NVIDIA Corporation: A Strategic Audit

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Abstract

NVIDIA is a company that has been involved with the production of computer hardware known as graphics processor units (GPUs) since the turn of the century. Over the past decade, NVIDIA has begun to explore other applications of its proprietary technology, including the fields of artificial intelligence (AI) and accelerated computing. Looking from a business perspective, this strategic audit analyzes the history of the company and its current state, as well as industry outlooks to provide a strategic recommendation. Annual reports, market reports, and press releases were all utilized to provide the best perspective of the industry possible. Though NVIDIA has been performing extremely well recently, a reorganization was proposed. This reorganization moves resources such as people and products around so that the business can operate more efficiently and make the research and development process more streamlined than it was previously.

Key Words: NVIDIA, strategic, audit, business, strategy
Background

History
Founded in 1993 by Jensen Huang, Chris Malachowsky, and Curtis Priem, NVIDIA entered into a highly competitive market with as many as 70 different competitors. In 1995, NVIDIA released NV1, the company’s first product, and has grown steadily since then. With a newly invented graphical processing unit, or GPU, in 1999 NVIDIA went public at $12 per share, and was added to the S&P 500 in 2001. Releasing the Compute Unified Device Architecture, or CUDA in 2007, NVIDIA enabled calculations other than graphics to be run on the GPU, massively increasing the potential uses for their chipsets. NVIDIA chips could now be used effectively in supercomputers, autonomous vehicles, and mobile devices too (NVIDIA History, 2018). With the rise of cryptocurrency, autonomous vehicles, and virtual reality in recent years, more and more computational power is needed. GPUs have become the main source for this computational power, and NVIDIA is uniquely positioned to take advantage.

Markets
Today, NVIDIA divides their business into four distinct markets — gaming, professional visualization, datacenter, and automotive — offering a unique set of products branded specifically for the challenges faced in each market.

The computer gaming industry is the largest entertainment industry, and many factors propel growth. Virtual and augmented reality, eSports, and online competitive gameplay are a few reasons gamers are ever demanding better performance. NVIDIA offers the GeForce GTX line for PC gaming, SHIELD devices for gaming and streaming, GeForce NOW for cloud-based gaming, and often partners with console producers to develop a custom graphics solution.

Professional visualization is another industry that is growing rapidly. Industries like architectural design, medical instrumentation, and aerospace development require designs and simulations that are nearly identical to our physical world. Digital content creators rely heavily on graphical processing through video-editing and post production, special effects, and broadcast-television graphics. NVIDIA offers the Quadro for this market, a card designed to be used in these high-performance workstations.

The datacenter market encompasses NVIDIA’s offerings for the AI and supercomputer needs. CUDA enables the calculations that are required to be offloaded to the GPU, and can process many of them at once, significantly speeding up the process. As development for these technologies ramps up, computers accelerated with NVIDIA GPUs are proving to be more and more useful. For NVIDIA, this market consists of their energy efficient GPUs, the CUDA programming language, specific machine learning libraries, and software products that allow applications to run over multiple GPUs, as well as organization-based and cloud-based supercomputing clusters.

Automobiles are relying on technology more heavily today than ever before, especially as strides towards fully-autonomous vehicles
are being made. Autonomous vehicles will rely heavily on sensor data being interpreted in real-time to make the best possible driving decision every second. To this end, NVIDIA offers several solutions under the DRIVE brand, ranging from infotainment solutions and advanced driver assistance systems to complete autonomous vehicle systems. NVIDIA also has the ability to provide over-the-air updates, adding new features and capabilities to these vehicles (NVIDIA Corporation, 2018).

Product Lines
Though NVIDIA offers a wide array of end-products, they are all based on a single underlying architecture, allowing the company to customize the offerings to their specific application without as significant of an investment. NVIDIA divides their products into two business segments: the GPU and the Tegra processor (NVIDIA Corporation, 2018).

The GPU segment includes the GeForce and GeForce NOW brands for desktop and cloud gaming, the Quadro brand for design professionals, the Tesla brand for AI and deep learning, the GRID brand for datacenters, and the DGX brand for AI scientists and researchers.

The Tegra Processor segment includes the DRIVE brand for automotive supercomputers, the SHIELD brand for mobile-cloud entertainment and gaming, the Tegra processor brand that enables branded platforms like DRIVE and SHIELD, and the Jetson brand that provides an energy-efficient embedded AI computing platform.

