

Power of machine vision

See Far, Go further

Tremendous amount of big data can be captured in surveillance camera market for deep learning and create the machine vision. We have high conviction that the global No.1 surveillance product provider, Hikvision (002415.SZ) will benefit with its AI cams and machine vision products (robots, industrial cams and drones).



Source: livemint

“It's going to be interesting to see how society deals with artificial intelligence, but it will definitely be cool.”

—Colin Angle, CEO of iRobot

“Artificial intelligence is the future, not only for Russian, but for all of humankind. It comes with colossal opportunities, but also threats that are difficult to predict. Whoever becomes the leader in this sphere will become the ruler of the world.”

— Vladimir Putin, the Russian president

The thing that's going to make artificial intelligence so powerful is its ability to learn, and the way AI learns is to look at human culture.

— Dan Brown, American author

Investment Highlights

Global video surveillance market grew at a CAGR of 11.1% (2017-2020E):

The global video surveillance market was valued at USD42.5bn in 2017 according to statista and our estimation and is expected to reach USD58.3 Billion by 2020, at a CAGR of 11.1%. Asia Pacific especially India and China will be the fastest-growing region in the video surveillance market because of heavy capex in building new and improve existing infrastructure, and also rising security concerns.

Expanding video analytics market: Tractica forecasts that the overall video analytics market will increase from USD858mn in 2015 to nearly USD3.0bn in 2022, at a compound annual growth rate (CAGR) of 19.6%. The top two application markets, retail and transportation are expected to continue to be the largest markets over the next several years.

We like Hikvision: We believe tremendous amount of big data can be captured in surveillance camera market for deep learning and create the machine vision. Inside HK and China stock coverage, we have high conviction that the global No.1 surveillance product provider, Hikvision (002415.SZ) will benefit with its AI cameras and machine vision products (robots, industrial cameras and drones).

Scale advantage: Hikvision is the global No.1 surveillance product provider for 6 consecutive years with about 21.4% global market share in 2017. It has 35 offices/branches throughout China, and 37 offices around the world, forming a marketing network covering more than 100 countries. Its scale advantage and strong SOE background are likely to support stable gross margins. Hikvision has scale advantage in terms of its: (1) sales force and distribution network, (2) R&D team and spending, (3) economies of scale in SG&A, (4) pricing power with its suppliers, and (5) data sets. These scale advantages reflect in its above peers gross margin and industry leading net margin. During AI era, this scale advantage is so valuable that it can gain numerous data which is critical to train the machine for analysis and making predictions, in our view.

Target price of RMB45.85, 'Buy' rating: Given Hikvision's leading edge in big data, we compare it to Global AI big data plays and find that it is inexpensive. We revise up our TP from RMB42.30 to RMB45.85 based on 2018 P/E of 36.7x

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and 2018-2020E EPS CAGR growth of 26% (PEG=1.4), implying a 17% upside. We like Hikvision due to (1) robust growth of smart surveillance industry, (2) bright future of machine vision during AI/IoT/Industry 4.0 era, (3) riding along the growth of edge computing, (4) strong scale advantage and (5) attractive valuation.

Valuation and financial ratios of AI big data related Stocks (Bloomberg Consensus)

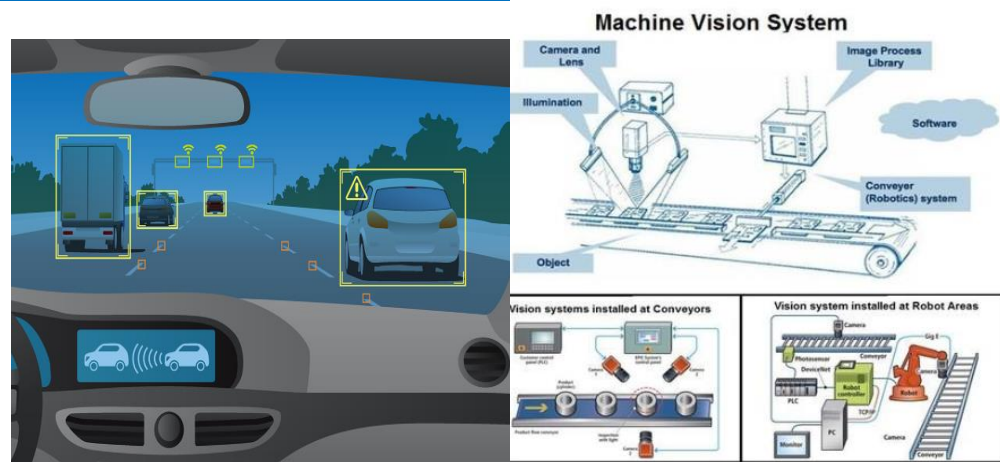
AI	Stock Code	Price (\$LC)	TP	%upside	18EPS YoY	19EPS YoY	18PE	19PE	18ROE	19ROE	18PB	19PB
Big Data												
Google	GOOGL US Equity	1132.71	NA	NA	20.95	10.75	21.78	19.67	17.88	16.93	4.30	3.55
Facebook	FB US Equity	189.10	NA	NA	22.56	20.22	22.13	18.41	24.76	24.41	5.90	4.42
Amazon	AMZN US Equity	1683.99	NA	NA	105.96	38.52	80.88	58.39	16.26	19.42	21.01	15.04
Microsoft	MSFT US Equity	101.63	NA	NA	24.29	5.04	26.55	25.27	36.13	37.35	9.51	8.18
IBM	IBM US Equity	146.14	NA	NA	0.18	1.92	10.57	10.37	62.35	54.95	6.37	5.26
Twitter	TWTR US Equity	41.21	NA	NA	60.68	19.80	58.29	48.65	9.71	13.65	5.46	4.65
Baidu	BIDU US Equity	263.59	NA	NA	3.43	17.27	25.60	21.83	16.06	16.28	4.30	3.65
Alibaba	BABA US Equity	205.07	NA	NA	27.68	29.09	31.29	24.24	19.81	21.02	7.22	5.76
Tencent	700 HK Equity	419.00	NA	NA	28.22	32.16	38.53	29.15	28.04	28.02	9.59	7.46
Hikvision	002415 CH Equity	39.20	45.85	17.0%	28.25	30.73	29.67	22.70	35.12	35.82	9.45	7.41
Average					32.22	20.55	34.53	27.87	26.61	26.78	8.31	6.54
Median					25.98	20.01	28.11	23.47	22.29	22.72	6.79	5.51

Source: Bloomberg, CASH

Machine vision

Machine vision (MV) is the technology and methods used to provide imaging-based automatic inspection and analysis for such applications as process control, and robot guidance, usually in industry. A large number of technologies, software and hardware products, integrated systems, actions, methods and expertise work together. A machine vision camera captures image data and sends it uncompressed to the PC. And network cameras or IP (Internet Protocol) camera can record video and compress it and they are widely used in surveillance. AI's applicability in machine vision relies on machine learning, in particular deep learning and we expect machine vision application will become more popular. According to IHS, in five years, for instance, it is possible that an end user could simply ask Siri to check their home surveillance system's facial recognition log and report back with information on whether or not the user's children have arrived home from school.

Figure. Machine Vision



Source: AIA | Vision, IndiaMART

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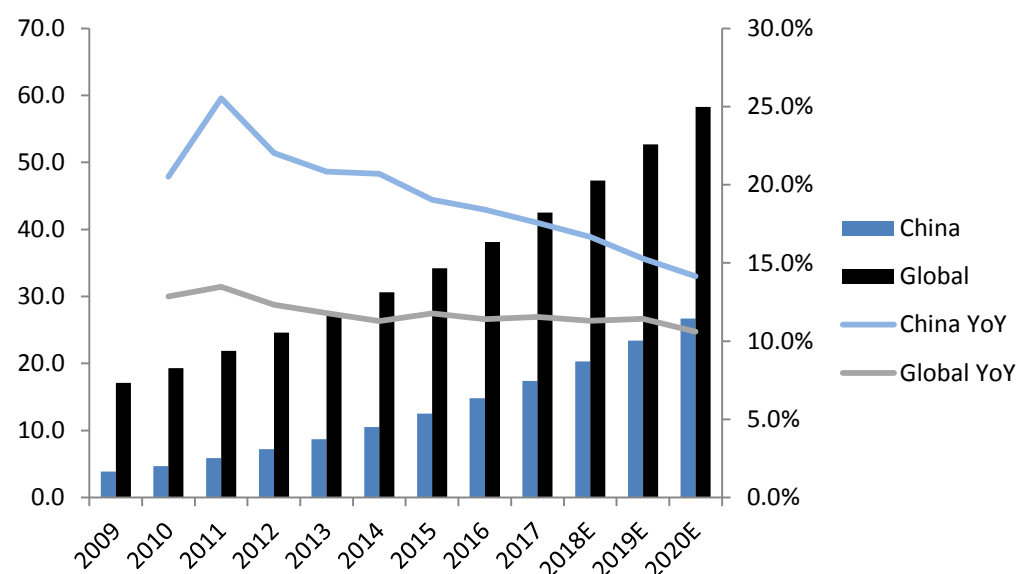
where the suspect went after committing a crime within a short period of time. Per our understanding, it usually takes about 30 days and 1,500 police to search around 10 days of video from >10,000 cameras, but AI systems need just several minutes to complete. **This chapter is to help investors figure out the investment opportunities related to machine vision and AI.**

The surveillance market

The global video surveillance market was valued at USD42.5bn in 2017 according to statista and our estimation and is expected to reach USD58.3 Billion by 2020, at a CAGR of 11.1%. Asia Pacific especially India and China will be the fastest-growing region in the video surveillance market because of heavy capex in building new and improving the existing infrastructure, and also rising security concerns. China video surveillance market will grow at a CAGR of 15.4% during 2017-2020 according to statista and our estimation.

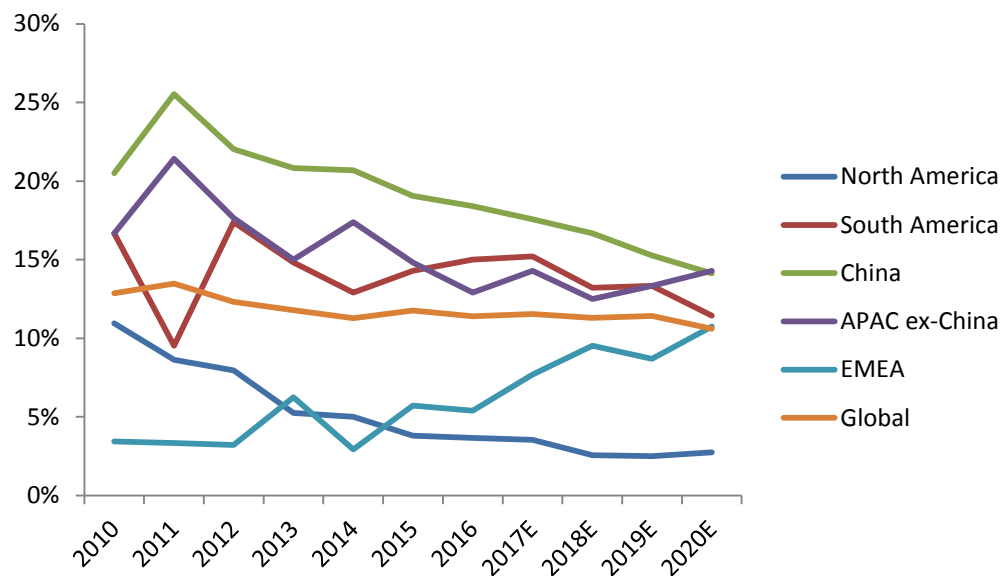
On the other hand, **we see the shifting preference from analog to IP systems.** The IP-based video surveillance is expected to grow at a CAGR of around 13.5% during 2017-2020. We believe the strong growth in IP based cameras is due to (1)enhanced image quality, (2)high scalability with easy installation, (3)remote accessibility, (4)video analytics supported with cloud storage and other cloud-related service for centralized data to fit 'smart city' and 'smart home' development.

Figure. Global/China video surveillance market from 2009 to 2019 (in bn USD)



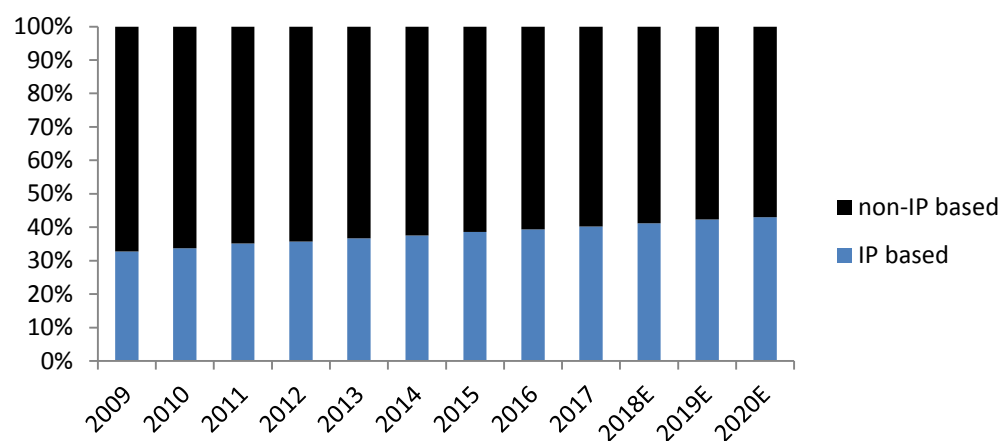
Source: Statista, CASH

Figure. APAC is leading the growth....



Source: Statista, CASH

Figure. Global shifting preference from analog to IP systems



Source: Statista, CASH

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The future of industrial cameras

Machine vision is an integrated system that allows robots to identify and analyze objects. It requires hardware (such as industrial cameras and vision controllers) and software to function. Machine vision is widely used in areas such as 3C (Computer, Communication and Consumer Electronics), metal processing, food and beverage, logistics and autos. Industrial cameras are a vitally important component for machine systems and transfer optical signals into electronic signals. Industrial cameras should be made sure to be highly reliable so that they operate for long periods and to capture fast-moving objects.

According to Markets and Markets, the overall industrial machine vision market was valued at USD7.91bn in 2017 and is expected to reach USD12.29bn by 2023, at a CAGR of 7.61% between 2017 and 2023. The market growth is attributed to growing demand for industrial automation, increasing adoption of AI and industrial 4.0 in manufacturing boosted by government policy initiatives. In 2016, the industrial machine vision market was mainly dominated by top 5 players, including **Cognex (US), KEYENCE (Japan), National Instruments (US), Basler (Germany), and OMRON (Japan)***. We believe Hikvision has its own advantages given its lower cost structure (low manufacturing costs due to automation plus low labor costs for software engineers) and given its close relationships with customers/SOE (strong distribution network to provide customized solution, while industrial cameras are especially hard to standardize).

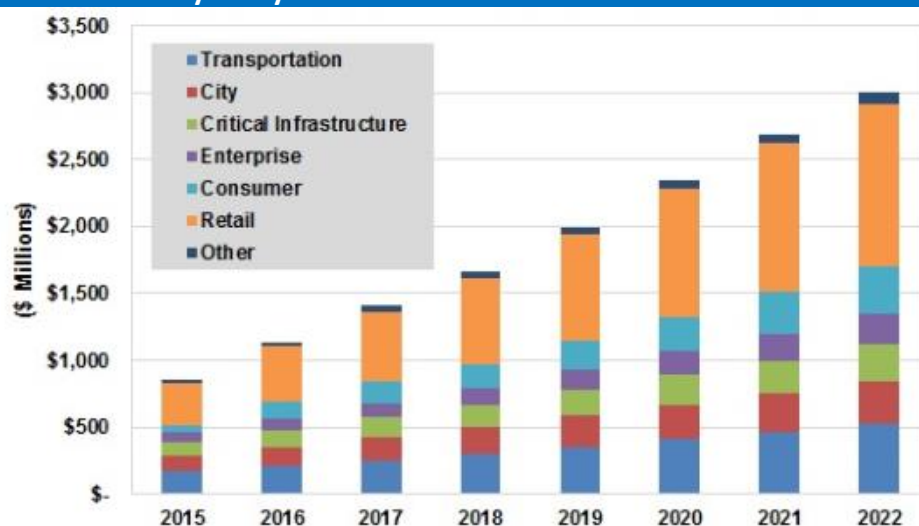
*Note: Some of the major strategies adopted by these players were new product launches and developments, mergers & acquisitions, and partnerships & agreements, among others

Expanding video analytics market

Video analytics systems, which extract useful information from video content, are gaining more attention in wide range of application including retail, transportation, consumer, cities, critical infrastructure, and enterprise, according to Tractica. These systems may use smart cameras with onboard vision processing or specialized server-based software platforms, which are increasingly being aided by deep learning algorithms to help interpret and analyze meaning within a multitude of video content.

Tractica forecasts that the overall video analytics market will increase from USD858mn in 2015 to nearly USD3.0bn in 2022, at a compound annual growth rate (CAGR) of 19.6%. The top two application markets, retail and transportation are expected to continue to be the largest markets over the next several years

Figure. Video analytics systems



Source: Tractica, CASH

Supportive China policy

The Next Generation Artificial Intelligence Development Plan stated that:

Step 1: By 2020 overall AI technology and application reach globally advanced level. AI industry becomes new economic growth point. AI technological application becomes new approach to improving people's livelihood to support our goal in becoming an innovation-driven country and building a moderately prosperous society in all respects.

Step 2: By 2025 AI basic theory makes breakthroughs. AI technology and application reach globally advanced level. AI becomes a major driving force for industrial upgrade and economic restructuring. Building an intelligence society makes progress.

Step 3: By 2030 AI theory, technology and application reach globally advanced level. China becomes global AI innovation center. Intelligence economy and society make marked progress, laying a solid foundation for becoming an innovation-driven and economically powerful country.

The Chinese government's "Made in China 2025" plan forms part of a three-stage blueprint to boost the country's manufacturing competitiveness. The plan states 10 strategic industries within the manufacturing sector: aerospace equipment, robotics, maritime engineering, new energy vehicles, electrical power equipment, new materials, rail transportation, agricultural equipment, medical devices and information technology. We think that China wishes to seize to capture a leading manufacturing position of Industry 4.0 with the use of industrial internet, artificial Intelligence, machine learning, robotics, sensing, and data collection. We expect that will create demand for industrial camera supported with video analytics (machine vision) which helps to monitor production process or robots (machine arms) which facilitate automation, save labor costs and boost efficiency (accuracy + processing speed). Other applications, including self-driving cars embrace bright future too.

Figure. China's state funded AI-related projects

China's state funded AI-related projects

Project focus	Funding (million yuan)	Granted in	Year period
Cloud and big data	475.41	2018	3
Smart cars	820.13	2018	3
Quantum and high performance computing	365.17	2018	3
Leading electronic materials	173.37	2018	3
Strategic technologies	351.66	2017	5
Smart robotics	458.76	2017	3
Smart medical devices	88.33	2017	3

Source: National Science and Technology Information System, SCMP, CASH

Hikvision (002415.SZ, Buy, Target price: RMB46.24)

AI and surveillance

Investment Thesis

- *Riding along the edge computing*
- *Scale advantage*
- *Attractive valuation*

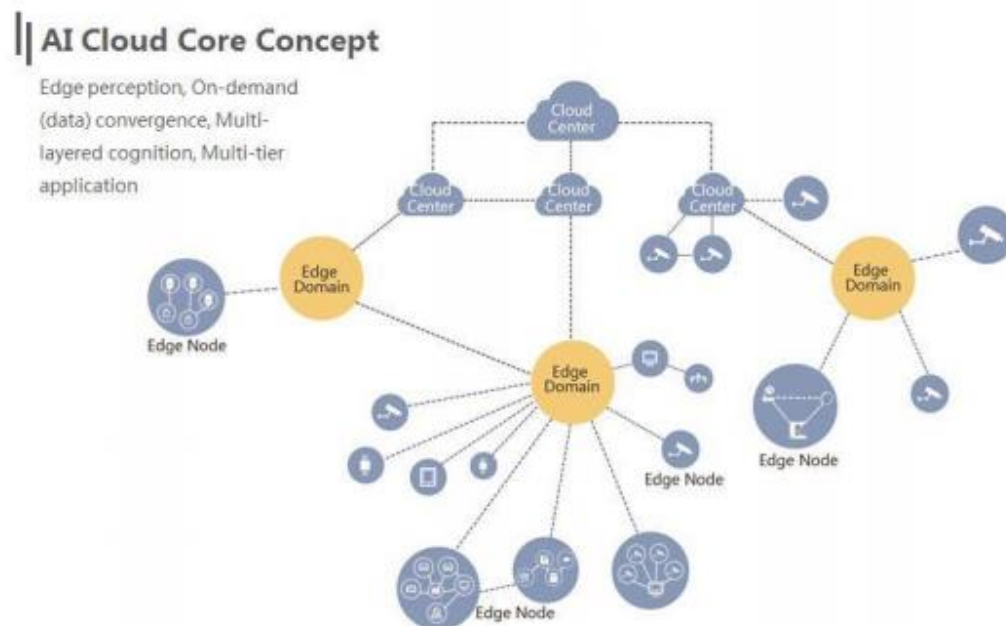
Riding along the edge computing

Edge computing refers to an open platform (discrete nodes like network video recorder and internet protocol camera) that converges networks, computing, storage, and application capabilities on the edge of the network close to the object or data source, to provide intelligent real-time services. This can help reduce extra cost of maintenance (labor or electricity cost), setup cost (uninterruptible power supply, air conditioning, space, etc) and also save transmission time, memory and network bandwidth when compared with cloud computing.

Hikvision's AI Cloud is a variable form of IoT edge computing: "edge node (for streamlined smart data collection) + edge domain (for time sensitive AI analysis) + cloud center (for non-time sensitive AI analysis)". The edge domain serves like a football "midfield", as it is responsible to determine the time, type and processing degree of the data transmitted to the cloud center and achieve "on-demand data convergence".

AI Cloud is an open platform in a sense that it is also open to developers and partners that are within the national security and government cloud domain. The edge computing products under Hikvision includes DeepinView(深眸) series intelligent video cameras, DeepinMind TrafficManagement Server(神捕), DeepinGo(明眸) series swing barrier turnstile with facial recognition terminal and DeepinMind(超腦) video analysis processing, etc. We think Hikvision's AI products will embrace a bright future given huge demand for data processing during 5G and AI era. Hikvision's is now to attract more developers and partners to this open platform and create a new TAM beyond the traditional video surveillance space.

Figure. AI Cloud



Source: Hikvision, CASH

Figure. Family of AI Cloud products by Hikvision



Source: Hikvision, CASH

Scale advantage

Hikvision is the global No.1 surveillance product provider for 6 consecutive years with about 21.4% global market share in 2017. It has 35 offices/branches throughout China, and 37 offices around the world, forming a marketing

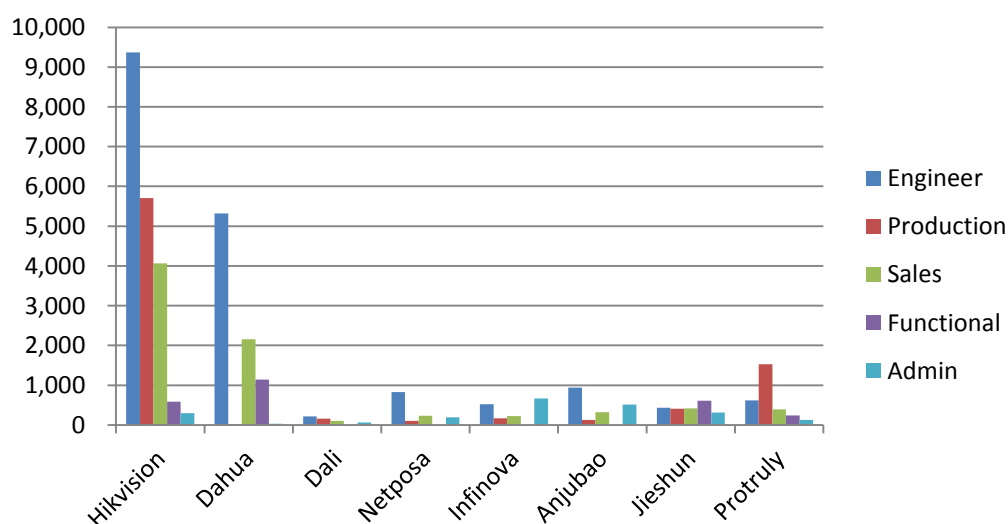
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network covering more than 100 countries. Its scale advantage and strong SOE background are likely to support stable gross margins. Hikvision has scale advantage in terms of its: (1) sales force and distribution network, (2) R&D team and spending, (3) economies of scale in SG&A, (4) pricing power with its suppliers, and (5) data sets. These scale advantages reflect in its above peers gross margin (2017 GPM: 43.5% > Dahua: 37.8%) and industry leading net margin (2017 NPM: 22.5% > Dahua: 12.8%). During AI era, this scale advantage is so valuable that it can gain numerous data which is critical to train the machine for analysis and making predictions, in our view.

1. Sales force and distribution network

Strong sales force which helps understand customers' need: As of end 2017, Hikvision had 26,330 employees in total, and 4,999 (19%) of these were from sales. Over the past ten years, Hikvision grew its sales force from 707 in 2009 to 4,999 in 2017 (28% CAGR). We think the trend will go on with Hikvision's global expansion. As of May 2018, there are 665 cities in China, Hikvision has over 7 sales people for every city. Hikvision's in-house sales force is significantly larger than that of Dahua, which ranked 2nd in China surveillance market (3rd in global according to A&S, 2nd position belongs to German company called Bosch Security Systems). This can help to **increase users' stickiness given its better understanding to customers' demand.**

Figure. Hikvision significantly higher vs domestic competitors in terms of employee scale (in 2016)



Source: Jetro Data, CASH

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Figure. Hikvision has 35 branches with >200 offices in China

Source: Company data, CASH

Figure. Hikvision's global exposure (>150 countries)

Source: Company data, CASH

Strong channels give quick response to demand from different sectors: In addition to the self-built marketing network and internal sales force, Hikvision has also established a three-tier service system, which comprises the Global Customer Service Center, the Branch Customer Service Department and the

Authorized Customer Service Station. Hikvision possesses over 10,000 distributors in China, or more than 15 distributors per city on average. **This wide coverage gives the Company more efficiency in detecting customer demand and developing new clients, which helps Hikvision spend its R&D and precisely focus on certain product/service improvement and quickly respond to clients' demand.** In terms of solutions, the Company has multiple scenario-based software platform solutions for seven industries of public security, transportation, law enforcement, education and healthcare, finance, energy and intelligent building, which helps **diversify its client's concentration risk.**

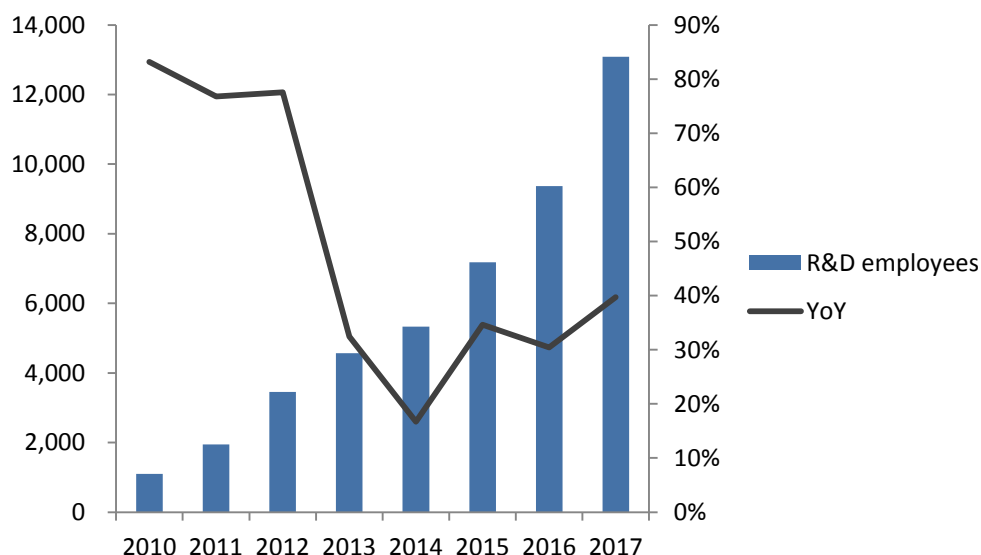
Overseas exposure: In the overseas market, Hikvision has established 37 overseas sales branches/ 106 overseas service points/77 authorized repair center, with products sold to >150 countries and regions, and partnership of more than 140 distribution partners. According to annual report, The Company established seven overseas subsidiaries in Kenya, Uzbekistan, Hungary, New Zealand, Czech, Malaysia and Germany and two new offices respectively in Indonesia and Vietnam in 2017. and the Company plans to continue expanding its overseas footprint and focus on the project/solution-based (from channel/product based) business after success in markets such as Singapore and the US. Hikvision strengthened its moat by providing high-quality products in competitive pricing through its strong distribution channels, and **now entered into solutions service.** We see **overseas growth engine turning into solution-oriented will continue to be the bright spot.** We believe that overseas expansion will help improve GPM given higher GPM of overseas market (~10% higher than domestic market with revenue accounting for about 30%).

2. Large R&D scale

Strong R&D growth with dedicated teams and cost advantage: As of 2017, Hikvision had 13,085 engineers in its R&D department (around 1.8X that of Dahua in 2016), accounting for 50% of its total employee. Employees with Bachelor Degree or above accounted for about 68% in 2017. Over the past decade, Hikvision grew its R&D team by around 16 times, with professional teams in video image processing, video and audio codec, video content analysis, streaming media network transmission and control, video and audio data storage, cloud computing, big data, deep learning, video structuralization, etc. Per our understanding, Hikvision offers higher salaries to attract the

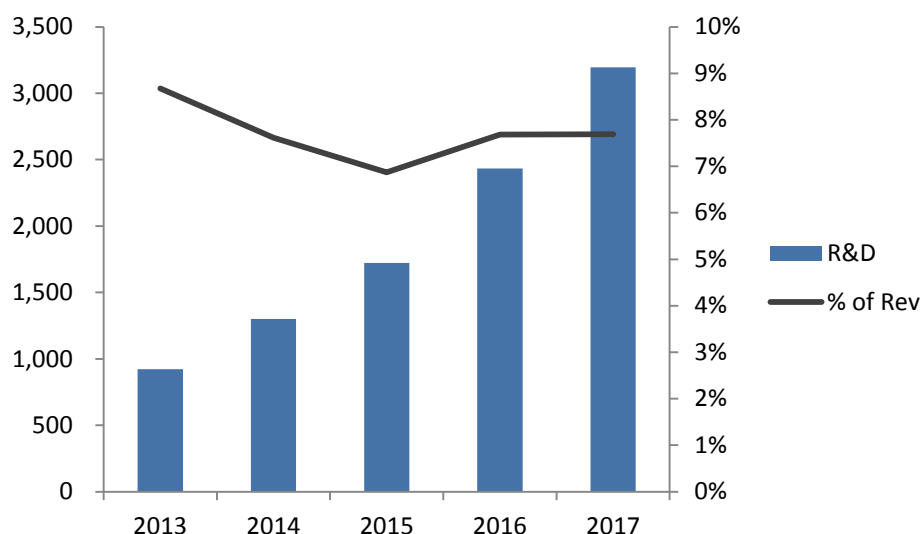
talents in the domestic market compared with local peers. Also, China has a relatively lower labor cost, this helps lower Hikvision's average engineer cost when compared with global peers.

Figure. Expansion of R&D employees



Source: Company data, CASH

High R&D spending to support innovation: Hikvision consistently allocates 7%-8% of its revenue to technology upgrade for the over the past 4 years. Hikvision's dedication and investment in technology has created a high entry barrier for any new entrants and small players, helping the Company capture the first mover advantage for its products. With its comprehensive product portfolio (front-end + back-end to control center equipment and software), Hikvision has achieved R&D synergy across different business segments, and also across industries.

Figure. R&D expenses as a percentage of revenue

Source: Company data, CASH

Incentive scheme to keep alert of the new technology trend: Starting from 2015, Hikvision implemented 'Management Measures for Core Staff Co-investment in Innovative Business' (核心員工跟投創新業務管理辦法) for incubating start-ups within the company (Core staff (40%) co-invest with Hikvision (60%) in innovative business projects). There are 3 new main business ventures currently: 1) EZVIZ Network Company (螢石網路公司), which is a Smart Home business; 2) Robotics Technology Company, focusing on industrial automation; and 3) Automotive Technology Company emerged, focused on intelligent automobile developments. Other two new innovative business entities include uncooled infrared sensor and SSD (solid state drive) storage technology. This structure aligns employee's interest with the Company and helps improving working efficiency and keeping Hikvision to be alert in terms of new trends in technology.

3. Low SG&A demonstrates economies of scale and automation

Hikvision has a below industry average SG&A to revenue ratio due to economies of scale and automation (Hikvision: 12.8%, Dahua: 15.3%). Hikvision currently has 3 manufacturing bases in Hangzhou, Tonglu and Chongqing, and has a large-scale production expansion plan in Wuhan, Tonglu and Chongqing. The Company has gradually launched more than 800 intelligent warehouse robots at the Tonglu Production Base which has an output value of more than RMB100mn, and comprehensively implemented

the warehousing and internal logistics automation, reducing the labor cost by approximately 58% and improving efficiency by nearly 84%.

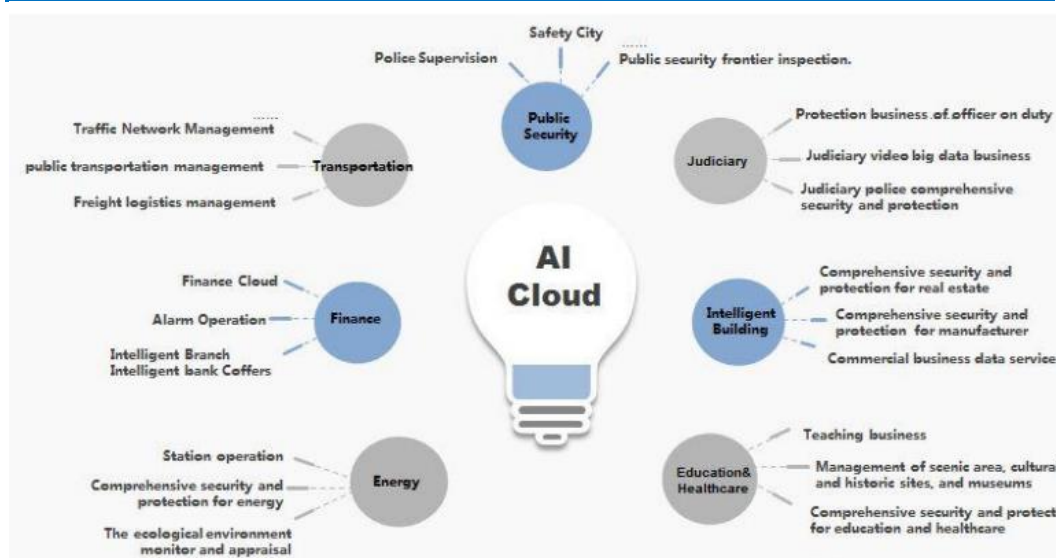
4. High pricing power with suppliers and customers

Hikvision was the largest global surveillance provider in 2017, and paid its top five suppliers a total of RMB7.16bn (~30% of total purchases) and its top one supplier RMB3.8bn last year (around 16% of total purchases). On the other hand, the top five customers accounted for a total of RMB2.2bn (~5.3% of total sales) and its top one supplier RMB0.8bn last year (~2% of total sales). We think this helps strengthen Hikvision’s bargaining power on negotiation a favorable pricing with its suppliers and customers. Per our understanding, Hikvision sometimes books the entire capacity of certain supplier for the next six to twelve months, and that Hikvision can continue to lead the other peers.

5. Strong database

Hikvision has started to introduce AI surveillance products into the market since 2015. With access to numerous data sets from its huge and wide customer base (covering public security, transportation, civil, judicial, financial, energy, and building) needed to train the machine, the Company has a strong competitive edge compared with peers. For example, we see potential demand in brick-and-mortar retail stores, who may need data on customer age profile and peak visiting hours to enhance sales efficiency.

Figure. Hikvision’s AI Cloud industry coverage



Source: Company data, CASH

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6. Supported by SOE to further enhances its pricing power

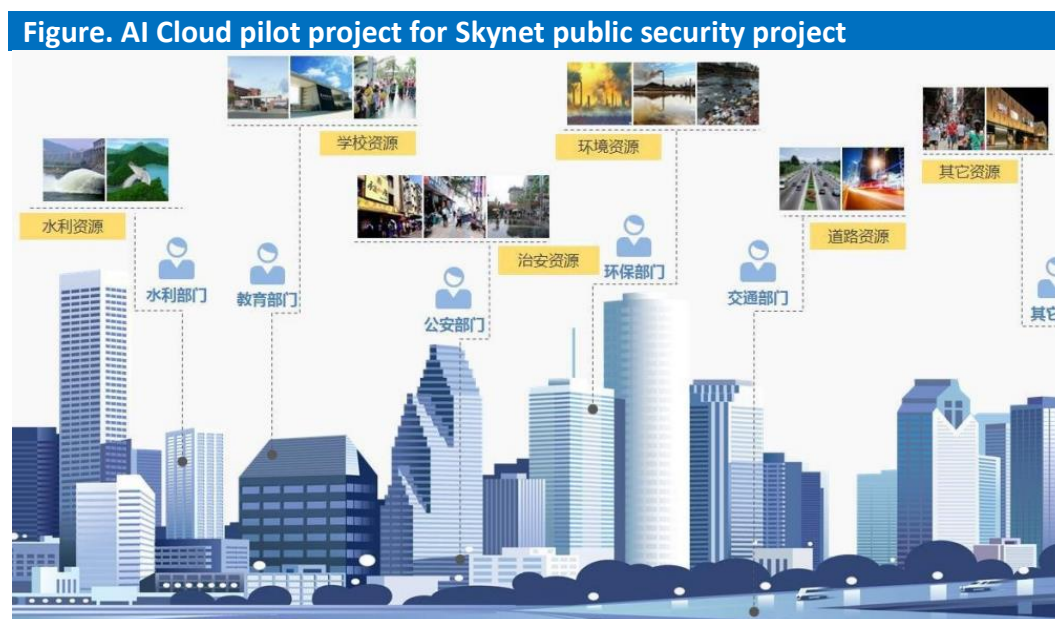
Hikvision was established in 2001 by the No.52 Research Institute of China Electronics Technology Group Corporation (CETC) (中國電子科技集團公司第五十二研究所), which is under the State-owned Assets Supervision and Administration Commission (SASAC). CETC is mainly involved in the research, development, and production of large-scale electronic information systems, communication and electronic equipment, software and key components for major national military and civilian applications. