

The UK Semiconductor Industry – Our Opportunity

Techworks Semiconductor Leadership Group

We welcome the recently published UK Government Semiconductor Strategy, which is an important initiative to boost this strategically important sector, where the UK already possesses significant strengths. The accompanying infrastructure feasibility study which seeks to understand the impact of developing specific UK capabilities to support onshore R&D, prototyping and speciality manufacturing is also very welcome.

In this paper, we wish to provide some further thoughts in support of the UK semiconductor sector, which we believe will drive commercial success especially where the UK has strategic advantages.

A successful and enduring industry with a strong national GVA contribution needs a complete eco-system comprising research, innovation, design, product engineering, manufacturing and end-market consumption. Due to recent geo-political events, there is a unique opportunity for the UK to build a semiconductor industry which competes on a global scale. However, this requires ongoing discussion between industry and government and a long-term view of how to achieve our goals.

Today, most chips are made from silicon which enables high density complex circuits at low power and low price. The need to increase performance and drive down costs over massive volumes in markets such as mobile phones, consumer electronics and GPUs has fuelled the ever-advancing march of Moore's law towards smaller geometries in fabs such as TSMC, Global Foundries and Intel, with associated increasing CapEx.

However, in major emerging markets such as Power Electronics, Net Zero, Photonics, AI, Quantum, IoT, Telecoms and Space the end product and technology demands are different. Indeed, many industry experts have pointed out that future devices need to adopt smarter architectures, multi-chip packaging and a mix of larger silicon geometries integrated with other compound semiconductor materials; so called 'heterogeneous integration'. In these areas, the UK has a strategic opportunity, with a competitive edge and existing businesses across the value chain looking to grow their operations.

The Semiconductor Value Chain

The Semiconductor value chain (*Figure 1*) is a complex web of interdependent entities, and in the UK there are many companies with strengths and unique capabilities across all of this (*Table 1*).

Exploring the value chain:

- Design Tools: Software (tools) for use in the design, simulation, validation, layout and fabrication of devices. Typically sold as a subscription business model. Significant investment required to keep up with technology and process trends.
- IP: Licensing business model, providing circuit blocks which are integrated into semiconductor devices designed and supplied by downstream companies.
- Fabless Semiconductor: Designers and sellers of semiconductor devices who outsource manufacturing to another company.
- Integrated Design & Manufacture (IDM): Designers and sellers of semiconductor devices who also manufacture in one organisation.
- Manufacture / Foundry: Manufacturing of devices for other (fabless) semiconductor companies.
- Packaging: This is increasingly important and often comprises multiple separate 'chip-lets'.
- Fab Equipment Supplier: Equipment supply to manufacturers. The UK has some global players here.

Typically (though not always) the value derived across the supply chain grows significantly from the initial innovation through the design phase, to manufacture and ultimately the sale to the end-user. Capturing value at key parts of the supply chain is important to build a successful and sustaining eco-system.

Because manufacturing costs are high (CapEx / OpEx) this has historically been amortised across high volumes and / or many (fabless / outsourced production) chip design companies in the ongoing race to stay at the leading edge of process technology which has, for some time, followed Moore's law. To support this cost base, a manufacturer needs to be competitive on a global scale to drive sufficient volumes, however, it is important to realise that post Moore's law manufacturing is expected to be less CapEx intensive due to the shift away from sub-10nm silicon geometry.

In some cases the design and manufacture of the chips must be tightly coupled to gain advantage from specific process capabilities, and this is increasingly so for newer materials and processes - which the UK has strengths in - as we move beyond Moore's law. This coupling leads to higher product differentiation and further drives the value to be gained post manufacture. Integrated design & manufacturer (design, manufacture and sales in a single organisation) is common in such circumstances with a strongly linked design and fab process.

The UK has a strong history in IP licensing (chip designs, or partial designs, which are supplied under license to other chip companies) with several businesses which supply the global semiconductor industry. However, the economic contribution made by end device shipments is higher than that from IP licensing alone. Developing more UK based chip companies which build on such IP will capture more of the end-device economic value.

Each part of the supply chain contributes to the end device value and stimulating domestic demand enables the UK economy to capture more of the value chain. This also leads to a more complete ecosystem driving UK industry growth through collaboration, customer / supplier business and acquisition. However, it is also important to minimise friction when engaging in overseas trade. As the UK sector grows, it will benefit from accessible domestic demand, but it must also have smooth access to trade for growth at a global level.

Scaling up UK Industry

To build a thriving UK industry, we must also consider another dimension, and that is the stage of each business. Different challenges are faced at each stage of a company's growth journey from initial R&D innovation to growth and ultimately scale-up to become a globally competitive player.

