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How NVIDIA builds sustainable competitive advantages in the artificial intelligence industry: A case study based on the dynamic capabilities and resource-based view

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Abstract
The fast advancement of artificial intelligence (AI) has created a major shift in worldwide semiconductor industry competition because digital innovation now depends on computing power as its essential strategic asset. NVIDIA started as a graphics processing unit (GPU) manufacturer before it became the main AI infrastructure provider which controls the entire AI ecosystem to achieve market leadership. The research investigates how NVIDIA developed its strategic operations to win and protect its market position during the AI revolution. This case study follows a single-case study approach which tracks NVIDIA's corporate development from 1993 until 2025 through the analytical lenses of Resource-Based View (RBV) and Dynamic Capabilities Theory and Porter's Five Forces Model. The analysis studies multiple aspects which include strategic development and industry position and ecosystem building and resource distribution and financial results. The research identifies three main elements which enable NVIDIA to maintain its market position through sustainable competitive advantages. The company maintains superior dynamic capabilities which allow it to detect and handle technological paradigm changes through its initial backing of Compute Unified Device Architecture (CUDA) and AI computing infrastructure development. The hardware-software system which NVIDIA built creates strong user dependencies through its network effects and switching barriers that protect its market leadership position. The intangible resources at NVIDIA consist of proprietary software platforms and global developer communities and extensive intellectual property portfolios and highly specialized human capital which fulfill all requirements for creating lasting competitive advantages. The financial review shows that NVIDIA achieved strong business results through its fabless operational model and its focus on ecosystem development and its premium product approach which produced high growth rates and strong profit margins and maintained financial stability and delivered superior market value to its investors. The company operates under multiple risk factors which include its concentrated supply network and political tensions between nations and growing government monitoring and new AI accelerator technologies entering the market. The research applies RBV and Dynamic Capabilities Theory to study AI platform ecosystems and high-tech oligopolistic industries which expands the current knowledge of strategic management. The research offers operational guidance to technology companies which need to transform their strategies while building ecosystems and generating lasting value through their fast-developing technological environment.

Keywords: NVIDIA, strategic transformation, dynamic capabilities, resource-based view, ecosystem strategy, artificial intelligence, sustainable competitive advantage

Introduction

The worldwide industrial framework receives its structural changes through the digital economy which applies artificial intelligence to modify both operational systems and competitive market frameworks. The AI industry's core production element depends on computing power which establishes the maximum potential for national technology sectors to achieve their technical capabilities and production amounts and market structure development. The serial computing architecture of traditional central processing units lets them handle logic operations and perform standard computing tasks but they fail to deliver sufficient power for deep learning and extensive matrix calculations and massive multimodal model training. The AI sector demands GPUs because these devices contain thousands of computing cores which operate through parallel processing to handle their complex computational requirements. The worldwide AI computing power now depends on GPUs which operate as the central processing units instead of traditional CPUs. The worldwide GPU sector has developed through its connection to PC entertainment and electronic games and professional design work and supercomputing and autonomous driving and general artificial intelligence because its supply chain expanded into new markets which led to huge market growth. The current industrial transformation reveals NVIDIA as a key company which demonstrates this change. The company started operations through its creation in 1993 by making standalone graphics cards for desktop computers while it built essential technologies and financial resources through its work with gaming industry clients. The company introduced the CUDA general-purpose computing architecture in 2006 which removed the barrier that restricted GPUs to graphics processing only. The AI boom triggered NVIDIA to transform its entire strategic approach which resulted in the creation of a complete business system that serves multiple markets including consumer electronics and professional design and supercomputing and artificial intelligence and autonomous driving and digital twins. During the fiscal year 2025, NVIDIA controlled 94% of the worldwide high-end AI training GPU market which created an absolute oligopoly and made the company one of the leading technology firms based on market value.

The GPU industry operates as a high-tech oligopoly which demands substantial financial input and intense

technological expertise to maintain its position through fast-moving technological progress and continuous industry changes and growing worldwide political conflicts. The strategic transformation process has entered a vital stage for multiple semiconductor design companies together with AI computing startups and established hardware manufacturers who strive to achieve market success. The entire industry faces a shared obstacle because organizations need to handle technological transformations while developing their essential market advantages and establishing industrial networks and operational risk control systems. NVIDIA has undergone three major technological shifts during its thirty years of business existence which started with PC graphics and evolved into general parallel computing and then AI computing. The strategic choices together with resource accumulation and ecosystem layout and operation model of this organization represent essential research elements. Strategic management has researched high-tech dynamically competitive industries because these markets remain a vital focus for strategic management research. The research focuses on NVIDIA as a single case study which uses Industrial Organization Theory together with the Resource-Based View and VRIO framework and Dynamic Capabilities Theory and Product Life Cycle Theory and Porter's Five Forces Model to perform a detailed longitudinal study of high-tech oligopolistic businesses' evolutionary methods and their competitive advantage development and their ecosystem development principles. The research establishes that classical strategic management concepts function within modern semiconductor and artificial intelligence business environments. Industrial Organization Theory explains that corporate profitability depends on external industrial structures while RBV explains that companies achieve sustainable competitive advantages through their unique internal resources. The Dynamic Capabilities Theory shows how companies develop their ability to identify resources which they then combine with their existing assets to transform their business operations during technological progress. The study investigates how external industrial factors affect NVIDIA's internal resources and capabilities through their development methods which show how high-tech industries use these theories in practice.

