An analysis of the semiconductor industry

The semiconductor industry began when the first transistor was built in 1947 by Bell Labs. This first use was as a hearing aid. In 1971 Intel introduces microprocessors which are the “ brains” of the computer onto one chip for the first time. Then in 2005 the semiconductor industry reaches sales of $227 Billion dollars (SIA. 2011). In 2010 the sales were about $300 Billion dollars. The growth of the semiconductor industry has been tremendous.

Semiconductors are everywhere. They are used in computers, electronics, telecommunication, industrial machines, transportation, wireless systems, medical, and military. The semiconductor industry is spread out internationally. There are major manufactures in the United States, China, Japan, South Korea, and Europe. You can see the scope and geography of the semiconductor industry is immense and meets us at nearly every aspect of our lives. It’s hard to comprehend how much of an impact this industry has made on the way we interact with one another on a regular basis.

Semiconductors can do several things. In general, semiconductors process and display information, handle power, store data, condition signals, and alternate between light and electrical energy sources (PPRC, 2008). These processes are unseen but very present in areas mentioned in the above paragraph.

The top three semiconductor producers as ranked by isupply. com are Intel, Samsung Electronics, and Toshiba. Intel and Samsung Electronics are set apart from all the others in terms of revenues as you will be able to see in a graph representing this data within the five forces framework section of the report.

This industry is very competitive. As technology changes consistently, industry competitors fight to bring the latest and greatest products to market. The semiconductor industry is well known for their innovations and volatile environment.

The Industry structure

Supply chain

End products

G-STEP

Global

In the 1980s, Asia was primarily a place for low-cost semiconductor assembly and low-end consumer electronic product sales. Today, the region not only leads in electronic equipment production-from low-end to advanced products-but it is also a significant consumer of sophisticated electronics. China is now the largest market for cellular handsets, representing 20 percent of demand, and the second largest market for personal computers. South Korea has the most advanced nationwide cellular network in the world. The electronic equipment and semiconductor industries have evolved into a truly global market.

Sociocultural & Demographic

Children have started getting exposed to electronic devices at a much younger age, than ever before. The electronic device manufacturers, also, use the technology to create things targeted towards children as young as 2-3 years old. This indicates that the market for these devices is continually increasing, hence, higher use of semiconductors. Another trend that we see

is people switching to smartphones, which again use comparatively more semiconductors that their current phones. In companies, increasing use of cloud computing to store data also helps the sales of semiconductors go up. In general our lifestyle is changing to a world where we use a lot of semiconductors. (Rephrase the last statement)

Efficiency will drive the industry. Lower power consumption wins!

doent really matter, it’s a very global industry. And everyone uses it. The workplace is already filled with people of different ethnicities. (What can I say about it?) (Read income distribution again!)

Technological

The semiconductor industry is heavily driven by the technological advancements in the products, processes and materials within the semiconductor domain. It is the technological upgrade rate that makes the industry highly cyclic. The industry is constantly striving for low cost, high speed, energy efficient and smaller chips. The technological upgrades are a prime reason for the “ barriers to entry” in the fab segment of the industry, as the change of the fabrication process is a very expensive affair.

But since then our public investment levels have been dropping. In 2011, federal investment in research and development has dropped below 1% of GDP.

(http://www. scienceprogress. org/wp-content/uploads/2011/02/SciProgResearchandDevelopment-101. pdf) (Page 3 graph)

With the emergence of associations like SEMATECH, SEMI and SIA some of the burden was taken off of the individual companies.

“ Intellectual property is now much more perishable than ever before and there are too many challenges to solve alone. We must recognize that alliances in the early stages of technological innovation are imperative to achieving breakthrough results that will deliver against the top and bottom line.”

John Warlaumont, VP of Advanced Technolog

http://www. sematech. org/corporate/annual/annual09. pdf

In the semiconductor industry, for example, a confluence of cost, technology and demand trends is creating a shakeout in manufacturing. Indeed, the fixed costs and minimum scale associated with building a new chip fabrication plant have risen almost as precipitously as unit costs (under Moore’s Law) have fallen. As a result, few companies can still make the next leap to fabs costing $4 billion apiece. This has created a new set of “ fabless” semiconductor companies, along with the “ foundries,” which focus on manufacturing chips designed by others. Semiconductor companies will need to carefully weigh their strategy.

http://www. bain. com/bainweb/consulting_expertise/industries_detail. asp?indID= 14

Economic

The economy of the country has an indirect impact on this industry. As the economy does poor the wages go lower, unemployment increases. This in

turn affects the sales of electronic goods in which these semiconductors are used. However, if the economic health of the country is good, the industry is rewarded. The projected growth in the industry from 2011 – 2013 seems to be about 10. 5%.

