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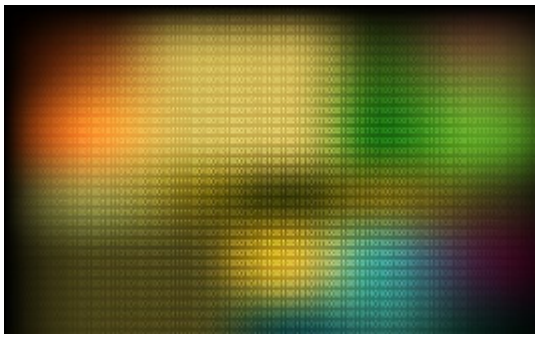


RESEARCH REPORT

EXECUTIVE SUMMARY

Video Analytics

Smart Cameras, Software, and Services for Retail, Transportation, Consumer, City, Critical Infrastructure, and Enterprise Applications: Global Market Analysis and Forecasts

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SECTION 1

EXECUTIVE SUMMARY

1.1 INTRODUCTION

Video analytics (VA) systems extract information from video content that is meaningful as perceived by the human eye. The connotation of the human eye is important because meaningful information could also be generated via a spectrum invisible to the human eye, such as ultrasound or infrared. The field of VA strictly deals with the type of information that the human eye would glean from a video and attempts to generate meaningful data that could be of potential use.

VA could be used to generate alerts or store data in a database. VA that automatically monitors cameras and generates alerts about events of interest is more effective than relying on a human operator. Human operators cost businesses money, possess limited alertness and attention, and can only monitor a limited number of video feeds. Moreover, the operator's ability to monitor the video and effectively respond to events is significantly compromised over time.

VA, when combined with human monitoring, creates a very powerful value proposition for businesses seeking security and surveillance. Not only do computers exceed humans in terms of attention span, but improved technology means that the results are as accurate as humans and can be generated in real time.

The same data can be stored in a database and analyzed for patterns over a period of time. This provides businesses with unprecedented insight into their businesses not available via other means. This has given rise to a new field of video-driven business intelligence, with users able to extract statistical data. Retail businesses have capitalized on this aspect of VA and it is proving to be a big market.

Over the past several years, VA has proven to be an ideal solution that meets the needs of surveillance system operators, security officers, and corporate managers. Maturing computer vision algorithms, coupled with increasing computational capacity and increased camera resolution, have helped increase the accuracy of results. Many industries have adopted VA systems in different application areas that extend well beyond security.

Tractica looks at the technology and business of VA systems in this report and provides an analysis of the current state of the market, as well as where it is headed in the years ahead. We have investigated application markets, use cases, fundamentals of technology, and limitations, and provided a 7-year market forecast. This report segments different application markets by hardware and software and provides forecasts for unit shipments and revenue by world region.

1.2 MARKET AND TRENDS

For the purpose of this report, VA is considered a horizontal market as the applications are spread across different application segments. Tractica has segmented the overall market into six key application areas: transportation, retail, critical infrastructure, city, enterprise, and consumer. All of these industries are starting to see a ramp-up of VA-based systems.

Each application market has its own drivers and challenges. VA vendors almost have to evaluate each application separately to come up with a solution. There is no single product

that fits all of the use cases and the software often needs customization for each application market. One of the vendors interviewed had as many as 30 different implementations available oriented toward different application markets. Table 1.1 below provides some details about each of the application markets.

Table 1.1 Application Markets for Video Analytics

Market	Major Buyers	Description
Transportation	Government	Safety and security of public is a big driver for video analytics solutions.
Retail	Businesses	Many security and surveillance applications, such as person tracking, are being adapted to retail to come up with business intelligence.
Consumer	Consumers	Consumer market is ramping up and the volume will pick up in the coming years.
City	City Governments	Smart cities, in particular, are aggressively going after VA solutions.
Critical Infrastructure	Governments	VA has found use mostly in security and surveillance-related applications.
Enterprise	Businesses	Enterprises are starting to use VA primarily for security-related applications.