The research establishes new theoretical frameworks which study how high-tech businesses unite their hardware and software systems into complete operational systems. The current research field concentrates its attention on building ecosystems for standard manufacturing operations and internet-based businesses but lacks sufficient detailed studies about how semiconductor design firms operate through their "hardware chips + software platforms + developer communities" system. The research investigates the development process of CUDA ecosystem while it studies its evolutionary path and money-making system to create a better theoretical framework for high-tech hardware businesses competing through ecosystems. The research expands Dynamic Capabilities Theory by analyzing its application during technological paradigm shifts. The company follows an unusual strategic approach which combines industrial turning points with its established technological path to achieve long-term success although it faces short-term financial difficulties. The research demonstrates how organizations allocate their resources to achieve their strategic goals through their dynamic capabilities which operate in changing environments. The research generates knowledge which future theoretical studies can use as their foundation. The global semiconductor industry faces rising competition along with geopolitical battles and technological limitations and supply chain modifications which create strategic confusion for multiple chip design and AI computing companies. The startup journey of NVIDIA which led to its position as a global leader in computing power provides essential operational insights for businesses that operate in similar fields.

The first reference path in the document allows high-tech businesses to establish their response to technological paradigm transformations. Businesses in fast-changing technological fields observe NVIDIA's approach to developing their CUDA system for long-term organizational success. The company implements its strategic planning through this method which enables businesses to escape their current operational paths while they analyze market developments and develop enduring business strategies. The document presents competitive defense strategies which semiconductor manufacturing businesses can use to protect their market position. The competition system of traditional chip manufacturers functions through hardware performance but NVIDIA creates user switching costs by developing software ecosystems which match their hardware products through a competition system that locks hardware with software. The industry now operates under a new system which combines hardware and software through this competition method. The document provides a standard which fabless businesses can use to enhance their supply chain operations and financial resource distribution. The asset-light fabless model drives NVIDIA to outsource its manufacturing operations while it focuses on research and development activities and ecosystem expansion and maintains production capacity through established long-term manufacturing agreements. Design-based semiconductor businesses can learn from its supply chain operations and capital management approaches. The research document reveals potential threats which might affect businesses that operate within the high-tech oligopoly market structure. The research identifies four major risk factors which affect NVIDIA and its similar business peers through its analysis of industry market cycles and supply chain operations and anti-monopoly enforcement and international political conflicts.

Core Concepts and Theoretical Foundations

Definitions of Core Technologies and Business Models

A Graphics Processing Unit (GPU) functions as an independent computing unit which operates separately from the conventional CPU architecture. The CPU operates through its complicated instruction sets while it follows a sequential processing approach which enables it to handle basic logic operations and perform serial processing and manage task execution. The GPU contains tens of thousands of small computing units which operate together to perform parallel processing at a large scale. The GPU technology which started as a tool for computer graphics and image processing now serves as the fundamental computing system for AI industry through its development in scientific computing and big data analytics and deep learning and autonomous driving applications. The GPU hardware delivers matrix and floating-point operations at speeds which surpass CPU performance by at least twenty times to fulfill deep learning model training and inference requirements. The Compute Unified Device Architecture

(CUDA) is a proprietary general-purpose computing platform and underlying architecture launched by NVIDIA in 2006. The GPU operated only for graphics processing before CUDA appeared because it lacked the ability to perform regular computer tasks. The CUDA programming environment which uses standard programming languages allows worldwide developers to access GPU parallel computing capabilities which transform GPUs from their original graphics purpose into versatile computing hardware. The complete toolchain of CUDA exists today because developers worked on it for almost twenty years to create drivers and compilers and mathematical libraries and AI acceleration libraries and development tools. The worldwide AI software network along with its developer base operates through this fundamental infrastructure which also stands as NVIDIA's most valuable non-physical property.

The semiconductor industry follows the fabless model which represents a standard vertical business structure for dividing work. The model requires businesses to sell their expensive manufacturing facilities which include wafer production and packaging and testing operations so they can concentrate on developing chip designs and software and conducting market operations and algorithm research. Professional foundries handle all wafer fabrication and advanced packaging and testing operations through their complete outsourcing services. The fabless business model operates with minimal physical assets which enable companies to reduce their fixed asset costs and depreciation expenses while enhancing their ability to innovate through technology and their financial resources can be directed toward research and development and market growth. The business model finds its application at top global chip design companies which include NVIDIA and Qualcomm and Broadcom.

Core Strategic Management Theories

Industrial Organization Theory presents strategic management with its basic theoretical framework which explains how external industry structures determine business market positions and financial success. The theory states that businesses need to develop their strategic plans through analysis of their operating industry environment. The total profit potential of an industry depends on how its structural elements including competition levels and market entry restrictions and substitute product risks and supplier and customer bargaining power affect its performance. To gain excess profits, enterprises need to select favorable competitive positions within the industrial structure and reshape the industrial landscape through strategic actions. The main analytical framework of Industrial Organization Theory consists of Porter's Five Forces Model. Porter's Five Forces Model breaks down industrial competition into five separate elements which include existing competitor rivalry levels and new market entry risks and alternative product threats and supplier and buyer negotiation strength. The five forces work together to establish how competitive an industry is and what level of profitability it offers and how attractive the market appears. The five forces in high-tech oligopolistic industries show distinct patterns because three main factors control market competition through entry barriers and hardware-software system differences and supply chain concentration levels. The research uses the model to perform a complete evaluation of the worldwide AI GPU market competition.

The Resource-Based View (RBV) developed by Wernerfelt in 1984 [27] and Barney expanded in 1991 [3] directs research efforts toward corporate internal elements instead of studying external market environments which stands against Industrial Organization Theory. The RBV core perspective states that businesses achieve sustainable competitive advantages and earn excess profits through their diverse internal resources which they cannot transfer to other companies. The company divides its resources into two main categories which include physical assets and financial resources and human capital and patents and brand and organizational culture and ecosystem. The diverse and immobile nature of intangible resources creates conditions where these assets can establish enduring market protection through competitive advantages. The VRIO framework determines if a resource or capability produces enduring competitive benefits through its four evaluation criteria. Firstly, Value: The resource supports businesses to identify market chances while protecting against outside dangers and achieving better operational results. Secondly, Rarity: The resource exists in possession of only a few businesses instead of being widely available to all industry players. Thirdly, Inimitability: The resource remains inaccessible to competitors because they cannot obtain it through duplication or purchase or employee recruitment. Path dependence together with social complexity and causal ambiguity create the main reasons which make things inimitable. Finally, Organization: The resource needs an organizational system which includes structure and management approach and cultural elements to achieve its full potential. The research establishes a new evaluation framework which combines Non-substitutability (N) factor to assess if organizations possess substitute resources or capabilities through their VRIO+N system. The assessment process establishes four distinct resource categories which include competitive parity and temporary competitive advantage and phased competitive advantage and sustainable competitive advantage.