Major Issues
The current strategy for NVIDIA hinges on a few key focuses: advancing the GPU computing platform, extending its technology and platform leadership in AI and visual computing, advancing the leading autonomous vehicle platform, and leveraging the intellectual property it already owns. NVIDIA does not manufacture anything directly, instead designs are sent to suppliers specializing in the technologies needed to create these devices, and the products are then tested for quality control.

There are common issues that affect all tech companies, like protecting intellectual property, maintaining strong system security and data protection, and retaining key employees. As a multinational corporation, NVIDIA is also subject to the issues that arise when operating internationally, such as different tax liabilities and government policies. However, there are a few major issues that NVIDIA specifically needs to focus on. Adapting to the needs of the market and identifying new products, services, and technologies is crucial for NVIDIA to stay ahead in the market. If it fails to do this, it will stagnate, and become obsolete. NVIDIA also faces high levels of competition and must deliver superior products consistently to remain an industry leader. A part of the reason NVIDIA has become so successful is consistency, so if the quality drops in either the design or the third-party manufacturing, there will be considerable damage to the

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brand, eroding the consumers’ trust in NVIDIA products. Another major issue is being able to meet consumer demand for the product. If NVIDIA is unable to do that, consumers will likely turn to competitors for similar products (NVIDIA Corporation, 2018).

Situation Analysis

NVIDIA’s actual business operations are uncomplicated: it designs new chips and systems for the various target areas, ships the designs to manufacturers, and then tests the results, iterating on the design and incorporating the latest manufacturing technology to produce the best possible chipsets each year. This contributes heavily to NVIDIA’s brand and reputation, as it consistently churns out high-performance, reliable chips year after year. NVIDIA is also very intentional with branding, often keeping their logo visible whenever possible. The resulting value created for the customer is that the brand is recognizable, reliable and performant. Even if competitors release chips that out-perform NVIDIA’s, consumers are likely to still choose NVIDIA due to its high-quality reputation. By engaging in partnerships with various companies, NVIDIA also can design custom chips for unique applications, delivering a superior experience to the end user, and further increasing its reputation.

NVIDIA spends a bulk of its time in research and development activities, as well as marketing its new innovations. The company also focuses on providing superior service to the end users. This is most visible through the frequent releases of “game-ready” drivers, where popular video games are optimized to run on NVIDIA’s GeForce GPUs.

NVIDIA does not own any manufacturing facilities; instead, it engages in long term contracts with several of the industry’s top suppliers for all parts of the manufacturing process. As a result, it can leverage the suppliers’ expertise to create the highest quality products possible. With manufacturing technology constantly improving, NVIDIA doesn’t have to expend time and capital constantly investing in the latest technology and can instead focus on providing designs that take advantage of said technology. On occasion, NVIDIA will work very closely with a specific manufacturer to release custom editions of its products as well, but the work is still not done by NVIDIA (NVIDIA Corporation, 2018).

External Analysis

NVIDIA mainly competes in two different segments, GPUs and embedded solutions, which aligns with its product segments. In the GPU segment, competitors include AMD, ARM Holdings, and Intel. These competitors produce discrete and integrated GPUs and accelerated computing solutions. In the Tegra segment, competitors include AMD, Broadcom, Intel, Qualcomm, Samsung, and Texas Instruments. These competitors produce devices that are embedded into automobiles, autonomous vehicles, smart televisions, and gaming devices (NVIDIA Corporation, 2018).

NVIDIA competes on two main fronts: quality and service. Because of lofty standards and thorough testing at every step of the process, NVIDIA products are trusted to have high degrees of performance and reliability. Drivers are frequently updated,
and a suite of software products exist to better manage NVIDIA’s offerings.

The GPU industry contains three major competitors: NVIDIA, Intel, and AMD. Intel held a 67.4% market share in Q4 2017, due to dominance in the CPU market and the default inclusion of integrated graphics. NVIDIA held 18.4% of the market, and AMD held the remaining 14.2%. When considering only discrete desktop GPUs, NVIDIA holds a 66.3% market share to AMD’s 33.7%. Market share is down over the last quarter for NVIDIA, due to seasonality of the industry and the pressures of cryptocurrency mining demand (GPU Market, 2018).

Mining cryptocurrency is a computationally expensive process, so miners use GPUs to accelerate those calculations. AMD’s hardware has a performance advantage of NVIDIA’s, and as a result AMD was able to take market share away (Mujtaba, 2018). Both companies have announced that they intend to focus on the consumer gaming industry rather than the cryptocurrency market. Due to high demand and the long production cycle for video cards, there is currently a GPU shortage, causing mid-to-high-tier cards to sell significantly above the original price point. This accounted for inflated revenue for both NVIDIA and AMD over the past quarters. However, if the downward trend of cryptocurrency stocks over Q1 2018 continues, the demand should return to more reasonable levels (Cryptomining Inflated, 2017).

