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Case 6: Nvidia

1) Nvidia has shown an exponential growth over the last decade, and its market cap surpassed that of Intel. What are the key success factors for Nvidia? Identify specific growth engines that have fueled the rapid growth.

- In 1993, the three founders of NVIDIA, Jen-Hsun Huang, Chris Malachowsky, and Curtis Prime saw an opportunity with **3D computer gaming**. Although it was a tough market to break into during the first two years, the realization that they needed to update their company's standards helped them make the launch by investing $1 million in graphics card emulation. This move allowed them to release a new graphics chip every 6 to 9 months. In 1999, they were able to raise $42 million, shares closing 64 percent on the first day of going public and trading.
- This led them to expand their company to gaming, professional visualizations, data center, and automotive by 2018. For all of its products, NVIDIA employed a single microarchitecture and invested heavily in R&D.
- NVIDIA also released **the first GPU**, GeForce 256 later in 1999. Not only did it outperform its competitor, but it also allowed the company to enter the computer-aided design market (CAD) due to the transformation and lighting (T&L).
- In 2012, during the ImageNet Competition, NVIDIA's GPU, GeForce 580 GTX, helped aid a Ph.D. student make a breakthrough in the artificial intelligence (AI) world; the network training (deep-learning algorithm), called **AlexNet,** took only days rather than months.
- Another key success factor was Microsoft's approach toward NVIDIA for their Xbox GPU. Microsoft ended up paying the company $200 million along with $48/unit for 5 million GPUs due to their fluctuating decisions between them and Gigapixel. This led to a later issue in 2002 as Microsoft later took NVIDIA to court for their high pricing. Later, NVIDIA obtained 3dfx and Gigapixel's assets, leaving only ATI as NVIDIA's main competitor for GPU.
- Due to Microsoft's demand for full control to avoid the pricing issues that occurred with NVIDIA, ATI was awarded the contract over NVIDIA to design the Xbox 360's Xenon GPU. This, however, led to NVIDIA outshining its competitor as ATI's hardware had defects that infested the program at a high rate, which was later known as the "Red Rings of Death."
- In 2006, AMD and ATI merged but met many struggles. During this, NVIDIA took advantage of their high-tension situation and set in motion the **GeForce G80**. This was a game-changer as the improvements included more cores that allowed them to double the speed of their run-time. With the desire to allow developers to get the most out of the GeForce G80, they also launched the programming model **Compute Unified Device Architecture (CUDA)**. Not only did this model allow programs to run 100-400 times faster, but CUDA also had a widespread ecosystem, such as medicine, chemistry, biology, physics, and finance, allowing various types of developers to use their products. Although there was an issue with the G80

varieties, the G80 started the GPGPU revolution which secured NVIDIA's front-runner position.
- Lastly, NVIDIA's launch of the new **"Tegra" SoC line** allowed entry into the automotive industry. This was due to Audi and Tesla Motor's declaration that they were using the Tegra 3 processor.

2) Recently, AMD and Intel took the GPU market seriously, as the GPU-centric computing became the mainstream. Identify Nvidia's strengths and weaknesses compared to these rivals.
- Strengths: AI, cryptocurrency mining
  - **Professional visualization:** NVIDIA's GPU has an increased processing speed and scalability for AI interface and training. This allowed customers to use their platform for a variety of medical advances. For example, Arterys used the company's GPU for speedy analysis of medical images in the GE Healthcare MRI machines. This assisted medical practitioners in diagnosing heart disease for their patients. Not only does NVIDIA's GPU help in medicine, but NVIDIA's ecosystem is widespread enough that it also helps in chemistry, biology, physics, and finance, allowing various types of developers to use their products.
  - **Data Centers:** Using NVIDIA's GPU for AI allowed deep-learning training (AlexNet). Platforms such as Amazon Web Services, Google *(even with Google having their own hardware Cloud TPU)*, and Microsoft also utilized NVIDIA's data center due to their deep learning applications. Along with this, NVIDIA's bid against Intel and Microsoft for Israel's chipmaker Mellanox in 2019 helped further their product. This union between the accelerated computing platform (NVIDIA) and the accelerated networking platform (Mellanox) powered over 50 percent of "the world's 500 biggest computers and cover and cover every computer producer and major cloud service provider" (Watkins, et al., 2019, pg. 8).
  - **Gaming & Mining:** GPU usage in cryptocurrency mining was NVIDIA's main revenue earner along with gaming. From mining alone, in 2017, JPR research approximated that 3 million GPUs were mined. This was rather significant as the cloud computing market was expected to reach $411 billion by 2020.
- Weaknesses:
  - **High pricing/high development costs:** Microsoft avoided working with NVIDIA a second time due to their high pricing. Their first interaction led to Microsoft taking NVIDIA to court to get some discounts on their supply. Furthermore, due to this, NVIDIA lost its second contract with Microsoft to their competitor ATI.
  - **Automotive:** The Mobileye was bought by Intel which put NVIDIA at a huge disadvantage. Mobileye's EyeQ3 powered Tesla's first autopilot hardware. Intel was also able to succeed in this venture due to its different approach from NVIDIA. Instead of developing the product and launching it themselves, Intel's preference for co-development allowed more flexibility in terms of efficient implementation based on the software.
  - **Gaming:** Although gaming was NVIDIA's main source of revenue, they were labeled as anti-competitive due to their statement against vendors using other GPUs.

3) Do you believe that Nvidia will maintain its market position and rapid growth over the next ten years? What are potential threats and opportunities? Would you be willing to bet on Nvidia?

- Although Google is still using NVIDIA's GPU due to its superior deep-learning applications, they should expect Google to be fine-tuning its model so they don't need to outsource from third parties.
- In addition to Google's impending threat to NVIDIA's success factor, NVIDIA also needs to look out for existing competitors and new competitors. Intel, AMD, and Silicon Valley start-ups such as Wave computing have all declared that their upcoming chips will take less power and will be 10 times faster than NVIDIA's existing products.
- However, NVIDIA is at an advantage in this case due to competitors surrounding their innovations around NVIDIA's current product. Investing in R&D and analyzing future problems could keep NVIDIA ahead of the game.
- NVIDIA should invest more in R&D to maintain its market position and rate of growth. By doing this, they will be able to keep up with the potential innovative competition in the GPU market while also launching new and improved products that their competitors would not be able to match for a year or more.
- Much like Corning, they must be careful not to launch their rather advanced products into the market too soon as this may cause issues with usability, inability to pivot, and more R&D costs due to the potential competition in research. They must launch their new products using incremental actions for revenue and usability.
- Furthermore, NVIDIA would need to consider the issues that future developers would face and create an opportunity by making several hypotheses on their potential necessities. This would be finding outside-of-the-box ideas that include the current need for faster range, cost efficiency, and energy efficiency.
- Another pain point that NVIDIA should consider is their weakness against Intel. The reason Intel beat NVIDIA in the automotive venture for autopilot hardware is due to their flexibility with co-development to match their customer's software. NVIDIA seems to be more set in their own developments, only creating more products to match their customer's software. This is expensive and less cost-efficient for their consumers, making their product less attractive. This could prove detrimental to their future growth as competitors will find a way to take advantage of these pain points.
- To mitigate the potential threats, they should see their existing pain points as an opportunity to pivot market strategy. For example, instead of making products that stack upon each other to fit a certain vendor's software, they should adopt Intel's strategy with flexible co-development or somehow rival it to be more attractive to their customers.
- Lastly, we should also consider the possibility of market saturation as more competitors are entering the market. This could affect growth rate, although perhaps not revenue.