Teece Pisano and Shuen introduced Dynamic Capabilities Theory in 1997 [24] which serves best for businesses that operate in fast-changing technology sectors and experience major shifts in their outside market conditions. Dynamic capabilities represent the full set of organizational abilities which allow businesses to detect market openings and risks and combine their resources to rebuild their capabilities while adopting new technological systems during ongoing environmental changes. The three fundamental elements which make up dynamic capabilities include environmental perception capability and resource integration capability and strategic execution and restructuring capability. Dynamic capabilities serve as essential tools for businesses operating in fast-changing GPU and AI sectors to move through technological transformations while maintaining their market position. The Product Life Cycle Theory explains how products develop through four basic stages which start with introduction and then move to growth before reaching maturity and finally entering the decline phase. The semiconductor industry faces fast product development cycles and quick technological shifts which generate a quick product lifespan for every chip solution. Businesses need to update their products at all times while they offer different types of products to reduce their business risks through an approach which includes multiple product iterations. The research uses this theory to study how NVIDIA develops its products and chooses its target markets.

Case Background: NVIDIA’s Development History, Vision, Mission and Strategic Evolution

Corporate Profile, Vision, Mission and Overall Business Layout

NVIDIA was established during February 1993 in Santa Clara California when Jen-Hsun Huang joined forces with Chris Malachowsky and Curtis Priem to start the company. All three founders boast top-tier electronic engineering expertise and rich experience in the semiconductor industry. The company’s name derives from the Latin word "Invidia", reflecting its ambition to develop disruptive graphics chips and lead the industry. The fabless asset-light model has been NVIDIA's operational approach since its foundation because the company concentrates on chip design and software development and market activities while it sends its wafer production and packaging and testing operations to outside facilities. For more than three decades, NVIDIA has established an in-depth strategic partnership with Taiwan Semiconductor Manufacturing Company (TSMC), which serves as its exclusive core supplier for advanced process technology and high-end packaging. The company has built its technological development and product distribution through its reliable network of supply chain partners. The company developed from its initial position as a PC graphics card supplier into a worldwide leader which operates in accelerated computing and AI computing through various strategic changes and market growth activities. The company operates with a global workforce of 68,000 employees who work at different locations but 42 percent of them belong to the research and development department as of fiscal year 2025. The team operates through four distinct segments which include hardware architecture and software ecosystem and AI algorithms and industrial software to create a unified research and development system which combines hardware with software.

NVIDIA established its corporate vision and mission through various technological changes which moved the company from its previous hardware manufacturing position to define its future organizational goals. Firstly, Vision: To change the way the world experiences computing. NVIDIA uses GPU and AI technologies to create a new computing experience which will transform how people use digital information and drive industrial digital development and establish the company as the top global accelerated computing power. Secondly, Mission: To create the future of computing by accelerating the adoption of AI. The company develops specialized computing platforms which deliver high performance to solve challenging technical problems that standard computers fail to manage including deep learning model training and scientific simulation and autonomous driving and robot simulation and AI technology deployment throughout various settings. The vision and mission statements at NVIDIA direct the company through its core business philosophy which focuses on technological advancement and ecosystem development and sustainable corporate growth. NVIDIA has developed four main business areas through its 30-year history to establish complete accelerated computing system operations which support all operational environments. Firstly, Gaming & Creative Design: The business focuses on consumer GeForce graphics cards which serve PC gamers and professionals who work on film and television post-production and 3D design and animation production. This is NVIDIA’s earliest core business and a stable source of cash flow. Secondly, Data Center & AI Computing: The business operates with three main components which include high-end AI training and inference GPUs and DGX integrated systems and AI software toolchains to serve cloud vendors and AI enterprises and research institutions. The business unit has developed into NVIDIA's primary money-making operation which now drives its major financial growth starting from 2022. Thirdly, Intelligent Vehicles & Autonomous Driving: The DRIVE platform together with in-vehicle computing chips power this system which enables autonomous driving and develops intelligent vehicle interaction and establishes contact between vehicles and road infrastructure. Finally, Enterprise Industrial Software & Digital Twins: The business expands through Omniverse digital twin platform and Cosmos physical AI foundation model to develop intelligent manufacturing and aerospace and robotics and industrial simulation applications which move NVIDIA's business from information AI to physical AI. The four business segments work together by sharing resources which creates a complete business cycle that operates through the single CUDA ecosystem foundation.

Five Strategic Development Stages of NVIDIA (1993–2025)

NVIDIA’s development history spans five distinct phases which emerged from major technological shifts and strategic business evolution and changes in industrial market structures. The following sections describe the market environment together with operational challenges and strategic decisions and management traits which define each stage of development.