Because of its global nature, NVIDIA must be wary of various international policies, especially those concerning protection of intellectual property. Different countries offer different protections, with the United States having some of the strictest policies, and most easily enforceable. In countries overseas, where the chips usually produced, the policies are not as stringent, so NVIDIA must constantly evaluate the necessary measures to take to protect their designs (NVIDIA Corporation, 2018).

Privacy is a major social issue within the technology industry. Major breaches of social trust, where companies are not protective enough of their user’s data, are likely to become more common, as people continue to put more of their lives online. Luckily chip makers like NVIDIA, AMD, and Intel are mostly protected from these issues because their focus lies in the low-level hardware they produce. However, supplemental software has fallen under scrutiny due to concerns about the type of data being gathered. NVIDIA has promised that any personally identifiable data will never be shared, only allowing partners to see aggregated and anonymized statistics.
like gameplay and hardware configuration (Frequently Asked, 2018).

Artificial intelligence is a rapidly growing technology and popular research topic. This broad area can cover anything from autonomous vehicles to enhanced modelling and decision making. The most practical aspect of AI is currently neural networks, a machine learning algorithm that is trained to recognize patterns between an input and an output and can then begin to predict outputs of any input. The parallel-processing-nature of GPUs allow for thousands of these calculations to be run simultaneously, greatly increasing the viability of AI-related algorithms. NVIDIA made this a possibility with the original development of CUDA in 2007, which unlocked the potential for GPUs to be used for purposes other than graphics. More recently, NVIDIA has focused on offering customized products for a variety of AI applications, and is the only one out of its competition to do so.

For the GPU industry, there is relatively little threat of new entrants into the market. The capital investments required to design and produce GPUs has created a huge barrier to entry. The threat of substitution is higher, but still low because people are going to need GPUs for performance reasons. Given the high number of suppliers in the industry, they have relatively little bargaining power. Suppliers must continually upgrade to the latest technology to be able to compete for contracts. Buyers also have relatively little bargaining power because there are only a few options available, and this is a necessary component for computing. The competitive rivalry is still high between the few companies in the industry, mostly because the cost of switching for consumers is little to none. Discrete GPUs have been developed with standard interfaces, so switching is as easy as purchasing a different one. Quality has been a big focus for NVIDIA, and as a result it has the reputation of producing more reliable chips. When considering GPUs of similar capabilities, consumers often choose NVIDIA even though the price is typically higher because of the reliability. Overall, it appears good to be in this industry if the competition with rivals remains manageable.

**Internal**

In FY 2018, NVIDIA reported $3.8 billion in total liabilities and $7.5 billion in total stockholder equity, giving a debt-to-equity ratio of 50.7%. This is down over the previous year’s ratio of 70.3% and can mainly be attributed to a $1.7 billion increase in retained earnings over the past year without any other significant changes. This is still indicative of a financially stable business, though FY 2018 benefited heavily
from a revenue stream that has proven to be extremely volatile: cryptocurrency. Revenue in the GPU segment has increased from $4.2 billion in FY 2016 and $5.8 billion in FY 2017 to $8.1 billion in FY 2018, due to strong sales of high-end graphics and overall strong demand from the market. It is estimated that revenue from GeForce GPU products increased by over 90% due to cryptocurrency mining. Revenue in the Tegra market has increased from $559 million in FY 2016 and $824 million in FY 2017 to $1.5 billion in FY 2018, indicating that devices and embedded platforms tailored for specific applications have been successful and demand is increasing for these customized solutions. Operating results have fluctuated in the past for NVIDIA, and seasonality plays a significant role in this. Sales tend to pick up in the second half of the fiscal year, and this trend can be seen across the computer entertainment industry. Many video game producers and hardware manufacturers target release dates near the holiday season to attract that crowd and see increased sales as a result.

**Assets**

NVIDIA often takes advantage of leasing whenever possible. The only properties it owns are its headquarter complex in Santa Clara, California, and a research and development facility in Hyderabad, India. It leases various research and development, sales, and administrative offices around the United States, Europe, and Asia, and datacenters around the world. Patents are a significant intangible asset for NVIDIA, with expiration dates ranging from April 2018 to January 2037. These patents range from basic GPU technology to the customized, application-specific devices. Reputation is also a significant intangible asset for NVIDIA, protecting it by enforcing rigorous quality testing. NVIDIA must litigate to protect its intellectual property but is subject to similar suits from competitors and the possibility of unfavorable outcomes. NVIDIA employs

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**NVIDIA Annual Revenue by Segment**

*Figure 3: Revenue has increased over the past 5 years for NVIDIA, with GPUs making up a large portion of that revenue.*
over 10,000 people, with about 70% engaged in research and development, and about 30% engaged in sales, marketing, operations, and administrative positions (NVIDIA Corporation, 2018). This high number of employees means the company can target many different areas that would benefit from GPU technology, but means the company might be slower to adapt to a changing marketplace, and that any restructuring efforts could prove to be costly.

