

Taxonomy

Defining Traditional HPC and HPDA/AI Subverticals

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HYPERION RESEARCH OPINION

Hyperion Research uses two different vertical and subvertical groups for traditional HPC and for HPDA/AI workloads. Since AI can be used in many verticals, these categories overlap. This document lists the most important HPC use cases corresponding to each traditional HPC vertical (see Table 1) as well as each HPDA/AI vertical. Hyperion Research tracks all quarterly HPC server purchases worldwide under both classification systems, as applicable.

Table 1

Vertical Descriptions

Vertical	Description
Bio-Sciences	Bioscience tasks: genomics, proteomics, pharmaceutical research, bioinformatics, drug discovery
CAE	Manufacturing workloads: finite element analysis, structural analysis, computation fluid dynamics
Chemical Engineering	Chemistry applications not related to biosciences: molecular modeling, computational chemistry
DCC & Distribution	Digital media tasks: rendering, animation, video editing and production, high-end gaming servers
Economics/Financial	Economic analysis: portfolio management, economic modeling, forecasting, financial analysis
EDA	Electrical/electronic tasks: chip design, system modeling, system development and testing
Geosciences	Earth resources–related applications: seismic analysis, reservoir modeling, GIS, mapping
Mechanical Design	Mechanical design applications: CAD and drafting, 3D wireframe, civil engineering
Defense	National security applications: surveillance and signal processing, encryption, geospatial
Government Lab	Government-funded research and development institutions that do not offer degree programs
Academic/University	Scientific research and engineering efforts conducted at institutes of higher education
Weather	Weather-related tasks: atmospheric modeling, meteorology, weather forecasting
Other	Any technical computing workloads not otherwise specified by the previous definitions

Source: Hyperion Research, 2021

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SITUATION OVERVIEW

Hyperion Research conducts extensive market surveys to collect a variety of vertical-specific information such as HPC applications used, current budget sizes, and future purchase plans. Notably, a report dedicated to verticals and applications survey results is published annually as part of the Multi-Client Study (MCS). The most common HPC applications used in each vertical are also available in a separate data construct. Both historical purchase data and collected survey information contribute to the quarterly HPC revenue forecasting, which is also broken out by vertical in the HPC Forecast Database. Descriptions for the major verticals and corresponding subverticals are below (Table 2).

Table 2

Vertical Descriptions

Vertical/Application Area	Description
Bio-Sciences	Bioscience tasks e.g., genomics, proteomics, pharmaceutical research, bioinformatics, drug discovery
CAE	Manufacturing workloads e.g., finite element analysis, mechanical computer-aided engineering, civil engineering, structural analysis, computation fluid dynamics
Chemical Engineering	Chemistry applications not directly related to biosciences e.g., molecular modeling, computational chemistry, process design, chemical analysis
DCC & Distribution	Digital media tasks e.g., rendering, animation, video editing and production, high-end gaming servers
Economics/Financial	Economic analysis e.g., portfolio management, economic modeling, forecasting, financial analysis, back office trading analysis, insurance analysis
EDA	Electrical/electronic tasks e.g., chip design, all forms of IT system design, ISV and software design, system modeling, system development and testing
Geosciences	Earth resources–related applications e.g., seismic analysis, reservoir modeling, mining, natural resource management, GIS, mapping, pollution modeling
Mechanical Design	Mechanical design applications e.g., CAD and drafting, 3D wireframe, civil engineering, storage and access of mechanical designs
Defense	National security applications e.g., surveillance and signal processing, encryption, homeland security, military applications, C3I, geospatial, classified codes
Government Lab	Government-funded research and development institutions that do not offer degree programs for students
Academic/University	Scientific research and engineering efforts conducted at public or private institutes of higher education
Weather	Weather-related tasks e.g., atmospheric modeling, meteorology, weather forecasting, climate modeling

Table 2

Vertical Descriptions

Vertical/Application Area	Description
Other	Any technical computing workloads not otherwise specified by the previous definitions