(Source: Tractica)

Due to the wide variety of application markets, it is possible to come up with virtually unlimited use cases for VA. The table below shows some of the commonly used alerts generated pertaining to cars, humans, or objects. A VA system can also generate alerts pertaining to cameras and find out if anyone is tampering with the system.

Table 1.2 Comprehensive Listing of Features Detected by Video Analytics

Alert Type	Alert Feature
Car-related alerts	• Number of cars counted at a location • Car entered lot • Car exited lot • Car entered restricted zone • Car exited restricted zone • Car made an illegal U-turn • Car violated red light • Abnormal activity around car detected • Car parked in handicapped zone • Car parked in restricted zone • Car pulled off the road • Car speeding

Alert Type	Alert Feature
	• Car started moving in wrong direction • Car stopped moving in wrong direction • Car trespassing line
Object-related alerts	• Object entered or exited • Object entered restricted zone • Object entered sterile zone • Object left unattended • Object merged • Object removed • Object started moving
Person-related alerts	• Number of people in a room • Room capacity exceeded • Person moving in wrong direction • Person started running • Person stopped running • Possible theft • Person trespassing line • Person of interest detected • Number of people waiting in a line • Person looked at the camera • Person looked at the camera for extended time
Camera-related alerts	• Camera blind detected • Camera blur detected • Camera blocked • Scene changed • Video feed lost

(Source: Tractica)

All of these cases are implemented in software and the vendor must design a customized version of its software for each application market. To some extent, it seems that the VA system could use an IF This Then That (IFTTT) system similar to the Internet of Things (IoT) market. IFTTT allows end users to define their own rules so it is possible to extend the functionality out of the box.

There are also other challenges in VA for extracting meaningful data. For instance, consider retail software that is used to count the number of people in a store. The store associate is considered to be yet another human for VA software and is counted as one person every time he or she moves from one corner to another. This results in an incorrect human count and impacts the results regarding traffic zones. To overcome this, different vendors have come up with their own solutions. Some vendors define sales associates and make corrections in the software. In some instances, associates may also carry a beacon that emits Wi-Fi or Bluetooth to transmit their location to the software.

1.3 KEY MARKET TRENDS

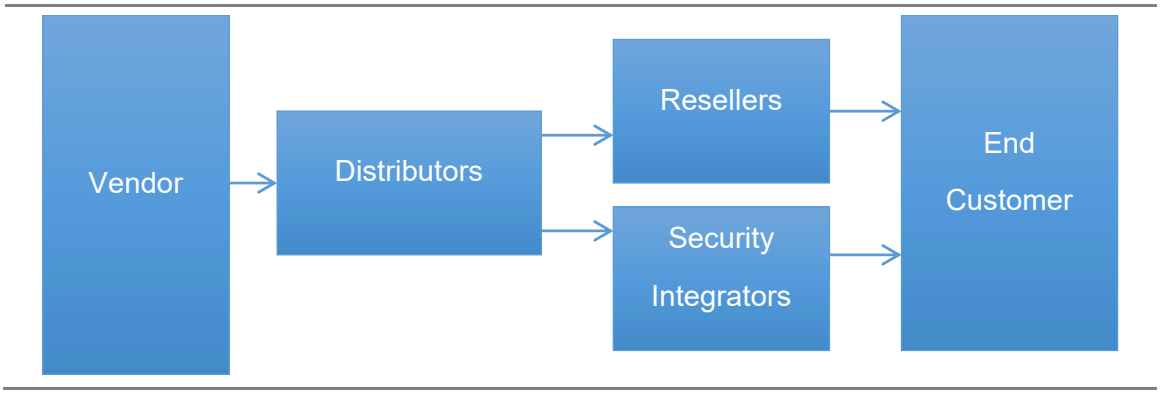
The VA industry has made quite a few strides in the last few years. Below are some of the trends that are shaping the industry:

