

# Considerations For Custom System on Chip (SoC) Decision: A Quick Guide!



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The rapid evolution of technology has led to a surge in demand for high-performance, energy-efficient, and specialized devices. One solution that has gained traction is the custom System on Chip (SoC). However, the decision to invest in custom SoC is not one to be taken lightly. It involves significant costs, long-term planning, and supply chain streamlining. In this article, I share some guidance with the companies that are considering embarking on this journey.

The influence of custom SoCs extends across various sectors, including wearables, automotive, aerospace, and defense, propelling significant technological advancements. In the wearables sector, custom SoCs have enabled the creation of devices with exceptional power efficiency and performance. A prime example is the upcoming Apple Watch's S9 chip, which is expected to deliver even greater performance enhancements while maintaining power efficiency, building on the success of its predecessor<sup>(1)</sup>.



## Is Custom SOC For You?

Here are a few things to consider when you are planning for your new product line based on a custom SoC.



## The Long-Term Commitment

Investing in custom SoC is a long-term decision, often involving a 3 to 5-year commitment. Some product development teams even view this as a time penalty trade-off with the unique feature advancement they hope to deliver. This time encompasses the chip's design, testing, and fabrication, as well as the integration of the chip into the final product. The process requires substantial upfront financial investment, meticulous planning, and an unwavering commitment from the leadership. It is pretty common and easy to pull the plug in haste. It takes leadership to stay the course and keep an eye on the long-term ROI and product roadmap.



## Carving Out From Common Supply Chain

The supply chain complexities for a new product launch are another crucial aspect to consider when planning the use of custom SoCs. The creation of a custom SoC necessitates a dedicated supply chain separate from off-the-shelf chips. This involves sourcing raw materials, managing production schedules, and ensuring the timely delivery of the final product. The complexity of this process can significantly impact the cost and timeline of the project. Often this becomes a high barrier that prevents new entrants from even attempting to build their custom chips.



## Balancing Cost, Time, Investment, And Return

The decision to invest in custom SoC hinges on a nuanced analysis of the cost, time, investment, and potential return. The initial investment in custom SoC can be high, but the potential return on investment (ROI) can be substantial if the unique use case or differentiation brought about by the custom chip justifies the investment.

For instance, Apple's decision to develop its custom silicon, the M1 chip, was a significant investment. However, the performance and efficiency gains from the M1 chip have given Apple a competitive edge in the market, justifying the investment. Now, Apple is doubling down on its custom chip-based line, and its latest M3 chip will bring significant performance and battery life gains on all Macs. The chip is fabricated on TSMC's 3nm process, which will deliver advanced computational and graphical performance<sup>(2)</sup>.



## Advantages Of Custom SoC

Custom SoC offers several advantages, including tighter management of the power-to-performance ratio, product differentiation, and the benefits of owning a dedicated supply chain.



### Power-to-Performance Ratio

One of the primary reasons for companies to choose custom SoC is to optimize the power-to-performance ratio based on their specific needs. This can lead to significant improvements in device performance and energy efficiency. For example, Tesla's custom Full Self-Driving (FSD) chip, designed specifically for autonomous driving, is claimed to have delivered multiple times the performance of previous chips while consuming the same amount of power. Today, Tesla is working on its Level-5 autonomous driving vehicles through custom FSD chips on its HW 5.0<sup>(3)</sup>.



### Product Differentiation

Custom chips also introduce leapfrog advancements in specific areas, such as AI, providing a unique selling point for the product. Google's Tensor Processing Unit (TPU), a custom chip designed for machine learning, has significantly improved the performance of Google's AI services, differentiating Google's products in the competitive tech market. Google calls Tensor a "milestone for machine learning" and has delivered unparalleled results in automatic speech recognition (ASR) supporting its Google Assistant and call transcription feature<sup>(4)</sup>. When OEMs deliver exceptional results to their customers through hyper-specialized chips, they are also able to charge a premium that directly boosts their profitability.



### Dedicated Supply Chain

Owning a custom chip's dedicated supply chain provides a strategic competitive advantage. It enables OEMs to control the production process, ensuring the availability of chips even during global chip shortages. This has been a significant advantage for companies like Apple, which have been able to maintain production schedules despite global chip shortages<sup>(5)</sup>. OEMs have also realized that as the volumes of these custom chips powered lines expand, the cost across the supply chain also drastically reduces.



### Cost-Efficient Solution At High Volumes

Contrary to common perception, investing in high-volume custom SoCs can substantially reduce costs. When tailored for specific high-volume applications, custom SoCs can be more economical, providing savings in unit costs and overall expenses. This is primarily due to the elimination of redundant features present in off-the-shelf solutions, which can lead to wastage of both power and space. Increased levels of integration contribute to higher system dependability. When a multitude of components and solder connections can be condensed and compacted into a fewer number of parts with fewer connections at the board level, the overall reliability of the system is improved. This approach not only strengthens the system but also reduces manufacturing expenses. Utilizing a custom integrated circuit (IC) solution that consumes less power allows the implementation of a more cost-effective power supply. Moreover, the reduction in boards translates to fewer connectors and the ability to use smaller, more budget-friendly cabinets as well<sup>(6)</sup>.



## Challenges In Custom SoC Development

Embarking on the path of custom SoC development is not without its pitfalls. This journey requires significant investment in terms of time and resources. It also needs specialized knowledge and chip design and fabrication skills, which may not be readily available within every OEM. The rapidly evolving technology landscape and geo-political developments can lead to market uncertainties, making it difficult for companies to predict the return on their investment in custom SoC.

Another critical challenge is the commitment of engineering talent. Custom SoC development is a resource-intensive process that can tie up valuable senior engineering resources for extended periods. This can detract from other critical product development efforts, potentially slowing down the overall innovation process within the company.



## Role Of Partner In Custom SoC Development

In such a complex landscape, a trusted partner like Quest Global can provide invaluable support and guidance. Quest Global's expertise in managing the end-to-end SoC development process, from design to fabrication, integration, and delivering tested parts and software, ensures a higher return on investment.

In addition to managing the end-to-end SoC development process, Quest Global has over 25 years of expertise in the realm of niche software development for engineering solutions. Such software, tailored to integrate seamlessly with custom SoC, ensures more coherent and powerful performance. From embedded systems to application-specific software solutions, Quest Global's capabilities augment the functionality and efficiency of custom SoCs, offering a unified solution that transcends chip design.

This comprehensive suite of services from Quest Global ensures not only a smooth transition to custom SoC but also flawless execution to product delivery. Through their long-standing partnerships with Quest Global, our customers redeploy their core engineering teams on new product developments, leading to more efficient use of resources and better business outcomes.



## References

1. <https://timesofindia.indiatimes.com/gadgets-news/apples-next-watch-may-be-its-powerful-ever/articleshow/100100480.cms>
2. <https://wccftech.com/3nm-m3-chip-debut-on-mac-book-air-and-imac/#:~:text=The%20M3%20chip%20will%20bring,advanced%20computational%20and%20graphical%20performance>
3. <https://www.kedglobal.com/korean-chipmakers/newsView/ked202307180017>
4. <https://www.theverge.com/2021/10/19/22710844/google-pixel-6-pro-tensor-processor-ai-speed-specs-details>
5. <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/amid-global-semiconductor-headwinds-apple-finds-solace-in-m1-chip-63877560>
6. <https://www.engineerlive.com/content/custom-mixed-signal-ics-can-be-more-economical-you-may-think>



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