Source: Hyperion Research, 2021

Major HPC Application/Industry Workload Categories

Hyperion Research identifies and tracks the following technical computing workload segments:

- **Biological sciences.** This workload centers on applications such as genomics, proteomics, pharmaceutical research, bioinformatics, drug discovery, bioanalytic portals, and agricultural research. Computational techniques include database searching and management, molecular modeling, and computational chemistry. These workloads appear in commercial, academic, and institutional research environments. Systems that are specifically targeted for these workloads should be included; systems purchased for more general scientific and R&D environments should be counted in the university and academic, national laboratories and research centers, or national defense segments.
- **Computer-aided engineering (CAE) and product design.** This workload centers on applications such as finite element modeling and analysis, mechanical computer-aided engineering, civil engineering, structural analysis, computation fluid dynamics (CFD), crash testing, NVH, and solid modeling. Like CAD applications, these CAE tasks are used to design automobiles, aircraft, running shoes, ski equipment, sailboards, beer bottles, and other everyday items. Workloads include those tasks generally accomplished by engineers, not drafters.
- **Chemical engineering.** This workload centers on applications such as molecular modeling, computational chemistry, process design, and chemical analysis. It includes all chemistry applications that are not directly related to biosciences research and development. These workloads appear in commercial, academic, and institutional research environments.
- **Digital content creation and distribution (DCC&D).** This workload category centers on applications such as 2D and 3D animation, film and video editing and production, and multimedia authoring for both CD and Web pages that utilize sophisticated graphics content. This category also includes servers used for image rendering, content management, and distribution of finished products for areas such as film, TV, commercial animation, advertising, product styling, and industrial design as well as servers used for large-scale games. These workloads are developed in large part in concert with scientific visualization research and technologies. In addition, the creation of special effects and animation for motion pictures requires significant amounts of computational capacity.
- **Economic and financial modeling.** This workload centers on applications such as econometric modeling, portfolio management, stock market and economic forecasting, and financial analysis. The segment includes both trader and computationally intensive non-trader tasks. In this case, the workload uses technical computing because of the numerically intensive requirements of most applications and their association with economic modeling and simulation-based research.

- **EDA (electronic design and analysis)/IT/ISV.** This workload area covers all electrical/electronic tasks, including schematic capture, logic synthesis, circuit simulation, PCB routing, and system modeling. It also includes the use of technical servers within IT manufactures for R&D, system development and testing, application development, software development, and other product design and testing. Systems used by independent software vendors for software development are also included.
- **Geosciences and geoen지니어ing.** This workload includes earth resources-related applications such as seismic analysis, oil services, and reservoir modeling. These applications are used in both institutional research and commercial enterprises. Geosciences can also include areas such as mining, natural resource management, geographic information systems (GIS), and mapping.
- **Mechanical design.** This workload focuses on computer-aided design (CAD) and drafting. It centers on applications such as mechanical computer-aided design; 2D, 2.5D, and 3D design and drafting; and 3D wire frame. Design and drafting applications require graphics capability but are less compute intensive than design engineering and analysis applications (see "CAE: Product Design" above). CAD tasks are typically performed by designers and drafters and are often used in conjunction with CNC machines. Users are found primarily in manufacturing industries such as automotive, aerospace, heavy machinery, and consumer goods.
- **National defense.** This workload centers around applications such as surveillance and signal processing; encryption; command, control, communications, and intelligence (C3I); geospatial image management and analysis; defense research; weapons design; and other national security applications. In addition, national security organizations may field applications that work to identify and track potential security threats through database-oriented pattern-matching applications. Although these applications may not always be numerically intensive, they will be developed and used by organizations that are firmly rooted in technical computing markets. In many cases, these applications will be run in conjunction with traditional security applications such as cryptography and image analysis.
- **Government laboratories and research centers.** This workload centers on government-funded research and development institutions. These organizations are generally funded at a state, national, or multinational level and may combine purely scientific research with research in areas of national priority (e.g., cancer research) and/or research for defense-related programs. These users are less bound by strict economic constraints than those in commercial development environments. These centers normally do not offer degree programs for students. Universities that receive major government funding are included under academic/university.
- **Academic/University.** This workload centers on scientific research and engineering R&D efforts conducted at public or private institutes of higher education and includes systems sold for both research and educational activities. Privately funded and/or nonprofit research institutes that have a strong academic mission (i.e., work to extend the bounds of public knowledge) are also included in this segment. Applications are typically compute or data intensive and often require high-performance graphics. These users are less bound by strict economic constraints than those in commercial development environments. This segment includes NSF sites that are located at universities.
- **Weather forecasting and climate modeling.** This workload centers on applications such as atmospheric modeling, meteorology, weather forecasting, and climate modeling. This segment includes systems dedicated to these tasks primarily in the government and defense segments.
- **Other.** This segment includes any technical computing workloads not otherwise specified by the previous definitions.