- On the technology front, deep learning is becoming the technology of choice for many VA applications. Traditional computer vision algorithms have focused on feature identification and then classifying an image into a category for recognition. Deep learning algorithms, on the other hand, work via statistical analysis of the incoming video or image. While traditional computer vision algorithms work well in many instances, they start to lose accuracy when the features start deviating from predefined features. For example, it becomes harder and harder to recognize a face when facial features like beards are present. Deep learning algorithms overcome this limitation and promise to improve the quality of results.
- On the business front, many companies are jumping into the field, leading to rapid innovation. The field of VA combines data science with video and computer vision. While computer vision and video has found most of its usage with consumers, data science is being widely used in enterprises. VA provides businesses with a new kind of business intelligence by combining video and computer vision.
- There are more than 50 vendors in this space consisting of startups as well as blue chip companies. Having such a large number of vendors comes with its own set of challenges. For instance, vendor switching costs tend to be high. These vendors work independently of one another and installing a new system would require starting from scratch. Some of the systems require a certain level of camera resolution and could impact overall results.
- Startups are driving the consideration of new business models. Hardware-as-a-service (HaaS) is one of the new business models mentioned in the media. The HaaS business model minimizes the upfront cost of a customer, in essence, renting hardware on a monthly basis and the customer has access to updated hardware as it becomes available.
- The consumer market, although a late entrant to the overall VA sector, is promising to be the highest growth market. Consumers are willing to spend on intelligent cameras, as well cloud-based software, to avail themselves of the extra security.

1.4 BUSINESS MODELS

VA industry participants rely heavily on partners to reach end customers. Most software and hardware vendors collaborate with distributors (see Figure 1.1 below), who, in turn, sell these systems to security integrators and resellers. These companies work with end customers to build, maintain, and enhance security systems.

Figure 1.1 Video Analytics Value Chain



(Source: Tractica)

Distributors specialize in local markets and have knowledge of overall industry and customer needs. These distributors often play a key role in guiding vendors regarding product development and features.

System integrators and resellers are responsible for end-user installations and creating optimal security solutions. They work closely with the end customer to develop a scheme that meets their requirements. VA vendors have developed training and certification programs to assist resellers and system integrators.

1.4.1 SOFTWARE-AS-A-SERVICE

The software-as-a-service (SaaS) licensing model involves payment on a monthly basis for software usage. This model is most popular with cloud- or web-based applications. The advantages of such a model are very low upfront costs and the fact that the user pays on a monthly basis. Very often, it is possible to cancel the subscription at any time with no penalties.

In the context of VA, this model is popular when the end customer requests low upfront investment. In such situations, vendors only provide their VA software that plugs into the existing camera that the end customer is using, enabling immediate VA access by the end user. This business model is particularly popular in the retail market.

1.4.2 HARDWARE-AS-A-SERVICE

HaaS takes the SaaS business model a step further. In this model, vendors provide hardware as well as the software necessary for VA implementation. Rather than charging the cost of the camera and other hardware, the end customer is billed on a monthly basis. This is a relatively new concept in the industry and startups, in particular, are pushing this aggressively.