(http://www. bharatbook. com/detail. asp? id= 87078&rt= Semiconductor-Industry-Forecast-to-2012. html).

During the past recession the wages of the " Silicon Valley tech workers" dropped down by 10%.

(http://www. ecademy. com/node. php? id= 157950)

Political/Legal

In the past five years, information technology, fueled by faster and cheaper chips, has reduced the U. S. inflation rate significantly and has doubled the nation's productivity growth rate.

http://www. sia-online. org/cs/about_sia

" Semiconductor design and manufacturing facilities are strategic to our nation's economic growth. However, our industry is faced with fierce global competition and our policymakers and regulators must ensure that we have balanced tax, regulatory and trade policies to allow our industry to continue to flourish in the U. S. and remain America's largest export industry," Brian Toohey, President SIA concluded in 2010.

http://www. sia-online. org/cs/papers_publications/press_release_detail? pressrelease. id= 1869

The president of SIA proposed a R&D tax credit for the US companies. This is in the favor of the industry, as they can spend more money in R&D. (Recent paper 17th news)

Industry analysis

Financial Performance

Based on the U. S. semiconductor companies revenues and net incomes 2007 – 2010 (Figures A, B,;;) the profit margins in the industry generally low. Some companies like AMD and Freescale were making losses even in 2007 before the recession hit. The three biggest U. S. semiconductor suppliers, Intel, Texas Instruments and Qualcomm, have been profitable during all the last four years. The smaller companies by revenue have clearly had worse financial performance. That suggest that the bigger players would have some advantage.

Of the top three companies Intel is integrated device manufacturer wheras Texas Instruments (Not Fabless IBM REPORT) and Qualcomm are fabless companies (see Strategic Groups section). There is no clear evidence that one of the strategies would be better than the other based on the recent financial performance.

Figure XXX. Top 9 U. S. Semiconductor Companies Revenues and Net Incomes 2007. Data from WRDS COMPUSTAT.

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Figure XXX. Top 9 U. S. Semiconductor Companies Revenues and Net Incomes 2010. Data from WRDS COMPUSTAT. The annual data for the rest of the 9 companies is not currently available.

Market Shares

The Top 20 Semiconductor industry players had a combined 65. 2 % market share in 2010 (Figure XXX). The semiconductor industry overall is very fragmented, especially the product development. However, the amount of cutting edge technology chip manufacturers seems to be decreasing.

Globally American companies hold about half of the market share. Japan and Asia-Pacific companies have about 20 % each and the rest is EMEA companies. Semiconductor business is a very global business. The

importance of Asia-Pacific region has been increasing during the recent years.

Figure XXX. Preliminary Estimate Semiconductor Suppliers Revenue Share % 2010. Data from iSuppli (Ford, 2011)

Figure XXX. Preliminary Estimate of Global Semiconductor Revenue Share % 2010 by Headquarters Location. Data from iSuppli (Ford, 2011)

Porter's Five forces

Threat of New Entrants

Traditionally, because of the huge capital expenditures for startup, it is very difficult for those new entries to be successfully invading the semiconductor industry. Obviously, it is great news for those large companies who can control the market in their favor by using their economies of scale. Besides, the pointed end research and development are other two indispensable barriers for new entries. (Ciolli, 2011)However, recently, with the evolvement of the industry, smaller players could move their attention from manufacturing to research and development. Benefit from the subcontracting of manufacturing, smaller companies has more resources and capital to invest into research of new technologies. The cooperation of subcontracting eased the financial burden of the smaller players and reduced the barrier of semiconductor industry to them. (Investopedia, 2011) This is extremely significant for those smaller entrepreneurial corporations even for the whole structure of the semiconductor industry.

Moreover, except the high technology requirement for new entry, another significant barrier to entry the semiconductor market is the software

compatibility. As a powerful semiconductor player, they are required to not only create physical technology, but also need to design convenient and compatible software which could collaborate with their processors well so customers could enjoy their product. ? What is the source for this paragraph?