Bio-Sciences

This workload centers on applications such as genomics, proteomics, pharmaceutical research, bioinformatics, drug discovery, bio-analytic portals, and agricultural research. Computational techniques include database searching and management, molecular modeling, and computational chemistry. These workloads appear in commercial, academic, and institutional research environments. Systems that are specifically targeted for these workloads should be included; systems purchased for more general scientific and R&D environments should be counted in the university and academic, national laboratory and research center, or national defense segments.

- **Genomics:** a branch of biotechnology concerned with applying the techniques of genetics and molecular biology to the mapping and DNA sequencing of sets of genes or the complete genomes of selected organisms, with organizing the results in databases, and with applications of the data (as in medicine or biology). HPC clusters are often used to process the results of purpose-built gene sequencing machines.
- **Proteomics:** a branch of biotechnology concerned with applying the techniques of molecular biology, biochemistry, and genetics to analyzing the structure, function, and interactions of the proteins produced by the genes of a particular cell, tissue, or organism, with organizing the information in databases, and with applications of the data. HPC systems are often used to process the associated large data sets.
- **Drug Discovery:** In the fields of medicine, biotechnology and pharmacology, drug discovery is the process by which new candidate medications are discovered. Historically, drugs were discovered through identifying the active ingredient from traditional remedies or by serendipitous discovery. HPC systems are used to quickly test large numbers (often millions) of drug candidates (small molecules) for lock-and-key fit with disease agents.
- **Bioinformatics:** the application of computer technology to the management of biological information. Computers are used to gather, store, analyze and integrate biological and genetic information, which can then be applied to gene-based drug discovery and development.
- **Agricultural Research:** the application of computer technology to the science of optimizing agricultural production and quality.
- **Epidemiology/Public Health:** the study of the etiology and spread of disease outbreaks that affect, or threaten to affect, large segments of a population. Public health is a general term for the study of phenomena that affect the health of a human population.
- **Precision Medicine:** a medical model based on customizing healthcare, with medical decisions, practices, and products tailored to the individual patient rather than on a set of standardized procedures applicable to all patients. HPC is helping to lead the way toward precision medicine, especially through DNA sequencing and acting as a decision-support tool for physicians and other providers.

CAE: Product Design

This workload centers on applications such as finite element modeling and analysis, mechanical computer-aided engineering (CAE), civil engineering, structural analysis, computation fluid dynamics (CFD), crash testing, NVH, and solid modeling. Like CAD applications, these CAE tasks are used to design automobiles, aircraft, running shoes, ski equipment, sail boards, beer bottles, and other everyday items. Workloads include those tasks generally accomplished by engineers, not drafters.

- **Structural Analysis:** the determination of the effects of loads on physical structures and their components. Structures subject to this type of analysis include all that must withstand loads,

such as buildings, bridges, vehicles, machinery, furniture, attire, soil strata, prostheses, and biological tissue.