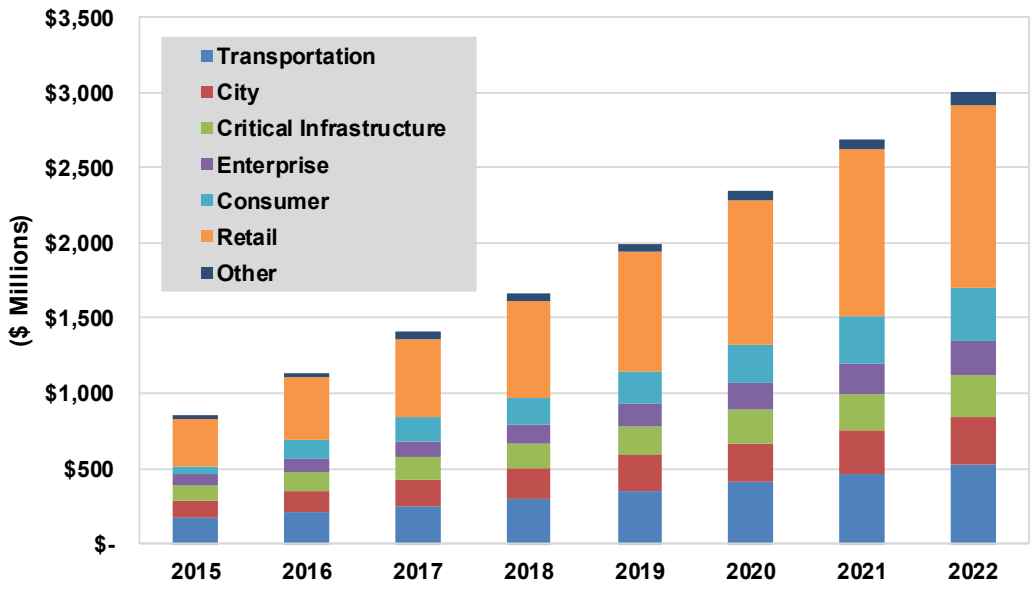
1.4.3 ONE-TIME PAYMENT AND MAINTENANCE

Most of the vendors interviewed for this report said that they use the one-time payment business model, which is perhaps the most popular business model in the VA market. One-time payment requires paying an upfront fee for the device or software. The customer then pays a 15% or 20% yearly maintenance cost to cover support. Most of the vendors hinted that the support does not cover major upgrades to the software. This model is popular with the government and transportation markets.

1.5 MARKET FORECAST

Tractica forecasts that the overall VA market will increase from $858 million in 2015 to nearly $3.0 billion in 2022 at a compound annual growth rate (CAGR) of 19.6%. The top two application markets for VA systems are retail and transportation. In 2015, the city market is expected to be the third largest market. The top two markets, retail and transportation, are expected to maintain their positions in 2022, but the city market will be replaced by the consumer market for third place. The consumer market is expected to exhibit the highest CAGR over the next 7 years, growing at 29.8%.

Chart 1.1 Video Analytics Revenue by Application Market, World Markets: 2015-2022



(Source: Tractica)

Some of the key driving factors for the overall market growth are:

- Falling prices of cameras and PCs leading to ease of VA system deployments
- Emergence of new use cases for VA to optimize resources and marketing
- Need for security and safety of citizens driven by the constant threat of terrorist attacks

While these factors are enabling rapid adoption of VA systems, the switching costs from the existing installed base of analog cameras are often cited by customers as a reason for not going forward with new VA projects. Changing the existing installations to include networked cameras and new systems may add significantly to the costs.

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SCOPE OF STUDY

This Tractica report examines the market trends and technology issues surrounding video analytics technologies and presents forecasts for hardware, software, and services during the period from 2015 through 2022. The report presents in-depth analysis of market drivers, market barriers, application markets, and technology issues, in addition to detailed profiles of 20 key industry players. Key application markets covered include retail, transportation, consumer, city, critical infrastructure, and enterprise. Market forecasts, segmented by world region, include hardware unit shipments as well as hardware, software, and services revenue.

