

## Question 1

**What are the factors that need to be considered by a company in deciding between outsourcing their manufacturing process or building their own fab? What does outsourcing the manufacturing process and building a fab mean?**

Before introducing the factors and elaborating them, it is important to understand the crux of the question. We have to first define the question and understand what it is asking for. The question is: What are the factors that need to be considered by a company in deciding between outsourcing their manufacturing process or building their own fab? What does outsourcing the manufacturing process and building a fab mean? According to the information we are given to answer this question: Outsourcing the production of semiconductor may not necessarily move all production to the 3rd party, it may outsource only some parts of the manufacturing process or even certain processing stages. E.g, outsourcing final testing chip to 3rd party before assembly. We acknowledged from this information that only certain parts of the manufacturing process/products are outsourced. However, in our article, we do not concern ourselves with the complexities of having multiple manufacturing processes (we do consider it but it is not our main concern), instead, we go in-depth on the factors of the two options and at the end of the article, there is a recommendation to the company and how they can achieve maximum profit, etc.

The factors which we believe that a company would consider are Cost, Quality, Stability, Confidentiality, Security, Efficiency, Time, and Management.

First and foremost, it is obvious that a company would consider the costs of these operations. What we believe is the most asked question is the comparison of the cost of outsourcing and the cost of building a fab. When a company consider outsourcing, in the short term, outsourcing is cheaper due to the instant production of the company. However, there will be a higher freight inward and contract cost as suppliers may increase prices over time. In the long term, outsourcing may be more expensive than building a fab due to the increasing contract cost racking up over time. When they consider building a fab, there are many factors to consider; taxes, wages, construction and equipment costs. All these factors would add up to approximate \$2 billion.

Secondly, companies would consider the quality produced by the different methods. We shall look at each side very carefully here. When a company outsources their manufacturing processes, the items produced by the vendor may not meet the company's quality requirements, which would cause the company to search for better vendors. Companies and corporations are profit-driven and may not meet the quality standards of the company. Outsourcing companies and some freelancers may often be motivated by profit rather than a job well done. That means the work you send out may come back quickly but will lack the standard and quality that

customers have come to expect from your products or services. Therefore, they may often be motivated by profit rather than a job well done. That means the work you send out may come back quickly but will lack the standard and quality that customers have come to expect from your products or services. However, in the status quo, because companies are profit-driven, they are less incentivised to produce subpar products as it lowers their chances for a prolonged contract or deal. Companies are often in the media's spotlight and when they inefficiently produce products that are subpar, there is often a negative backlash for them. This therefore may cause fewer companies to cooperate with them and thus there will be less profit gained. Hence, quality is a minor issue as profit-driven companies will benefit more from the production of quality products rather than the production of subpar products. To be safe, the company can sign a deal with more respectable companies as they are less likely to produce subpar products. However, this comes at an additional cost, but we believe that it is a necessary evil to ensure the quality of the company's products. The quality of the tools and the capability of the technologies that they are planning to use should be taken into consideration.

If the company builds their fab, it will be able to regulate all the quality and managerial systems of the fab. Managing the fab would allow for the company to reach the quality of products that it requires, it is easier to do so in a fab that the company owns than outsourcing to other fabs. However, we have to ask ourselves if the cost-benefit ratio is worth it. Factoring in the cost of the construction, wages, inventory, non-current assets, etc. This all adds up to a large amount of money for seemingly low benefits. The company may not profit from this project for many years and even if it does, it seems unlikely that the company will be able to match the number of profits than if it were to outsource to other fabs.

Next, the company has to consider the stability of each option. Outsourcing to other fabs is unstable, as the outsourcing company may go through financial, managerial difficulties (recession, change of leadership, etc) creating sudden stop/slow in production. Whereas, building a FAB is more stable than outsourcing as the company would rely on their own equipment and manufacturing processes that they can constantly monitor. However, the company may be overwhelmed by too many of these high-precision processes and management, there may not be a stable leadership/system in the company. This would result in lowered production and in some extreme cases, riot.

Confidentiality and security are very important factors to consider. When the company looks at outsourcing, they have to agree that when working with the outsourcing company, certain areas of production are entrusted to them thus they'll have knowledge on certain sensitive data which they might leak affecting the security of the company. Whereas, if the company Builds their own fab, information and data will be kept within the company thus there are lesser risks of leakage ensuring the confidentiality and security of the company.

Efficiency would also be a factor to consider by the company. Outsourcing may be more production efficient. The company is able to pick outsourcing companies that are specialised in specific parts and thus may be more skilled. While building their own FAB helps reduce the cost of production thus making the products cost-efficient in the long run. But the quality of the FAB may not be as good as the outsourced products as it is not time efficient.

We all agree that companies are profit-driven and time is a major factor as everyone wants to make money fast as well as in the long term. When a company consider outsourcing, the benefits are that the production process of outsourcing is immediate as the outsourced company will start production instantly after the agreement/deal/contract. The company can receive the produced products within a shorter amount of time which would equal a much higher revenue in the short run. When outsourcing to other companies, the company does not have to consider the factor of time. However, the company does have to consider the other factors which we are stating in this article. When a company consider building their own fab, they have to wait for the construction of the fab as well as the recruiting of skilled workers and structuring of the managerial system. In the short run, building a fab is counter-productive as it yields a very low revenue with a very large expense. In the long term, the production of the products will be much cheaper and the overall production cost of the finished product is much lower, which would yield a greater revenue for the company. However, Fab takes a long time (~2years) to build, so benefits can only be reaped after some time. If there is an urgent need for it, it may not be the most practical solution.

