon markets.
- **Tax implications** due to supply chain shifts.
- **Early write-offs or devaluation of plants and equipment**, from policy changes or reduction in demand for current products.
- **Fundamental shifts in competitive and investment landscape**, driven by technological innovation or market changes.

Net zero opportunities in manufacturing

- **Increased costs** from changes to carbon markets.
- **Early write-offs or devaluation of plants and equipment**, from policy changes or reduction in demand for current products.
- **Fundamental shifts in competitive and investment landscape**, driven by technological innovation or market changes.
- **Tax savings** by shifting supply chains.

Manufacturers need to meet future demands from customers and end-users by re-designing products and using alternative materials with energy efficient, low-carbon processes

Alternative and recycled materials

Innovative bio materials, low-carbon cement, recycled steel

Renewable energy and alternative energy sources

Wind and solar power, hydrogen as heat source or reduction agent, biomass as heat source

Dgital technology

Enabler to deliver the transition and strucural change at pace and scale

Electric vehicles (EVs)

Considerably lower emissions over their lifetime than conventional (internal combustion engine)

There are a number of challenges, however … Assessing the boundaries of downstream emissions and making the business case

Complexity and lack of clarity

- Complex to assess and address scope 3 emissions, and uncertainty around how far downstream the manufacturing company's responsibility goes, being placed far up the value chain.

Unclear business benefits and risks

- Need to understand the benefits and risks from business and financial perspectives, e.g. carbon price and tax.
- Some are starting to develop an understanding of the cost and introduced Internal Carbon Price, however it is still not a common practice.

Lack of capability and negotiation power

- Companies do not necessarily have in-house capability to analyse the data from which to identify where the major sources of emission are and how to address them effectively.
- Smaller-sized companies might not have enough negotiating power against suppliers and thus are unable to influence their supply chain.

Decarbonisation levers are available across the manufacturing and automotive value chain... Electrification and energy storage are critical

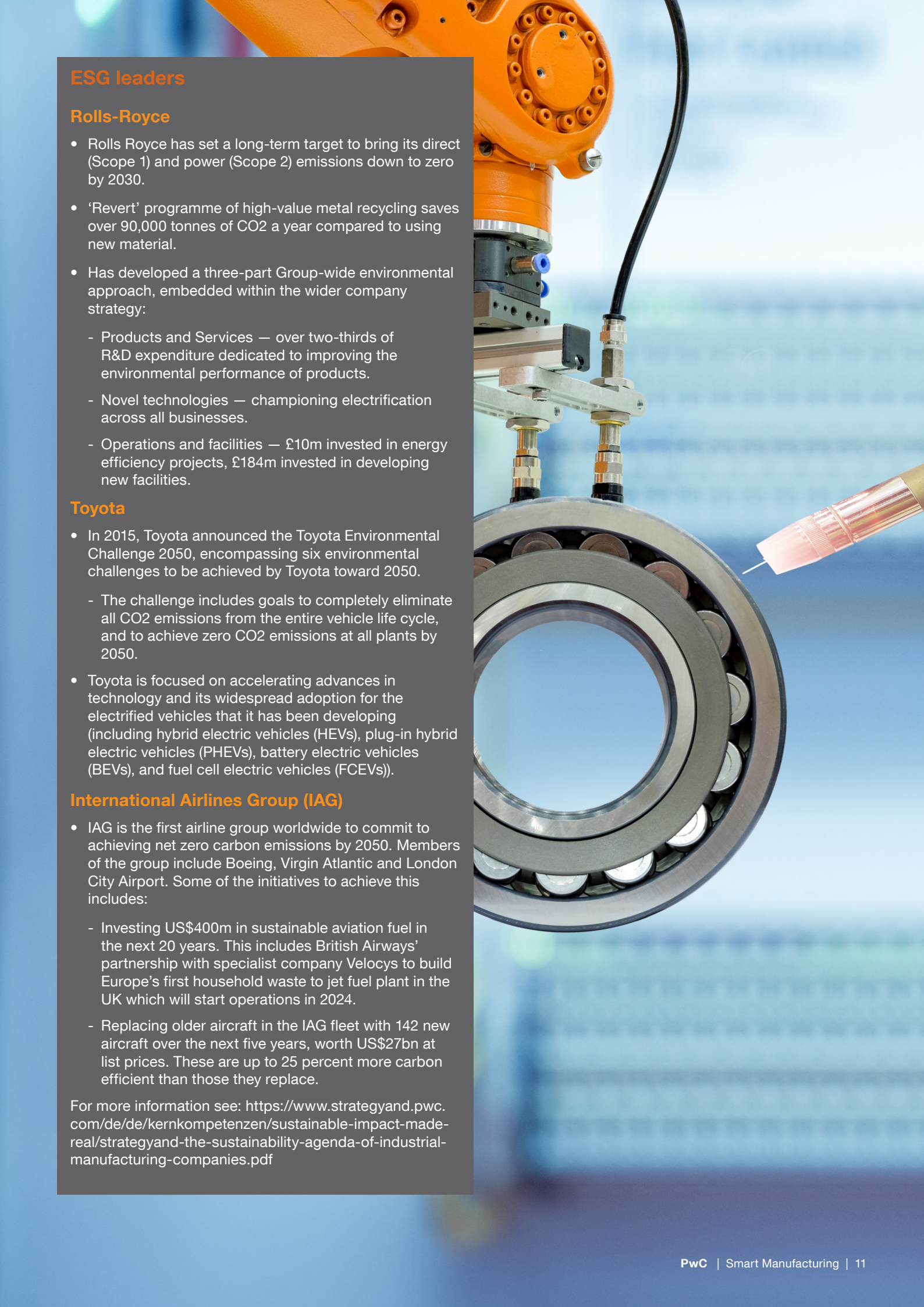
- Shift in design with improvements in energy efficiency of engines and airframes
- Electric engines
- Energy efficiency and low-carbon processes during manufacturing
- Renewable energy