SOURCES AND METHODOLOGY

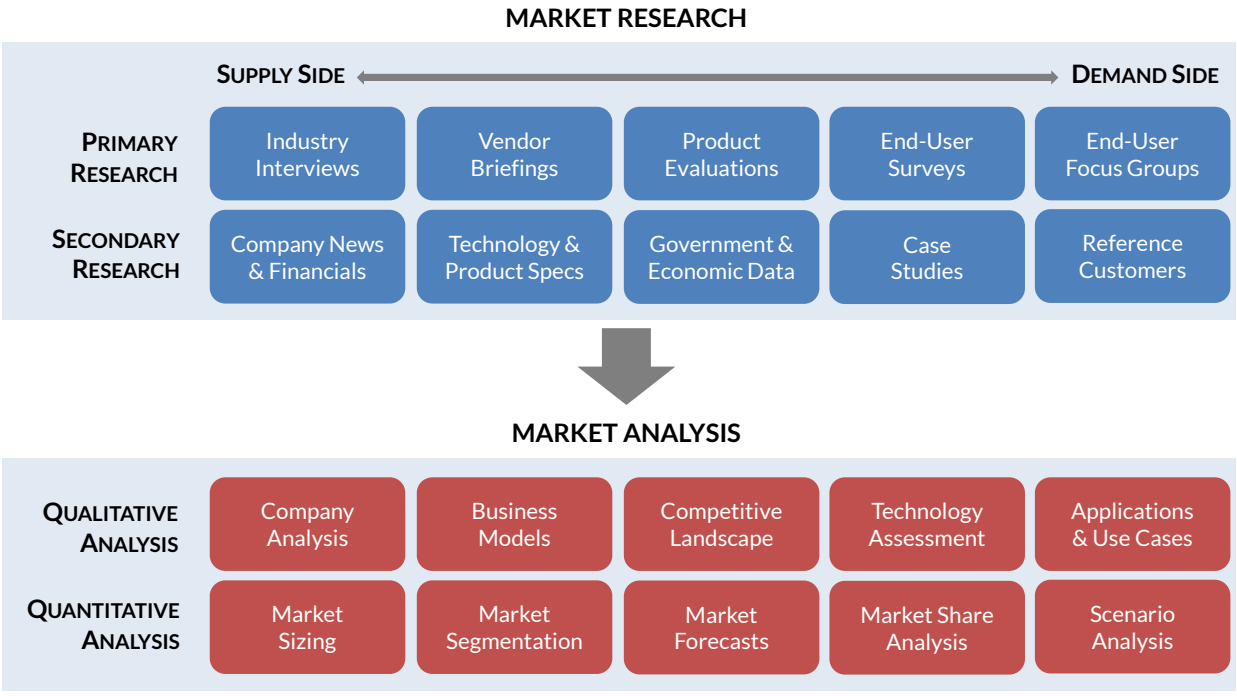
Tractica is an independent market research firm that provides industry participants and stakeholders with an objective, unbiased view of market dynamics and business opportunities within its coverage areas. The firm's industry analysts are dedicated to presenting clear and actionable analysis to support business planning initiatives and go-to-market strategies, utilizing rigorous market research methodologies and without regard for technology hype or special interests including Tractica's own client relationships. Within its market analysis, Tractica strives to offer conclusions and recommendations that reflect the most likely path of industry development, even when those views may be contrarian.

The basis of Tractica's analysis is primary research collected from a variety of sources including industry interviews, vendor briefings, product demonstrations, and quantitative and qualitative market research focused on consumer and business end-users. Industry analysts conduct interviews with representative groups of executives, technology practitioners, sales and marketing professionals, industry association personnel, government representatives, investors, consultants, and other industry stakeholders. Analysts are diligent in pursuing interviews with representatives from every part of the value chain in an effort to gain a comprehensive view of current market activity and future plans. Within the firm's surveys and focus groups, respondent samples are carefully selected to ensure that they provide the most accurate possible view of demand dynamics within consumer and business markets, utilizing balanced and representative samples where appropriate and careful screening and qualification criteria in cases where the research topic requires a more targeted group of respondents.

Tractica's primary research is supplemented by the review and analysis of all secondary information available on the topic being studied, including company news and financial information, technology specifications, product attributes, government and economic data, industry reports and databases from third-party sources, case studies, and reference customers. As applicable, all secondary research sources are appropriately cited within the firm's publications.

All of Tractica's research reports and other publications are carefully reviewed and scrutinized by the firm's senior management team in an effort to ensure that research methodology is sound, all information provided is accurate, analyst assumptions are carefully documented, and conclusions are well-supported by facts. Tractica is highly responsive to feedback from industry participants and, in the event errors in the firm's research are identified and verified, such errors are corrected promptly.

Chart 10.1 Tractica Research Methodology



(Source: Tractica)

NOTES

CAGR refers to compound annual growth rate, using the formula:

CAGR = (End Year Value ÷ Start Year Value)$^{(1/steps)}$ – 1.

CAGRs presented in the tables are for the entire timeframe in the title. Where data for fewer years are given, the CAGR is for the range presented. Where relevant, CAGRs for shorter timeframes may be given as well.

Figures are based on the best estimates available at the time of calculation. Annual revenues, shipments, and sales are based on end-of-year figures unless otherwise noted. All values are expressed in year 2016 U.S. dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

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