**Competitive Advantage**

To be successful in this industry, all competitors must demonstrate competencies to adapt quickly to the latest manufacturing methods and to continually improve performance. Moore’s law estimates that performance of computers doubles about every two years, due to improvements in fabrication methods and energy efficiency (Britannica, 2017). Competitors must make regular performance increases to keep the hardware they produce following this trend.

NVIDIA also excels in a few distinctive competencies. Support of its products is a main one. Driver updates are frequently released, making sure all devices can take advantage of the latest software optimizations. Long-term warranties, lasting between 1 and 3 years based on the device, are also a great example of support. The 3-year warranty applies to all the discrete GPUs and covers hardware and manufacturing defects (Frequently Asked, 2018). Common advice is to upgrade GPUs when a new card can double or triple the performance of an old card. With that happening every 2-3 years, this warranty covers a good portion of the card’s expected lifetime. Intentional branding has also served NVIDIA well, and it seems to be something that it does better than the other major players. Even though every single one of NVIDIA’s products are based on the same underlying architecture, each device has been optimized for a specific function, and an appropriate brand has been assigned. GeForce for gamers, Quadro for content creation, Tesla for scientists, and DRIVE for autonomous vehicles are all based on a single platform, customized to provide the best experience for the intended use. As a result, reports like a GeForce product functions horribly in a self-driving car or a Quadro product can’t run the newest AAA video game rarely surface. Instead, the products perform excellently at the expected task, further increasing NVIDIA’s reputation. Herein lies NVIDIA’s competitive advantage: with superior branding, reputation, and support, consumers are willing to pay more for a product by NVIDIA than a similar product from a competitor.

As a company, NVIDIA still has room to grow. It has been very successful in the discrete GPU market and has started to branch out into other areas. This seems to be a good fit for where the organization is at, and founder Jensen Huang still seems to be the correct person to lead this company. Huang is best described as a visionary-type CEO, focused on new and exciting innovations that will allow NVIDIA to continue to grow. As a company, it is still expanding into new markets and exploring new products, so overall this seems like a good fit.
Strategy Recommendation

Goals
NVIDIA should have two major goals moving forward. The first one is to maintain its discrete GPU leadership (Chauhan, 2017). For this to happen, NVIDIA will have to consistently provide performance increases in line with competitors. Two metrics to track progress on this goal are market share and benchmarks. NVIDIA has held a majority market share for over a decade, so it is important to maintain. Benchmarking is a process that tests a GPU in various situations and reports a score that can be used in direct comparisons with other GPUs, so metrics should be used to make sure performance improvements continue to match pace with competitors. Acceptable benchmarking scores and market shares will ultimately depend on the specific recommendation. The other major goal for NVIDIA will be to grow the AI and accelerated computing markets. Over 80% of NVIDIA’s revenue comes from the GPU business segment, and it can be assumed that a majority of this revenue stems from discrete GPU sales (NVIDIA Corporation, 2018). By diversifying NVIDIA’s revenue streams, it won’t be as heavily affected in the future by rapidly changing and highly volatile markets such as the cryptocurrency mining market.

Alternatives
Creating hardware for the specific purpose of cryptocurrency mining would be one way to grow and maintain market share in the GPU market. This would allow NVIDIA to recapture market share from AMD, who has released such devices. However, with the recent downturn of the market and the significant investment required to develop specialized hardware like this, it’s possible the market could be non-existent by the time a product would be released. Additionally, NVIDIA has released statements publicly declaring it would support the gaming industry over cryptocurrency, so this action would likely be seen as a hypocritical one and could tarnish NVIDIA’s reputation.

Another alternative would be to expand into CPU development with the purpose of building more efficient CPUs for accelerated computing purposes. NVIDIA has experimented in this area with the development of the Tegra processor for inclusion on the small and energy-efficient embedded platforms, but the development could be expanded to more intensive applications like data centers where physical size is not as much of a limiting factor. Given that NVIDIA’s main competitors AMD and Intel are already heavily invested in CPU development, it is unlikely that NVIDIA would be able to compete with the economies of scale that exist. Since CPU and GPU design are fundamentally different, it is also unlikely that NVIDIA would be able to use any intellectual property to give it an advantage.