- **Fluid-Structure Analysis:** the determination of the combined effects of loads and the fluid flows (air, water, etc.) on physical structures and their components.
- **Crashworthiness:** the ability of a structure to protect its occupants during an impact. This is commonly tested when investigating the safety of aircraft and vehicles.
- **Combustion Design/Testing:** the evaluation and optimization of a combustion reaction, such as in an automobile engine. Used to test and improve the performance of fuel-burning machinery and equipment.
- **Noise/Vibration/Harshness:** the study and modification of the noise and vibration characteristics of vehicles, particularly cars and trucks. While noise and vibration can be readily measured, harshness is a subjective quality and is measured either via "jury" evaluations or with analytical tools that can provide results reflecting human subjective impressions.
- **Aerodynamics:** the study of the physical properties of air, including its interactions with objects such as aircraft. HPC simulations can be used to safely test the flightworthiness and optimization of an experimental craft.
- **Environmental Friendliness:** a term that refers to goods and services, laws, guidelines and policies that inflict reduced, minimal, or no harm upon ecosystems or the environment. HPC systems are routinely used to improve the environmental friendliness of vehicle designs.
- **Materials Science:** the scientific study of the properties and applications of existing and new materials of construction or manufacture (such as ceramics, metals, polymers, and composites).
- **Autonomous Vehicles:** autonomous vehicles can operate independently to some extent but may be aided by limited human intervention or supervision. Involves generating real-time decisions on speed, direction, path, hazard detection, object avoidance, and more.
- **Smart Cities:** a city that uses "smart" technology to address city planning or operational problems such as optimization, development, or automation of traffic lights that respond to traffic in real-time. Often involves collecting and processing large amounts of data collected by sensors throughout the city.

Chemical Engineering

This workload centers on applications such as molecular modeling, computational chemistry, process design, and chemical analysis. It includes all chemistry applications that are not directly related to biosciences research and development. These workloads appear in commercial, academic, and institutional research environments.

- **Chemical Process Engineering:** the development and optimization of processes used to convert raw materials into finished products.
- **Molecular Modeling:** a technique for deriving, representing, and manipulating the structures and reactions of molecules and those properties that are dependent on these three-dimensional structures.
- **Chemical Analysis:** determining the chemical composition of a material. Can be used to identify a substance, determine a material's physical properties, or evaluate the quality of a product.

DCC (Digital Content Creation) & Distribution

This workload category centers on applications such as 2D and 3D animation, film and video editing and production, and multimedia authoring for both CD and Web pages that utilize sophisticated graphics content. This category also includes servers used for image rendering, content management, and distribution of finished products for areas such as film, TV, commercial animation, advertising, product styling, and industrial design as well as servers used for large-scale games. These workloads are developed in large part in concert with scientific visualization research and technologies. In addition, the creation of special effects and animation for motion pictures requires significant amounts of computational capacity.

- **3D Animation/Special Effects:** the production of 3D animated video content or post-production special effects such as green screens or explosions. Production-quality effects often must be very detailed and require significant computing resources to achieve the desired resolution.
- **Film Editing/Production:** editing raw footage into a finished product such as combining videos from different camera angles or adjusting frame rate, color, lighting, or sound.
- **Advanced Rendering:** the generation of images from a model. This can be compute-intensive at high levels of resolution when taking into account details such as texturing, lighting, shading, and so on.
- **Film/Video Distribution:** the distribution of media such as streaming of movies, television shows, or short video clips. HPC may be used for the storage and real-time access of such media.
- **Advanced Gaming with Central Servers:** video games that rely on central servers for synchronization between players playing remotely, such as massively multiplayer online (MMO) games.

Economics/Financial

This workload centers on applications such as econometric modeling, portfolio management, stock market and economic forecasting, and financial analysis. The segment includes both trader and computationally intensive non-trader tasks. In this case, the workload uses technical computing because of the numerically intensive requirements of most applications and their association with economic modeling and simulation-based research.