- Electric vehicles (electric drivetrains)
- Hydrogen fuel cells
- Charging infrastructure
- Energy storage (batteries)
- Renewable energy
- Improvements in internal combustion engine design in aerodynamics and in tyre design

- Sustainable jet fuels
- Electric and solar powered aircrafts
- Electric vehicles
- Renewable energy and low carbon heating
- Drones

- New materials – e.g. hydrogen based steel
- Low carbon heat
- Circular business models

- Sustainable jet fuels
- Electric and solar powered airplanes
- Efficiency of aviation operations in traffic and other operational improvements)



ESG leaders

Rolls-Royce

- Rolls Royce has set a long-term target to bring its direct (Scope 1) and power (Scope 2) emissions down to zero by 2030.
- 'Revert' programme of high-value metal recycling saves over 90,000 tonnes of CO2 a year compared to using new material.
- Has developed a three-part Group-wide environmental approach, embedded within the wider company strategy:
  - Products and Services — over two-thirds of R&D expenditure dedicated to improving the environmental performance of products.
  - Novel technologies — championing electrification across all businesses.
  - Operations and facilities — £10m invested in energy efficiency projects, £184m invested in developing new facilities.

Toyota

- In 2015, Toyota announced the Toyota Environmental Challenge 2050, encompassing six environmental challenges to be achieved by Toyota toward 2050.
  - The challenge includes goals to completely eliminate all CO2 emissions from the entire vehicle life cycle, and to achieve zero CO2 emissions at all plants by 2050.
- Toyota is focused on accelerating advances in technology and its widespread adoption for the electrified vehicles that it has been developing (including hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), battery electric vehicles (BEVs), and fuel cell electric vehicles (FCEVs)).

International Airlines Group (IAG)

- IAG is the first airline group worldwide to commit to achieving net zero carbon emissions by 2050. Members of the group include Boeing, Virgin Atlantic and London City Airport. Some of the initiatives to achieve this includes:
  - Investing US$400m in sustainable aviation fuel in the next 20 years. This includes British Airways' partnership with specialist company Velocys to build Europe's first household waste to jet fuel plant in the UK which will start operations in 2024.
  - Replacing older aircraft in the IAG fleet with 142 new aircraft over the next five years, worth US$27bn at list prices. These are up to 25 percent more carbon efficient than those they replace.