Stage 1: Startup and Survival (1993–1997)

The company began its existence during the Startup and Survival period which lasted from 1993 until 1997. The worldwide PC industry experienced a strong expansion during the first half of the 1990s which brought multimedia capabilities and 3D graphics technology into PC development focus. The United States became home to more than seventy startup companies which focused on designing graphics chips. The market operated with multiple independent segments which competed with each other while companies followed different technical standards. The initial startup period of NVIDIA included developers who predicted PCs would become entertainment devices so they focused on making dedicated 3D graphics chips. NVIDIA launched its first commercial product named NV1 chip during 1995 as their debut entry into the market. The company chose to use the unappealing quadric surface rendering system which proved to be a wrong choice for their technical development because it did not work with Microsoft's Direct3D which became the standard for triangular rendering. The NV1 system included too much extra hardware which brought about multiple compatibility problems that destroyed its market position. The company faced partners who stopped working with them while their product inventory stack grew into a major problem which drained their financial resources until their operational funds reached nine months of minimum requirements. The company needed to fire 60% of its workforce during its first survival crisis which threatened to destroy the entire organization. NVIDIA switched its entire business model to support Microsoft DirectX standard and Windows operating system after it faced an existential crisis which threatened its existence. The industry leader 3dfx maintained its

proprietary Glide system which eventually led to their downfall as a company. In 1997, NVIDIA released the RIVA 128 chip fully compatible with DirectX. The product achieved fast market success because of its excellent cost performance which resulted in one million units sold during the first four months while gaining entry to major PC manufacturers' distribution networks including Dell. The company achieved its first annual profit during this phase while it eliminated bankruptcy threats and secured a permanent manufacturing contract with TSMC to build its core supply network. Theoretical models show this stage demonstrates how businesses compete through dynamic systems while they adjust to changing market environments. Small and medium-sized enterprises need to follow industrial standards because their first step to survive and grow in an industry with unstable technical standards and multiple technical paths involves dropping their independent research and development activities.

Stage 2: Establishment of GPU Standards and Industrial Consolidation (1998–2006)

The capital market provided financial backing to NVIDIA through its NASDAQ stock market debut which occurred during January of 1999. The GeForce 256 chip emerged as an official industry standard for Graphics Processing Units (GPUs) when it launched during October of that year. The product achieved graphics computing separation from CPUs through its hardware-based implementation of 3D geometry and lighting computing which created the first independent GPU hardware system. NVIDIA used market differentiation strategies for its product distribution because the GeForce series focused on consumer gaming graphics cards to build its main business. The Quadro professional graphics cards found their way into commercial markets which included industrial modeling and workstation operations and film and television production studios to create a twofold product system which served both consumer and professional segments. 3dfx lost its position as industry leader because the company faced operational problems which stemmed from their decision to block outside technical access while their financial systems collapsed. The year 2000 saw NVIDIA acquire every intellectual property asset together with the core research and development teams from 3dfx which resulted in the disappearance of their primary market opponent. The worldwide discrete graphics card market transformed into a two-player system which consisted of NVIDIA and AMD by 2006 because industrial sectors underwent restructuring and companies combined their operations. NVIDIA established industrial technical standards through its strategic mergers and acquisitions and market differentiation strategies which led to the formation of a new industrial competitive system while reducing competition intensity according to Industrial Organization Theory.

Stage 3: CUDA Layout and AI Technology Accumulation (2006–2015)

NVIDIA reached its strategic turning point during the year 2006. The entire industry dedicated its resources to achieve superior hardware performance in gaming graphics cards which resulted in price battles and uniform market competition. Jensen Huang decided to invest hundreds of millions of US dollars each year into CUDA platform research and development work which he saw as different from the industry standard. He worked to solve GPU graphics restrictions by developing general computing capabilities through GPU parallel processing. The initial stages of CUDA development encountered various obstacles which hindered its progress. The development of a software platform required extended periods to build developer communities but it failed to produce immediate financial gains. The project experienced continuous financial losses which lasted for six years and this situation made investors doubt its viability while company staff members suggested ending the project. The need for additional silicon area to produce CUDA-compatible chips forced manufacturers to increase their production expenses which led to reduced profit margins for their hardware products. The company stuck to its plan of providing free development tools and funding ecosystem development because it helped them build a larger developer community. During this period, NVIDIA launched the Tegra mobile chip to foray into the smartphone market, but encountered fierce competition from Apple and Qualcomm and failed to achieve expected results. The mobile computing technology which Tegra developed created an unexpected base for the autonomous driving DRIVE platform which started its journey on an entirely new path. The industrial sector experienced a major transformation when artificial intelligence technology reached its peak during 2012. The ImageNet image recognition competition showed that AlexNet deep learning model achieved its highest recognition accuracy through two NVIDIA graphics cards which showed how GPUs naturally worked with deep learning systems. Deep learning requires large-scale matrix operations which GPUs perform well because of their parallel architecture. NVIDIA had developed its complete base driver system and compiler and toolchain for CUDA after six years of development. The company introduced the cuDNN deep learning acceleration library which mainstream AI frameworks including TensorFlow and Caffe adopted as their native framework. NVIDIA completed its development process which changed the company from a gaming graphics card producer into an AI computing infrastructure provider. The Resource-Based View shows that NVIDIA chose to lose immediate financial gains because it wanted to create software ecosystems which became its vital combination of intangible assets for future market success.

Stage 4: Rise of the AI Computing Empire and Leadership of Technological Paradigms (2016–2022)

The worldwide cloud computing sector began its fast development after 2016 when major cloud providers started building AI computing server systems which created an entire market for server power rentals. The Pascal and Ampere chip architectures from NVIDIA received dedicated development to enhance matrix operation performance for deep learning applications. The A100 training chip series functions as flagship AI training technology because it contains Tensor Cores which work as AI processors and HBM memory to satisfy cloud service providers and big AI business computing needs. The worldwide success of ChatGPT during late 2022 sparked a worldwide increase in large model research which resulted in customers buying expensive AI training chips while computing resources became deeply limited. The data center business of NVIDIA achieved higher revenue than their gaming division which now generates the most income and profit for the company. NVIDIA created a complete business model which includes hardware chips and software toolchains and DGX integrated

systems to move beyond selling chips into full computing solution provision. The CUDA ecosystem network effects together with user path dependence enabled NVIDIA to establish complete control over the worldwide market for advanced AI training GPUs which established the industry competition structure. NVIDIA used its full range of environmental perception skills and resource integration abilities and business model restructuring capabilities to take advantage of large AI model opportunities while turning its early software ecosystem resources into industrial ecosystem protection through technological advantages.