- **Portfolio Optimization:** the process of choosing the proportions of various assets to be held in a portfolio in such a way as to make the portfolio better than any other according to some criterion. The criterion will combine, directly or indirectly, considerations of the expected value of the portfolio's rate of return as well as of the return's dispersion and possibly other measures of financial risk.
- **Pricing Exotic Instruments:** a derivative that is more complex than commonly traded "vanilla" products. This complexity usually relates to determination of payoff. The category may also include derivatives with a non-standard subject matter (i.e., underlying) developed for a particular client or a particular market.
- **Global Risk Management:** management of the worldwide financial risk incurred at any point in time by a company that trades stock, bonds, or other financial instruments, based on calculating the aggregate risk incurred by all of the firm's traders.
- **Economic Modeling:** prediction of future economic conditions through the use of a model, often in order to make financial or fiscal decisions. HPC can be used to optimize model generation for accuracy and simplicity.

EDA (Electronic Design and Analysis)/IT/ISV

This workload area covers all electrical/electronic tasks, including schematic capture, logic synthesis, circuit simulation, PCB routing, and system modeling. It also includes the use of technical servers within IT manufacturers for R&D, system development and testing, application development, software development, and other product design and testing. Systems used by independent software vendors for software development are also included.

- **Schematic Capture:** the creation of an electronic design model, called a schematic capture, that represents an electronic circuit.
- **Logic Synthesis:** the stage of electronic circuit design where a model called a register transfer level (RTL) is converted into an optimized logic gate representation.
- **System Modeling/Testing:** the production and testing of system models, such as functional or architectural models.
- **ISV and Other Software:** the development, testing, and commercial sale of application software.
- **System Vendors/OEMs:** the development and testing of new computer systems.
- **CSP (Cloud Service Providers):** only computers used for their internal operations, such as R&D.
- **IOT Devices and Systems:** a network of "things" (e.g., devices, sensors) capable of collecting, transmitting, and/or processing data to accomplish a task, usually needed in near-real time.
- **Other Types of IT & Telecom:** other workloads not listed above, such as the processing and transmission of data over the internet.

Geosciences

This workload includes earth resources-related applications such as seismic analysis, oil services, and reservoir modeling. These applications are used in both institutional research and commercial enterprises. Geosciences can also include areas such as mining, natural resource management, geographic information systems (GIS), and mapping.

- **Seismic Processing:** processing seismic data to reduce noise and enhance signal. Aims to improve the quality of the data to be used for interpretation.
- **Reservoir Modeling:** 3D modeling of a reservoir, such as petroleum, that takes into account the physical and chemical properties of both the material in the reservoir and the earth surrounding it. Such models are used to predict future production of the reservoir and inform development decisions.
- **Other Types of Earth Modeling:** includes all types of earth modeling except reservoir, weather, and climate modeling. Environmental agencies like the EPA also use HPC to develop a variety of models for assessing and predicting earth-related public health risks such as air quality or pathogens on recreational beaches.

Mechanical Design

This workload focuses on computer-aided design (CAD) and drafting. It centers on applications such as mechanical computer-aided design; 2D, 2.5D, and 3D design and drafting; and 3D wire frame. Design and drafting applications require graphics capability but are less compute intensive than design engineering and analysis applications (see "CAE: Product Design" above). CAD tasks are typically performed by designers and drafters and are often used in conjunction with CNC machines. Users are

found primarily in manufacturing industries such as automotive, aerospace, heavy machinery, and consumer goods.

- **CAD and Drafting:** the creation and analysis of an edge or skeletal representation of a real-world object in 2D, 2.5D and 3D.
- **3D Wireframe:** the analysis of an edge or skeletal representation of a real-world object. 3D wireframe models consist of points, lines, arcs, circles, and other curves that define the edges or center lines of objects.
- **Storage and Access of Mechanical Designs:** the use of HPC servers to store and access mechanical designs.
- **Civil Engineering Design:** design for civil engineering purposes, such as structural and stress analysis for large applications such as bridges or buildings.