In 2007, CUDA was first released, opening the first potential for accelerated computing on a GPU. Ten years later, serious advances have been made, but there are more applications that could benefit from GPU technology outside of AI and computer vision. NVIDIA could work on exploring other applications, outside the current areas. This type of experimental research is difficult to justify to shareholders, though. Since the
company already has 70% of employees engaged in research and development activities, it is unlikely that an increase in resources would yield significantly different results.

**Recommendation**

NVIDIA has been performing well recently, however some improvements could still be made, especially in positioning for the future. Back in a 2002 interview with Wired Magazine, Jensen Huang stated, “Anywhere there's a pixel, that's where we want to be.” With recent announcements of customized gaming monitors, it seems that this vision is still holding true, however there is so much potential from other markets to explore. NVIDIA needs to redefine the focus as an enterprise to be narrower. The goal should be to advance the fields of gaming, artificial intelligence, and accelerated computing using its unique technology, without becoming distracted by development of peripherals. In relation to other organizations, NVIDIA must continue to seek out partnerships, within the gaming and autonomous vehicle industries especially. Remaining relevant in these industries allows NVIDIA to reinforce the brand name it has created for itself.

NVIDIA appears to have two main areas it is focusing on: graphics and accelerated computing. To date, it has been able to utilize a unified underlying architecture and apply it to two very different use cases, however this might not always be possible. Changes in architecture for one application may not be beneficial for the other application. As these markets continue to grow, it will be important for NVIDIA to accept technological advances that might be only be beneficial to one area. NVIDIA should restructure the company and resources to be better aligned with these markets. Operations should be reorganized into two separate segments, and the product lines redistributed accordingly. Furthermore, research and development on the Tegra processor should taper-off, as GPU and CPU design are significantly different, and it is not the best use of NVIDIA’s resources, when partnerships with CPU manufacturers can easily be reached.

This proposed restructure would allow NVIDIA to co-locate people and resources dedicated to solving very similar problems and developing products and applications with very clear overlapping concerns in close proximity to each other. Likely, this organization is already used to some degree, but making it more intentional could enable increased productivity, since more co-workers would be working in the same domain and have a better understanding of the challenges faced. There also may come a time when the underlying architecture will need to split, and if that time comes, allocating resources like this will enable a more efficient transition. By making these two segments more independent, performance can be tracked easier and adjustments can be made easier to achieve a more even distribution of revenue than the estimated 85-15 split currently seen between the GPU and Tegra segments of today.
Implementation

Restructuring and reallocation of resources can sometimes be costly. However, since NVIDIA’s main resources are people, it is a little easier. A plan should be put in place to move people around so that they can be in close proximity to those working on similar areas. The timeline could vary depending on the extensiveness of the reorganization of the work spaces. Moving desks or buildings in the same complex could be accomplished in hours or days. A typical remodeling project could take up to 3-4 months to complete, if the working spaces themselves need to be adjusted. Relocation into other states or countries would probably not be necessary given modern levels of telecommunication connectivity, but could prove to be beneficial, and would likely take 6 months to a year before transitions could be completed.

Since this recommendation looks at adjusting the relative allocation of resources within NVIDIA, some contingency plans should be developed to address possible negative impacts. One possible impact with the increased focus on AI, accelerated computing, and other similar areas is that the gaming and design markets could suffer. As mentioned previously, market share and benchmarking should be used to determine when changes to this plan are necessary. If market share drops below 55% in discrete GPU sales or if competitors’ benchmark scores exceed NVIDIA’s consistently at a similar price, resources should be focused back towards graphics. Losing the edge NVIDIA has maintained over the past 15+ years in both market share and performance would severely impact the profitability of the company. As research turns more industrial in the AI and accelerated computing fields, there will be potential applications for NVIDIA to capitalize on. However, if one year goes by without seeing sustained growth quarter over quarter, the company should re-evaluate the profitability of those markets. These will serve as the trigger points to reallocate resources back towards the more traditional structure the company had, focusing more heavily on the gaming and design markets where profits have been the strongest historically.

Conclusion

NVIDIA is performing well as a company, enjoying increased revenue and high demand for their products. A recommendation to shift the business segments and accompanying resources was made to increase efficiency and streamline operations. This recommendation will also allow the company to be more transparent in its resource allocation, further increasing stockholder confidence. For the most part, no changes to NVIDIA’s operations were recommended due to excellent performance. Overall, NVIDIA is well-positioned to remain a leader of the graphics, artificial intelligence, and accelerated computing industries.
Sources