Stage 5: Full Ecosystem Expansion and Layout for Next-Generation Physical AI (2023–2025)

NVIDIA began its complete ecosystem development and upcoming technology arrangement between 2023 and 2025. The company launched Blackwell and Vera Rubin chip architectures for hardware development which improved training speed of big multimodal model clusters. The company improved its NVLink multi-GPU connection system and optoelectronic packaging techniques while it kept expanding its technological leadership over its market rivals. The gaming business achieved its consolidation through the release of RTX 50 series graphics cards and DLSS 4.5 image technology for consumer markets. The company launched the RTX Spark AI PC which connected terminal AI inference with cloud computing power. NVIDIA used its Omniverse digital twin platform to achieve extensive industrial expansion which now includes physical sectors like intelligent manufacturing and aerospace and architectural design. At the 2025 GTC Conference, NVIDIA released the Cosmos multimodal physical AI open-source foundation model, officially deploying in cutting-edge tracks including embodied intelligence, industrial robots and physical world simulation, realizing the technological paradigm shift from information AI to physical AI. NVIDIA faces three major industrial obstacles which include decreasing returns from large model computing power and fast-paced ASIC development by cloud providers and technology companies and quick progress of new semiconductor businesses. The organization maintains its hardware interconnection system through continuous updates while it develops software ecosystem protection measures and works on future technology layouts to establish permanent market leadership.

Three Core Strategic Logics of NVIDIA

The five development stages reveal that NVIDIA achieved multiple technological cycles through its three-step strategic approach which forms their core competitive philosophy that sets them apart from traditional semiconductor companies. The company established its strategic direction through three consecutive stages which form the foundation of its competitive approach that differentiates it from conventional semiconductor manufacturers. The first step requires businesses to establish their future direction through strategic planning which includes making decisions about their upcoming path. High-tech industries face two major challenges because they operate in an environment with unpredictable technological progress and unsteady market dynamics. Most businesses follow the latest trends but they only focus on short-term profits. However, NVIDIA operates with strong environmental awareness which enables them to make strategic decisions at industrial inflection points. The company stopped creating its own computer systems in 1997 when it started following standard industry norms. The company made a bold move to invest in their unprofitable CUDA project during 2006 against what most industry experts predicted would happen. The company established AI acceleration libraries which they distributed for free to develop their operational systems in 2012. The company followed an independent strategic path which later became the standard approach for technological innovation. The company has made strategic choices which focus on long-term success to drive its various business transformations.

The dual-driving model operates as the second system which drives hardware and software ecosystems. The traditional competition methods of semiconductor chip manufacturers focus on their hardware production techniques and chip output quality because their hardware benefits become obsolete through technological progress. The hardware system of NVIDIA functions as a basic computing structure which they back up with their software ecosystem that brings together developers from all over the world and their end users who create strong obstacles for users to switch platforms. The strategic integration of hardware with software systems produces competitive advantages which exceed the value of hardware specifications because it creates an ecosystem barrier that proves difficult for competitors to overcome. The business operates through an asset-light framework which produces a self-sustaining cycle of business activities. The fabless business model enables NVIDIA to protect itself from factory equipment value drops and factory operational downtime because it directs all its financial resources toward research and development and building its ecosystem for better capital usage. The business logic for software sector adoption rests on free tool distribution to build developer communities which then drives hardware sales through ecosystem feedback that creates a self-perpetuating business cycle which drives worldwide growth.

Industrial Environmental Analysis: Competitive Landscape of the AI GPU Industry Based on Porter's Five Forces Model

The research focuses on the worldwide AI GPU computing market during 2025 while using Porter's Five Forces Model to assess its competitive system and the strength of its five market forces and NVIDIA's active response methods. The worldwide AI GPU market shows a three-level structure which includes complete market control by few players at the top end and partial market competition at the middle level and open market competition at the base level. The business sector allows major profit opportunities to emerge although its concentrated supply network throughout the upstream operations creates the highest level of risk.

Intensity of Rivalry among Existing Competitors: Low with Obvious Tiered Competition

According to 2025 industrial data from TrendForce, NVIDIA holds a 94% market share in the global high-end AI training GPU segment with absolute market dominance. The market shows partial competition at the middle level for inference and edge computing but general-purpose graphics cards in the lower range operates in a fully competitive market. The industry experiences minimal competition between its current players because no intense price

competition has developed within the core profit area which focuses on premium products. Major competitors are listed as follows. Firstly, AMD: The world's second-largest GPU vendor, with an overall market share of approximately 6.5% in AI accelerators in 2025. The Instinct MI series from AMD serves mid-level AI inference operations together with government and enterprise computing requirements. The open-source ROCm ecosystem from AMD exists to challenge CUDA but developers face a major difference because of its smaller developer base and incomplete tool systems and restricted software enhancement options. The company faces obstacles which prevent it from joining the primary market sector that focuses on major model training operations during the upcoming timeframe. Secondly, Intel: Its Gaudi series chips focus on lightweight cloud inference scenarios, with an overall market share below 1%. The combination of hardware design flaws in parallel computing systems together with insufficient software infrastructure prevents Intel from establishing its position in the top-tier market. Finally, Regional Local Chip Vendors: Relying on local policies and geographical advantages, they capture partial shares in edge inference and low-end computing markets. The company cannot break into international markets because it lacks access to modern production methods and faces challenges when building software infrastructure. NVIDIA employs its coping strategy through differentiated competition which emerges from their distinct technological capabilities. The company needs to direct its funds toward the high-end training market because this approach will help them keep their technological advantage and protect their gross profit percentage which stays above 70%. The business should avoid price battles in its base market while working to increase its earnings through its most profitable business segments.