Power of Suppliers

In terms of large semiconductor companies, they have inherent advantages when choose suppliers from thousands of them (Investopedia, 2011). The large diversified companies usually use enough number of suppliers to minimize the power of each. However, in the specialized semiconductor industry, in which the “ fabless manufacturing” model is used by most of the companies. As a result, fabless companies play an important role in this specialized sector. Besides, not every sub-contractor has the capability to satisfied the needs of the specialized companies, so suppliers are much powerful than those in the large generic semiconductor sector (Ciolli, 2011). There are several supplier groups present to the semiconductor industry. A few of those groups are; capital equipment makers, suppliers of silicon, chemicals, gases, water, energy, metals and other materials are used in manufacturing semiconductor products (PPRC, 2008).

Rivalry Among Industry Players

The semiconductor industry is very highly competitive. The firms within this industry compete on a daily basis to produce or manufacture a product that is smaller, faster and cheaper. The industry changes rapidly as technology changes rapidly. This keeps it competitive as each competitor can seek and opportunity to create something great before the others do. Within this

competitive industry there is a constant pressure to come up with better products.

The products of this industry are much undifferentiated as the products they are trying to create are essentially improvements to similar products that already exist. The accomplishments of the products change very little. The methods of production is where can see differentiation. The players are trying to come up with innovative ways to do the same things only in a smaller, faster, and cheaper manner (Investopedia, 2010). Comment by Joona: I disagree with this paragraph to some extent. For example ARM has gained very much competitive advantage with is mobile chip technology, similarly Intel has been the number one in the laptop microprocessors becaus of superior product performance

The result of an industry that is this competitive is emerging technology that is cutting-edge. The technology is constantly changing into something better so for competition it makes it hard to remain at the top. What tends to happen in this type of an industry is that there are several industry players with similar size rise as the larger players. This is because no one player can keep excelling with the newest, fastest, and cheapest product available.

The four main products of the semiconductor industry are memory chips, microprocessors, commodity integrated circuit, and complex SOC (system on a chip) which is a combination of a system of semiconductors compacted into one small product. The following are the top ten ranked semiconductor industry leaders as of 2010: Intel, Samsung Electronics, Toshiba Semiconductors, Texas Instruments, Renesas Electronics, Hynix,

STMicroelectronics, Micron Technology, Qualcomm, and Elpida Memory (Ford, 2010). The graph below shows how these competitors are doing against each other in terms of revenue. It gives a basic understanding how they sit against each other and who are the major players.

Figure XXX. Top 20 Semiconductor Suppliers Revenues 2010. Data from iSuppli (Ford, 2011).

Power of buyers

The buyers of the semiconductor industry are endless. There is a buyer at literally every corner. The switching costs of the buyers in the commodity semiconductor market is small as they can purchase from any semiconductor industry player who is representing the lowest cost available as long as the technology is compatible. The strong role of the industry giants like Intel and Samsung limits the bargaining power of buyers. Computers are definitely the largest piece of demand presented by the buyers in 2011, although it is declining due to the rising sales of smart phones and media tablets (Mutschle, 2011). Buyers in the semiconductor tend to be very price sensitive as the industry is constantly producing products at a lower cost to push the demand of their product.

Within the buyers, there are several buyer groups that should be mentioned. The computer industry takes of the bulk of buyer demand, mobile devices and tabloids, and the medical industry to mention a few. These buyers make purchases from the semiconductor industry to continue in daily operations as they are a large part of ongoing business. Joona: This sentence needs clarification.

Threat of substitutes

The industry has the ability to change in a very short time. This takes away opportunities from substitutes to enter the market segment. It would not take the semiconductor industry very long to respond to a successful substitute as they would find a way to produce the product themselves. The problem that would be present is the money constraint. It can be done but at a cost. The industry players can find themselves spending a lot of money to research and develop new products just to find that their competition beat them to it by a few months. This keeps the business environment volatile and competitive. Joona: This paragraph would need some sources to back the claims up. In addition I found it hard to understand some of the logic.

Strategic groups

Joona: This is one way to classify the industry. I don’t know if it is necessarily the best way to do it. Product line based classification is at least one alternative, but it requires some effort.