Business stage:

- Incubation : Innovation and invention -> Early stage startup funding and incubation
- Seed : Technology proof, Business & Market planning -> Initial proof of concept
- Early Business : Minimal Viable Product -> Production & Delivery to first customers
- Growth Business : Competitive products to Multiple customers -> Growth capital
- Scale-up Business : Mainstream player, Globally competitive -> Scale capital

Globally, all developed nations with a semiconductor sector provide industry support through a mix of different measures in CapEx (Land, Construction, Equipment), OpEx (Labour, Energy, Materials) and Tax. These grants and funding mechanisms can range from 20% to 50% or even 75% of costs.

To maintain global competitiveness as they scale, UK Semiconductor businesses have said for many years that some form of support is needed, but it is important to note this does not necessarily mean a blind subsidy. Targeted support which is measured to ensure performant Return on Investment would be welcome.

The proposed UK Semiconductor Infrastructure Initiative is a positive move; but it only addresses certain points in the value chain and business stages and does not help all UK companies. Early-stage innovation, design and IP creation businesses will welcome the prototyping and design tool support, but more support is still required for fabless chip vendors or IDMs in their growth business phase, or UK resident manufacturing companies with a need to scale-up their operation through significant CapEx.

The UK currently produces wafers and devices across more than 20 manufacturing sites throughout the UK from SW England, Wales, SE England and the East of England to the Midlands, Northeast, Northern Ireland and Scotland. By way of illustration, a new non-advanced geometry fab (above 10nm) could cost more than 1 billion pounds to build, whereas updating or repurposing an existing fab catering to a moderate geometry level could cost 10's to 100's million pounds. Some innovative approaches using novel materials and processes (where the UK has strengths) can deliver new fabs for multiple 10x lower CapEx than conventional fabs, but in any case, building and / or maintaining a manufacturing facility is a costly and long-term business.

Long Term Support of UK Industry

Although many countries wish to build sovereign capability, all companies compete on a global basis. We believe that further market interventions are necessary to build a long term sustainable and successful microelectronics industry in the UK which can participate in a meaningful way on the global stage:

1. Build a sustainable ecosystem which comprises each element of the value chain (Materials > Equipment > Design > Fabrication > Packaging > Test > Sales) to create a critical mass of UK know-how, talent and cross-industry support & collaboration and facilitate a UK 'seat-at-the-table' globally.
2. Support all players across the sector through appropriate mechanisms; in the manufacturing sector through CapEx or tax incentives to scale up operations to compete globally; or in the fabless or IDM sector through programs to enable business and roadmap growth to remain competitive. Such initiatives might require an element of guaranteed supply to the domestic market and/ or be subject to performance related metrics.
3. Incentivise the domestic market to build local customer / partner relationships and UK based supply chains to build national resilience and provide alternatives to an IP or enterprise sale to foreign acquirers. Perhaps through a national challenge program?
4. Provide access to patient / long-term capital from investors with real-world semiconductor experience and understanding to enable semiconductor device vendors (fabless or IDM) to scale over a meaningful period of time. This exists outside the UK, but accessing it across borders places UK companies at a disadvantage and may mean the loss of UK ownership.
5. Foster friendly inward investment, which is supportive but not exploitive.

Some further thoughts:

1. UK has strong capital markets, however unlike other global markets, they do not understand the Semiconductor sector. There is an opportunity for education and promotion here and for government interventions which will incentive potential investors.
2. Creation of a significant sized investment fund could support major semiconductor industry scale-ups. This could be a public-private mix, provided the aforementioned expertise is in place.
3. Increased support for R&D; especially collaborative R&D between companies and with universities.
4. We need a major initiative in skills and talent. Across Industry, Universities and Schools, but also though increasing public awareness and interest. We have got to reverse the aversion in society to science and engineering as a career aspiration. STEM should be 'cool'.

5. Programs to support retraining from declining industries into important semiconductor related roles.
6. Inward investment in new facilities would provide a ready-made talent pool for UK based start-ups.
7. There is a strong opportunity to collaborate across different semiconductor companies to develop heterogeneous system architectures which stretch across chip, material and process boundaries. Yet, to build capability in advanced system packaging, the UK needs to play in design and manufacturing.
8. Semiconductors are a long game (5 - 10 years) and thus beyond the horizon of any single government. We need bi-partisan support and a clearly defined critical national infrastructure approach as developed in other countries.