Threat of New Entrants: Extremely Low with Dual Entry Barriers

The high-end AI GPU industry faces two major entry barriers which block new market participants because they need both hardware expertise and software platform control thus creating a locked market with high entry barriers. The market analysis shows two main groups of potential new entrants but they do not present a major threat to NVIDIA's position. Firstly, the top global cloud vendors have created their own chips which include Amazon Trainium and Google TPU and Microsoft Maia. The customized ASICs function to boost internal processing strength but they lack the ability to perform standard computing tasks. The products stay hidden from outside buyers because they lack authorization to enter the third-party general big model training industry. Secondly, the startup companies together with local semiconductor manufacturers struggle to obtain advanced manufacturing systems and build their software platforms which restrict their ability to enter the basic edge computing market but they remain stuck at their current position without any opportunity to move forward. NVIDIA's Defense Strategy: First, shorten the product iteration cycle to one generation per year and raise the time barrier for hardware via continuous technological innovation. Second, the developers need to update CUDA toolchains for free while they build up their user base and create higher switching costs for industry users. Third, deploy a full product portfolio covering top-tier training chips to edge computing chips to squeeze the market space for potential entrants.

Threat of Substitutes: Moderately Low with Partial Scenario Substitution

The primary alternatives to AI GPUs consist of two main options which include ASICs and Field-Programmable Gate Arrays (FPGAs). Substitutes create only particular market changes which do not affect the fundamental market structure thus they present a low general threat level. Firstly, ASICs: The design of ASICs focuses on specific algorithms through their removal of unnecessary components which resulted in lower prices and power needs for dedicated applications like cloud inference and image recognition and they have steadily gained market presence in the mid-level inference sector. The fixed design of ASICs prevents them from handling changing algorithms which use large models or multimodal training so they remain unfit for entry into the core high-end training market. Secondly, the low latency of FPGAs combined with their programming capabilities enables their use in industrial automation and real-time edge inference applications. The devices possess lower computing density than GPUs so they cannot perform extensive parallel computing operations. NVIDIA wants to unite the market for advanced training systems while they should strengthen their standard computing strength to fight back against substitute products which threaten their business. The solution requires companies to develop specialized inference processors which will enable them to shrink their production expenses for ASICs. The company needs to license its chip intellectual property (IP) to principal customers who will develop semi-custom chips through NVIDIA technology to decrease their interest in switching to substitute products.

Bargaining Power of Buyers: Moderate with Differentiated Customer Groups

The market contains two main buyer segments which each possess their own level of negotiation strength while the overall buyer influence remains at a manageable level. Firstly, top cloud vendors: The worldwide market for cloud services belongs to Microsoft Azure and Amazon AWS because they control approximately 40% of NVIDIA's data center business shipment volume. The company holds strong negotiation rights because it purchases many products and because it designs its own semiconductor technology. The vendors depend on NVIDIA's high-performance chips to attract top-tier AI clients but their ability to negotiate remains limited. Secondly, small and medium-sized clients: The group consists of research institutions together with AI startups and IT departments which belong to conventional business organizations. The customers need to buy different items at various times but their actual order quantities remain minimal because no other product exists to match these requirements. The customers possess no negotiation power because they accept all prices without any resistance. NVIDIA needs to establish framework agreements which will last from three to five years with its primary customers to secure permanent business relationships through price-based software customization and service packages. The company needs to choose production capacity as its top priority because this strategy will protect its major clients from price fluctuations. The organization needs to help professional computing cloud service providers which operate in small to medium-sized businesses to enhance their client base while decreasing their need for particular essential clients.

Bargaining Power of Suppliers: Extremely High and the Core Structural Risk

NVIDIA uses the fabless asset-light business model which lets them outsource their wafer manufacturing and advanced packaging and core memory component production to maintain their upstream supply chain concentration. The company faces its main structural risk because suppliers operate with maximum bargaining strength which creates significant challenges. Firstly, wafer fabrication and advanced packaging: TSMC serves as the sole provider of advanced 3nm/4nm process technologies and CoWoS high-end packaging services which NVIDIA depends on. The worldwide supply of advanced process capacity remains tight because TSMC controls all pricing and delivery schedules and capacity distribution since no other suppliers exist for short-term needs. Secondly, High-Bandwidth Memory (HBM): As a core component of high-end AI GPUs, the global HBM market is an oligopoly of SK Hynix and Samsung, with a combined market share of over 90%. Upstream memory vendors reach into NVIDIA's production costs and product delivery dates through their control of manufacturing amounts and their ability to shape market price levels. NVIDIA's Supply Chain Strategy requires the company to deliver major upfront payments while they establish permanent capacity contracts (LTAs) which will secure TSMC's advanced manufacturing capabilities. The company needs to operate two different suppliers for their HBM products because this strategy will create market competition and protect them from sudden supply shortages. The company needs to send its engineering teams to work together with upstream partners for joint research and development activities which will transform their current procurement-based relationship into a mutually beneficial ecological partnership. Overall evaluation: The global AI GPU industry contains few competitive rivals which makes it difficult for new market players to enter while buyers maintain their purchasing power and substitute products remain scarce so the industry offers major profit opportunities through its steady industry competition. Instead of merely adapting to the industrial environment passively, NVIDIA takes the initiative to reshape competition rules through technological innovation, ecosystem construction and business model design. A severe risk exists within the supply chain because three major suppliers maintain total market control.