For more information see: https://www.strategyand.pwc.com/de/de/kernkompetenzen/sustainable-impact-made-real/strategyand-the-sustainability-agenda-of-industrial-manufacturing-companies.pdf

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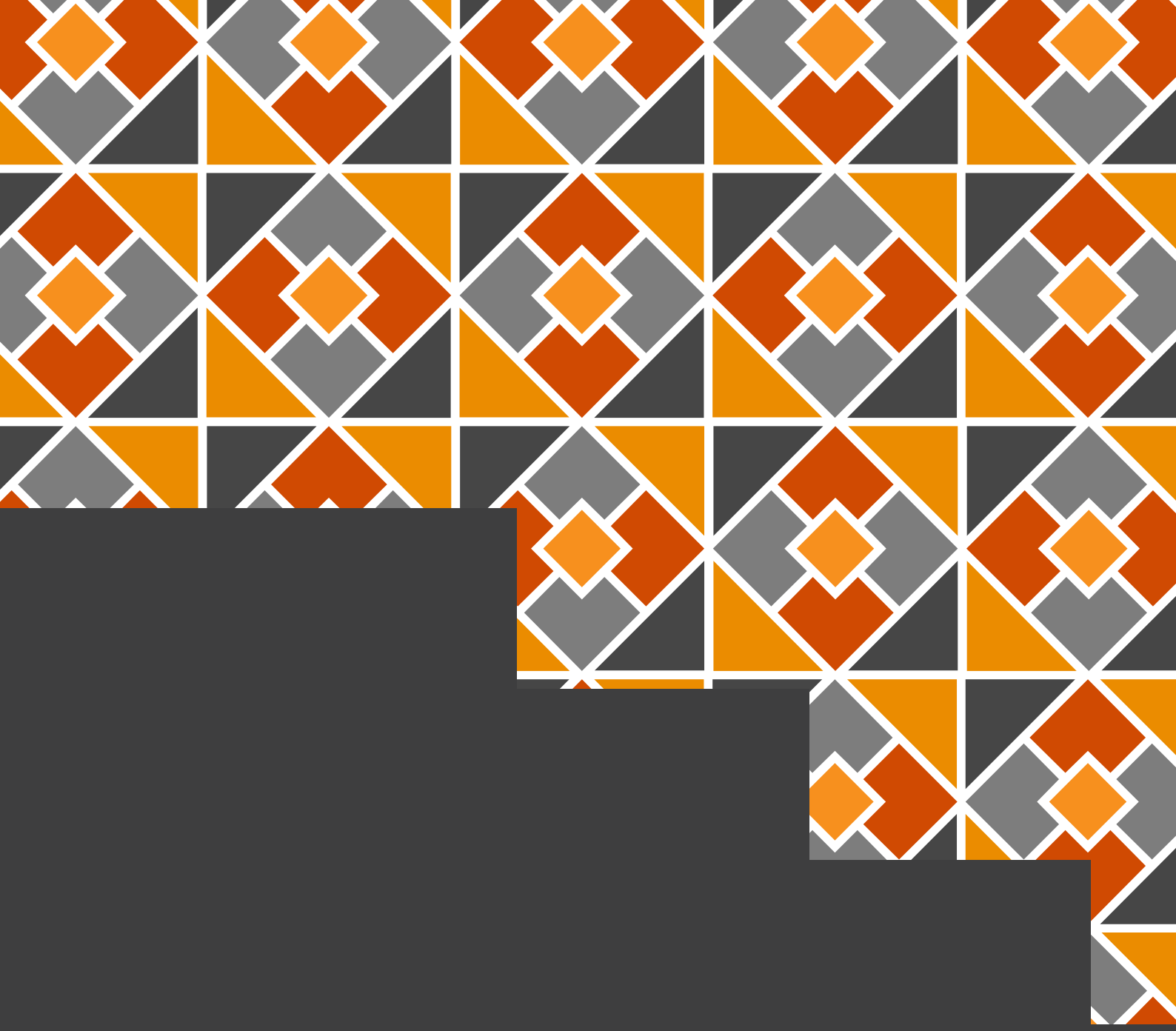

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