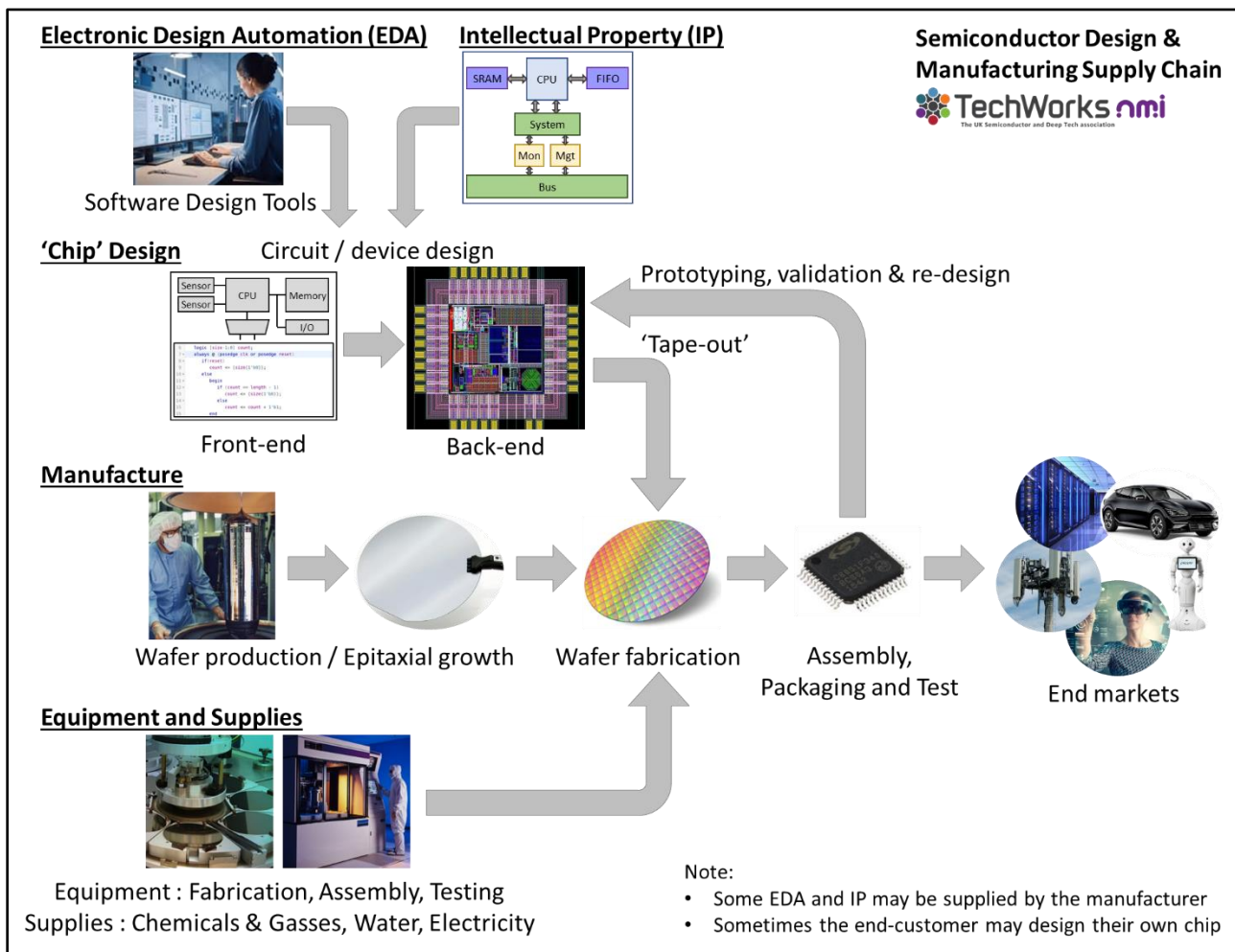


Figure 1- Mapping out the Semiconductor Value Chain.

IP	Design	Manufacture	Packaging	End market sales
>10	>120	>20	>10	>50

Table 1- Approx number of UK Companies engaged in each stage of the value chain.

In Conclusion

We urge government to work with industry in defining a set of policies which work in concert to build a long term sustainable and successful microelectronic ecosystem. Each element of the value chain should be supported to build a critical mass of UK know-how, talent and cross-industry collaboration. A complete ecosystem will also ensure more business value is captured within the UK economy.

Globally, all developed nations recognise the fundamental importance of semiconductors to their economies and provide support through various government interventions.

The UK already has valuable skill sets and innovations across many key areas and we believe that the following measures, together with the several more outlined in this document will significantly advance the sector, enabling our businesses to compete globally and ensure the UK remains a serious player on the world stage.

- Support with CapEx for semiconductor manufacturers and fabless chip companies to upgrade existing or build out new facilities or to invest in new disruptive roadmaps to remain competitive globally.
- Incentivise the domestic market to create local supply chains to build national resilience and retain more value within the economy. Making interventions dependent on domestic supply will increase local collaboration and industry critical mass.
- Increase the supply of truly patient / long-term capital from investors with real-world semiconductor experience and understanding. Doing this in the UK is imperative, not least to reduce the number of businesses being acquired by overseas owners.

Techworks Semiconductor Leadership Group

Techworks Semiconductor Leadership Group consists of executives from across the UK semiconductor value chain and is supported by the Techworks Semiconductor and Deep Tech Trade Association.

Our aim is to work with Government to help identify the strengths and opportunities which face the UK semiconductor sector and provide expert advice and recommendations for directed action which can deliver the most positive impact.



www.techworks.org.uk/semiconductor-leadership-group