Finally, the last factor that we believe a company would consider is the managerial system that is involved in both decisions. In outsourcing, all aspects of that production will be managed and done by outsourcing companies. This may cause friction being created when the companies are unable to come to terms with certain aspects of production which might lead to poor coordination that might affect the delivery/ quality of the products in the long run. There is also the decreased ability to control operations of activities or processes that are outsourced. When a company builds their own Fab, they will have full control over all of the production this will ensure more uniform coordination over the production (more synchronized deliverables: some of the common problem areas include stretched delivery time frames, sub-standard quality output and inappropriate categorization of responsibilities. Thus it might be easier to regulate them within the company itself)

We believe that in the event of having to choose between outsourcing to other companies and building your own, the most cost-efficient and cost-beneficial way is to outsource to other FABs. However, we believe that there is a method to outsource to other FABs which would yield the maximum quality and cost-benefit. How? We have to look no further than in the status quo, companies like Apple, Intel, etc, have been manufacturing their chips in a very similar style. The method is to first outsource to multiple other FABs as an assessment of the quality and management of the FAB. The order does not have to be a very large one, a small one will do as it

is just to assess the capability of the FAB. After narrowing down the FABs to one or two different options, the company can just sign a large contract with them that often is over the limit of the production of FAB. What does this mean? Let's say the FAB has a production capacity of 10 thousand chips per month(120 thousand chips a year), the company will then order 144 thousand chip for the year from the company which is above the limit of the FAB. Why? This forces the company to focus all its products on the company alone instead of having multiple companies to produce goods for. It also forces the company to expand its resources and technology which would increase its production capacity. This essentially binds the FAB to the company and forces them to only produce products for the company. This solves all the problems that are faced by the company about outsourcing to other FABs, not only that, it is very cost and quality efficient as the company already made sure of which FABs have good quality and proper managerial system

For example, let's take a look at Apple, the company responsible for selling phones and computers, etc. They have outsourced their chip production to 9 major companies(which were previously small companies): Foxconn, Wishttron, Pegatron, etc. They have used this method with great success. Apple is currently one of the world leaders in the technological industry and they have amounted to \$104,956 in profits in 2020 (microtrends) This clearly highlights the effectiveness of this method and why it is imperative to use this method for maximum profits.

Research:

- <https://nix-united.com/blog/outsourcing-who-does-it-and-why/>
  - Companies outsource for a multitude of reasons, 59% of companies outsource to reduce costs showing that the cost factor is the main reason companies choose to outsource and 31% to increase the service quality of the products that they are selling
  - **Examples of 'big companies' reasons to outsource.**
    - Though it is a huge company 'Google also understands that even with its size, it cannot do it all. Google outsources so as to access 'the pool of talents and skills, solving capacity issues, improving quality, reducing costs.' By outsourcing Google is able to 'maximize its budget utilization.'
    - Skype is another major company that outsources, and they picked Estonia (East Europe) as a source of talent and brought on several developers to work on the product. The strategy worked for Skype as Microsoft bought them for \$8.5 billion in 2011. Skype outsources because of 'reducing costs, solving capacity issues, accessing the pool of talents and skills.'

- <https://simplicable.com/new/insourcing> (this is not a very good link tho)
  - Companies may choose to insource which is basically to ‘perform functions. Processes and projects with internal sources’ such as building their own fab for various reasons
  - **It has some benefits such as**
    - better direction and control over internal functions that allows them to innovate and improve
    - It also allows us to control information such as ‘trade secrets’ more closely
    - It also gives us a ‘competitive advantage’ because when we outsource we ‘will get the services as other firms’ thus it lacks creativity and innovativeness of our products
  - **It also has some disadvantages**
    - Lack of capability (aka the quality and skill of the workers)

Examples of semiconductor companies (MICRON) choosing to build their own fab for a variety of reasons.

- <https://telecoms.com/507224/huawei-reportedly-starts-work-on-its-own-chip-fab/>
  - Huawei chooses to build their own ‘chip fab’ due to the difficulty they face when outsourcing due to US-China tensions
- <https://www.cnbc.com/2021/03/23/intel-is-spending-20-billion-to-build-two-new-chip-plants-in-arizona.html>
  - Intel also chooses to build their own fab aka 2 new chip plants allocating a budget of 20 billion. Intel has opened factories called ‘wafer fabs’ and ‘Intel’s foundry will offer the U.S. and Europe-based alternative to Asian chip factories.’ so that it can potentially provide resources for other major companies such as Google, which Intel has said could be its potential customer

Recommendation

Apple product chain companies

<https://www.investopedia.com/articles/personal-finance/051915/corporate-tax-rates-highs-and-lows.asp>

Apple annual gross profit

<https://www.macrotrends.net/stocks/charts/AAPL/apple/gross-profit>