Analysis of Internal Resources and Competitive Advantages Based on the RBV and VRIO Framework

The Resource-Based View states that businesses create long-term competitive advantages through their unique resources and abilities which they cannot duplicate or transfer to other organizations. This section first sorts out NVIDIA's four categories of core resources, and then evaluates their competitive value via the extended VRIO+N framework to identify the company's core competitive moats.

Inventory of Core Corporate Resources (Fiscal Year 2023–2025)

NVIDIA maintains its fundamental resources through two main categories which include tangible assets and intangible assets. The company operates through four main resource categories which consist of physical assets and financial resources and human capital and various intangible assets.

Physical Resources (Tangible Resources)

NVIDIA operates as a fabless design company which means it does not possess any manufacturing facilities of its own. The company operates physical resources which include laboratories and supply chain rights: first, world-class laboratories located in Silicon Valley, Munich, Taipei and other regions, equipped with flagship GPU systems and NVLink interconnection test clusters to support new architecture and product verification. TSMC maintains its position as the main hardware production supplier because it operates its own advanced process facilities and CoWoS packaging capabilities which it protects through extended contracts and financial deposits.

Financial Resources (Tangible Resources)

The financial strength of NVIDIA has grown fast because AI computing demand reached its highest point. The company generated operating cash flow of 5.641 billion USD during fiscal year 2023 and 28.09 billion USD in fiscal year 2024 and 64.089 billion USD in fiscal year 2025. The company maintained a low asset-liability ratio of 23.1% during fiscal year 2025 because its debt portfolio consisted mainly of operating liabilities without interest charges and it maintained very limited financial obligations which required significant interest payments. The company maintains sufficient cash reserves together with retained earnings and bank credit facilities which enable them to perform their work and make capacity payments and execute their strategic acquisition plans while facing minimal financial risk.

Human Resources (Intangible Resources)

NVIDIA employs 68,000 people across the world while its research and development team makes up more than 42% of the total workforce. The team consists of four groups: GPU hardware architects, CUDA software engineers, AI algorithm experts and industrial software developers, gathering top interdisciplinary talents in parallel computing and AI compilation. The management team under Jensen Huang now leads the company after gaining thirty years of experience in semiconductor industry leadership. The company has established an organizational environment which allows employees to make mistakes while they develop innovative solutions for the long term. The organization maintains its technical knowledge and team-based work system and company values which cannot be duplicated through basic employee recruitment methods.

Other Intangible Resources (Core Competitive Moats)

NVIDIA maintains its core competitive advantages through its diverse intangible assets which include two main elements: First, the company holds intellectual property rights which encompass more than 16,000 worldwide authorized patents that protect its fundamental technologies including GPU architecture and parallel computing and AI acceleration and multi-GPU interconnection systems. The CUDA software ecosystem supports 5.5 million developers who have registered for its platform. The majority of AI projects which operate globally choose to use CUDA for their operations which has created powerful network effects and made users follow set usage paths. The company maintains brand equity through its established global brand recognition which operates in sophisticated computing and AI markets and its ability to set market prices.

Resource Evaluation via the VRIO+N Framework

Physical Resources

The production facilities which include laboratories operate as dedicated resources to deliver valuable results through their operational efficiency and their ability to develop new products. The process and packaging capabilities exist as rare resources because advanced systems remain scarce but standard laboratory equipment stays widely available. The resources which competitors can obtain through financial backing and production agreements become straightforward to duplicate. The organizational system achieves complete utilization of this resource. The replacement process for this resource exists with multiple available options. The physical resources create short-term advantages which fail to develop into permanent competitive barriers.

Financial Resources

The organization holds valuable resources because its financial stability enables it to fund research and development activities and perform business acquisitions while maintaining operational security. The financial structure operates with minimal debt but on a large scale which makes it different from what other companies in the industry normally do. The capital accumulation process of large technology enterprises through financing and operational revenue streams becomes simple for other organizations to copy. The organization has complete capacity to use this resource. The resource exists with limited replacement options. Financial resources create short-lived competitive advantages which serve as defensive strategies instead of becoming fundamental elements of business success.

Human Resources

The research and development teams which belong to the highest level maintain their ability to create new technologies and achieve business growth through their work. The worldwide availability of professionals who specialize in both parallel computing and AI compilation remains extremely rare because of their scarce numbers. The team collaboration system together with organizational values and extended experience in the field create social complexities which produce unexplainable results that cannot be duplicated through expensive employee recruitment methods. The organization operates at its complete potential. The resource exists with limited replacement options. Human resources have passed all VRIO+N assessments which confirms their status as permanent competitive advantages.

Intangible Resources (CUDA Ecosystem + Patents + Brand)

The industry receives its highest value from patents together with ecosystems which create entry obstacles that protect worldwide user access. The worldwide AI computing standard operates through CUDA because it stands as the only system which matches its size. The two decades of ecosystem development have created an unbreakable path which makes it impossible to duplicate the system. The organizational system functions as a foundation which allows the ecosystem to grow and sustain itself. The resource exists with limited replacement options during the initial period. NVIDIA maintains its core sustainable competitive advantages through its intangible resources which simultaneously serve as its industrial defensive barriers. The RBV perspective shows that NVIDIA possesses multiple levels of competitive advantages which exist at different levels. Physical resources together with financial resources generate temporary competitive edges which competitors can duplicate through their own resources. The company maintains its global oligopolistic position through intangible ecosystems which CUDA operates and its top interdisciplinary teams who create barriers through path dependence and network effects and social complexity. High-tech enterprises need to apply their resource allocation system for hardware security and software combination to achieve permanent above-average profits.