Defense

This workload centers around applications such as surveillance and signal processing; encryption; command, control, communications, and intelligence (C3I); geospatial image management and analysis; defense research; weapons design; and other national security applications. In addition, national security organizations may field applications that work to identify and track potential security threats through database-oriented pattern-matching applications. Although these applications may not always be numerically intensive, they will be developed and used by organizations that are firmly rooted in technical computing markets. In many cases, these applications will be run in conjunction with traditional security applications such as cryptography and image analysis.

- **Surveillance/Signal Processing:** surveillance is the close observation and tracking of the behavior of suspect individuals or groups. Signal processing is an enabling technology that encompasses the fundamental theory, applications, algorithms, and implementations of processing or transferring information contained in many different physical, symbolic, or abstract formats broadly designated as signals.
- **Encryption:** the process of encoding a message so that it can be read only by the sender and the intended recipient. Decryption is the process of reading the message by applying the secret code.
- **Communications Intelligence:** information gathered from the communications of individuals, including telephone conversations, text messages, and various types of online interactions.
- **Anti-Terrorism:** activity aimed at identifying and counteracting sources of manifest or potential terrorism.
- **Geospatial Image Management & Analysis:** geospatial images may include traditional photographs, multispectral or hyperspectral images such as infrared scans, or 3-dimensional models such as elevation maps. At high levels of detail, HPC may be needed to store and manage such data. HPC may also be used for analysis such as combining several sources of images into a more detailed model, detecting abnormalities, or tracking changes in such images over time.
- **Weapons Development:** modeling, developing, and testing weapons. Applications used often overlap with other verticals such as chemical analysis or mechanical design, but this vertical is distinguishable by the purpose of such applications.
- **Warfighter Support:** support of people and other resources engaged in combat.
- **Law Enforcement and Homeland Security:** refers to the use of HPC resources to carry out or support law enforcement, such as for national fingerprint or DNA databases.

- **Other Defense:** any other defense applications not listed above, or defense applications that are not specified due to security reasons.

Government Lab

This workload centers on government-funded research and development institutions. These organizations are generally funded at a state, national, or multinational level and may combine purely scientific research with research in areas of national priority (e.g., cancer research) and/or research for defense-related programs. These users are less bound by strict economic constraints than those in commercial development environments. These centers normally do not offer degree programs for students. Universities that receive major government funding are included under academic/university.

- **Scientific Research:** pursuing advances in fields of science - this is the main activity of most government labs.
- **Stockpile Stewardship:** testing and maintaining the stockpile of nuclear weapons, now decades old. Computer-generated models are used instead of physical tests to predict the reliability and safety of the stockpile. HPC is used to provide the highest resolution and accuracy to such simulations.
- **Industrial Partnering:** refers to collaborations between government labs and private sector HPC vendors or users.
- **National Programs:** programs on a national scale utilizing HPC, often supported by one or more government agencies. Focus is on science and engineering efforts of national economic and/or security interests.
- **New Technologies:** the exploration and development of emerging HPC technologies such as AI, ML, DL, and quantum computing.

Academic/University

This workload centers on scientific research and engineering R&D efforts conducted at public or private institutes of higher education and includes systems sold for both research and educational activities. Privately funded and/or nonprofit research institutes that have a strong academic mission (i.e., work to extend the bounds of public knowledge) are also included in this segment. Applications are typically compute or data intensive and often require high-performance graphics. These users are less bound by strict economic constraints than those in commercial development environments. This segment includes NSF sites that are located at universities.

- **Scientific Research:** research into any scientific discipline using HPC. A primary purpose of most academic institutions. Oftentimes a single university conducts research into many different scientific disciplines simultaneously through different departments. This includes professors' and students' use of HPC.
- **Industrial Partnering:** a joint partnership between university and industry site that utilizes the university's HPC resources. Such partnerships combine R&D efforts of both parties for mutual benefit.