Groups Based on Level of Vertical Integration

Integrated Device Manufacturers (IDM)

Some companies, such as IBM and Intel, have both semiconductor design and manufacturing capability. They try to achieve efficiency through vertical integration.

Foundry Companies

Merchant manufacturers do manufacturing for companies that do not have own manufacturing capacity. Cutting edge semiconductor manufacturing process technology is getting more and more expensive, and thus less and

less companies can afford to have own production capacity (Jelinek, 2010). The largest foundry company is Taiwan Semiconductor Manufacturing Company (TSMC). It is a pure play foundry, which means that it only offers manufacturing services without designing own products.

Fabless

The fabless companies do not have manufacturing capacity. They design chips and buy manufacturing capacity from foundry companies. The fabless companies do not have as large risks relating to manufacturing technology, but as the amount foundry companies decreases, the foundry companies bargaining power will likely increase. This group includes companies like Qualcomm, AMD, Nvidia, Broadcom and MediaTek (Osborne, 2010).

Key Success Factors

What would it take for some firm to compete successfully in the industry(9)

Joona (these guesses are just out of my head, no sources, no proof of validity):

Ability to constantly develop new, better, cheaper faster designs

Ability to produce breakthrough innovations

Ability to form effective networks and partnerships in order to gain advantage of the resources of the collaborating companies

New opportunities and threats

What are the major emerging trends in the industry that may impact the industry firms in a significant way?(8)

The New Threats and Opportunities

The most critical treat for semiconductors industry is the rapid price declines due to more player enter the market and the substitute products become available. (Joona: Are new players really a threat given the resources and money needed to enter the industry?) The research by Ross Seymore (A Deutsche Bank Equity Research analyst) suggested that compare with the 30% revenue growth in last year, the chip industry faces a 25% revenue drop due to lower average selling prices for chips and the cyclical demand for semiconductors hits a lull. Seymore also mentioned that a largest average selling price drop may be waiting for the the memory segment which could cause risk to margins across the industry following 2010’s record levels as well. (KAWAMOTO, 2011).

However, there are some news opportunities for semiconductors players as well. One is the Smart Grid which could save resources in the busy time to balance the application amount of the power. Currently, about two-thirds of power is wasted because of the power grid aging. Inevitably, those aging power grid will be substituted by Smart Grid, which will give a new profit growth point to semiconductors industry. (Xiaona, 2010) Another significant technical innovation will benefit the semiconductors industry is the Immersion lithography which probably will drive the the lithography solution for semiconductor devices manufacturing in the following generation. Who can grasp this new technology will take a vantage point in the next decade of competition.(JVSTB, 2004)

Joona: We should try to find some “ big picture” opportunities and threats that have could have a significant impact on the industry

Predictions (Next 5 years)

How dynamic is the industry, stage of its life cycle? What is the likely demand situation during the next five years?(7)

High inventory levels in Q4 2010

According to iSuppli the semiconductor suppliers' inventories reached the highest levels in two and a half years during the fourth quarter of 2010. If the the semiconductor industry growth slows in 2011, this could bring troubles to the companies. (Stiefel, 2011) This is another example of the cyclicality and weak predictability of the industry.

Joona: Could we somehow combine this with the previous section.

More predictions needed. My best guess is that the industry is going to end up in a somewhat stable situation. 2010 was a boom because of the recession 2008-2009 and low inventory levels.

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Future : http://isscc. org/doc/2010/ISSCC2010_TechTrends. pdf

http://www. engadget. com/2011/02/19/intel-to-spend-5-billion-on-new-14nm-fab-in-arizona-creating-4/

Ravi: " The fortunes of the semiconductor industries are ultimately tied to the demand of the end products." (Dirk Meyer, president and CEO of AMD, NDTV, interview) http://www. youtube. com/watch? v= dpDx7LPdhqs&feature= related

“ Semiconductor design and manufacturing facilities are strategic to our nation’s economic growth. However, our industry is faced with fierce global competition and our policymakers and regulators must ensure that we have balanced tax, regulatory and trade policies to allow our industry to continue to flourish in the U. S. and remain America’s largest export industry,” Brian Toohey, President SIA concluded in 2010.

http://www. sia-online. org/cs/papers_publications/press_release_detail?pressrelease. id= 1869

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John Warlaumont, VP of Advanced Technolog

http://www. sematech. org/corporate/annual/annual09. pdf