In-Depth Financial Performance Diagnosis (Fiscal Year 2023–2025)

Based on NVIDIA’s public financial reports from fiscal year 2023 to 2025, this section conducts a longitudinal analysis from five dimensions: asset-liability structure, solvency, operational efficiency, profitability and cash flow. The analysis reveals how the company's business model together with its strategies produce financial results while identifying operational risks which the company must manage (Unit: million US dollars). The data reveals that NVIDIA experienced massive growth in its total assets together with operating revenue and net profit between 2023 and 2025 while its net profit grew at a 297.3% compound annual rate. The growth rate of shareholders’ equity (125.8%) outpaced that of total liabilities (100.7%), indicating that asset expansion was mainly driven by internal profit accumulation rather than external borrowing. Inventory levels followed market demand but the rate of inventory growth stayed below revenue growth so inventory risks stayed under control. Firstly, short-term Solvency: The quick ratio stood at 4.38 in 2023, 6.35 in 2024 and 7.88 in 2025, all far above the industry safety line of 1.0. The company's current assets consist mainly of cash and marketable securities which provide strong liquidity that eliminates any major short-term solvency concerns. Secondly, long-term Capital Structure: The asset-liability ratio declined from 27.50% to 23.10%. The company expanded its asset base multiple times while the leverage ratio showed a continuous downward trend. The company holds interest-free operating liabilities which include accounts payable and customer advances but it does not have any debts that require interest payments. The business faces no dangerous financial risks which could emerge during the next few years. NVIDIA operates with an appropriate capital structure which serves as its fundamental financial foundation. The business maintains its financial stability because it operates with minimal assets while generating strong profits which create a strong financial safety net.

Conclusions

The research investigation analyzes NVIDIA's strategic development together with its operational success from fiscal year 2023 through 2025 to study how high-tech businesses achieve competitive advantages through their technological leadership. The study identifies four fundamental results which serve as its main findings. The research identifies three main strategic development periods which establish the foundation for long-term business

results. Firstly, the organization developed multiple original strategic plans which it used to handle vital technological transitions between different time periods. The company used its exceptional ability to recognize environmental changes and its strong resource management skills to achieve success in three distinct technological periods which included PC graphics and general computing and artificial intelligence. The company established its initial survival through industrial technical standard compliance before it used its technological understanding to build the CUDA architecture and later capitalized on its technological strengths during the AI industry expansion. The company uses its dynamic capabilities as its core strength to navigate through various industrial transitions which enables it to keep its position as an industry leader. The research proves that Dynamic Capabilities Theory offers effective explanations for high-tech businesses which operate in industries with fast-changing technology. Organizations need to identify environmental shifts while transforming their assets and business structures to maintain their competitive advantage through different market phases. Second, NVIDIA maintains its lasting market dominance through its distinct non-physical assets which operate together with its combined hardware and software platforms. The RBV together with the VRIO+N framework shows that physical and financial resources produce only short-term competitive advantages because competitors can copy them easily yet these resources fail to create enduring competitive advantages. The software environment based on CUDA systems operates with core patents which number in the tens of thousands while top research teams from various fields work together to meet all VRIO framework requirements including non-substitutability. The company maintains its unique core competitive strengths through these elements. This business model uses hardware to serve as the carrier while software functions as the link between components and the ecosystem operates as the boundary which has established new competitive standards that go beyond traditional semiconductor performance evaluation methods.

The industrial sector operates through a small number of powerful companies which maintain full control over the upstream supply chain thus creating major risks for this area. The global high-end AI GPU industry shows high entry barriers and limited competition among peers and threats from substitutes and controllable bargaining power of downstream buyers which creates an industry with abundant profit potential according to Porter’s Five Forces Model analysis. The wafer fabrication and HBM sectors operate through an oligopolistic structure which allows suppliers to control prices and production volumes and product distribution thus creating the main structural risk for NVIDIA and its entire industry. The market share growth generates additional anti-monopoly surveillance while the global semiconductor industry faces growing external operational challenges because of international political conflicts between nations. Finally, the business model together with its strategies generates excellent financial outcomes through their ability to disguise different market cycles which affect various business segments. The financial records from 2023 through 2025 demonstrate that NVIDIA experienced rapid expansion of its revenue and profit and cash flow while maintaining a simple capital structure and strong ability to pay debts and top operational performance in its industry. The company's core business activities generate all of its profit growth which makes it one of the leading technology companies worldwide based on its financial strength. The successful financial numbers of the company hide potential operational performance changes which stem from AI computing infrastructure development and increasing manufacturing expenses and worldwide regulatory restrictions. Organizations need to create permanent systems which will defend their operations from possible threats.

The research conducts an extended single-case study which combines various established strategic management frameworks with semiconductor and artificial intelligence industry characteristics to develop new theoretical frameworks. Firstly, it extends the application scope of the RBV in integrated hardware-software ecosystems. The RBV research field mainly studies physical assets together with basic non-physical assets which appear in manufacturing and standard service sectors but researchers have not studied the combined intangible assets which include "software ecosystems + developer networks" in high-tech hardware businesses. The research uses the VRIO framework to analyze CUDA ecosystem value and rarity and inimitability and organizational ability to use it which shows that developer ecosystems based on network effects and path dependence stand as vital heterogeneous resources in modern digital economy. The research establishes new evaluation criteria for RBV which help high-tech businesses that operate with both hardware and software components to evaluate their performance.

The case study produces additional empirical data which researchers need to understand how Dynamic Capabilities Theory functions during technological paradigm transition. The current empirical research about Dynamic Capabilities Theory studies focus on two main types of organizations which include internet businesses and manufacturing firms that transform their operations. The research uses NVIDIA as a case study to investigate how businesses perform during three essential technological paradigm changes which the company experienced. The research uses NVIDIA as a case study to examine how businesses develop their dynamic capabilities through their entire process of selecting technology routes and their continuous resource allocation and their business model adaptation and their entry into different market sectors. The study demonstrates how businesses use their environmental awareness and resource management and organizational activities to establish new ecosystems which they repeat through their development process during technological industry changes. The study offers a real-world example which researchers can use to study dynamic capabilities of technology-based high-tech companies in future work.

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