Weather/Climate

This workload centers on applications such as atmospheric modeling, meteorology, weather forecasting, and climate modeling. This segment includes systems dedicated to these tasks primarily in the government and defense segments.

- **Weather Forecasting:** the prediction of future weather attributes such as temperature and precipitation at a given location. Includes historical weather analysis of both long-term and seasonal weather patterns, as well as analysis of detailed near-term data in the region.
- **Climate Research:** the use of HPC to study the dynamics and effects of past and ongoing climate change, and to predict future change.

Other

This segment includes any technical computing workloads not otherwise specified by the previous definitions. Retail and marketing is one of the main application workloads included in this category, as is transportation and logistics.

- **Transportation and Logistics:** transportation and logistics tasks such as package routing, traffic management, pattern recognition, and linear programming.
- **Retail and Marketing:** a variety of retail-related applications such as affinity marketing, targeted advertising, and prediction of future sales.
- **New Non-Traditional Applications:** new applications in traditionally non-HPC enterprise space, such as business intelligence.

FUTURE OUTLOOK

The future outlook in each vertical varies over time. Current projections for each vertical area are produced quarterly and available separately in the HPC Forecast Database or through an HPC Market Update Briefing. However, HPDA and AI verticals in particular are rapidly evolving. There is major overlap between the HPC verticals and the HPDA/AI verticals, as described below.

High Growth Area: HPDA/AI Verticals

HPDA and AI are both important subsets of the HPC server market. High performance data analysis (HPDA) and AI are forecasted to have particularly high growth over the next several years, outperforming even that of the HPC market writ large. HPDA and AI applications are used in a variety of settings, so they often intersect with the major verticals (see "Major HPC Application/Industry Workload Categories" above). Because HPDA/AI is a specialized field, it also has correspondingly narrow application areas. Table 3, below, describes the most promising application areas within HPDA/AI. These HPDA/AI use cases also overlap with major verticals listed above, as shown in the second column of the table.

Table 3

HPDA/AI Vertical Descriptions and Commonly Associated Major Verticals

HPDA/AI Vertical	Related Major Verticals	Description
Precision medicine	Bio-Sciences	An emerging approach for disease treatment and prevention that considers individual variability in genes, environment, and lifestyle for each person
Automated driving systems	CAE: Product Design	Vehicles that can operate independently to some extent, perhaps aided by limited human intervention or supervision

Table 3

HPDA/AI Vertical Descriptions and Commonly Associated Major Verticals

HPDA/AI Vertical	Related Major Verticals	Description
Fraud and anomaly detection	Economics/Financial and most other verticals	Analysis to recognize potentially fraudulent activity, performed quickly enough to take action on the identified anomalies
Affinity marketing	DCC and Distribution	The process of leveraging an ever-expanding number of consumer attributes to analyze and extract distinct patterns and traits with the end goal of unique targeting of messages and campaigns to like-minded groups and specific individuals
Business intelligence	Economics/Financial	Targeted data analysis to inform specific business decisions
Cybersecurity	Defense, Economics/Financial	Protection of networks, devices, and data from cyberattacks such as data theft or corruption
Internet of Things (IoT)	EDA/IT/ISV, Government Lab	A network of "things" (e.g., devices, sensors) capable of collecting, transmitting, and/or processing data to accomplish a task, usually needed in near-real time

Source: Hyperion Research, 2021

About Hyperion Research, LLC

Hyperion Research provides data-driven research, analysis and recommendations for technologies, applications, and markets in high performance computing and emerging technology areas to help organizations worldwide make effective decisions and seize growth opportunities. Research includes market sizing and forecasting, share tracking, segmentation, technology and related trend analysis, and both user & vendor analysis for multi-user technical server technology used for HPC and HPDA (high performance data analysis). We provide thought leadership and practical guidance for users, vendors and other members of the HPC community by focusing on key market and technology trends across government, industry, commerce, and academia.

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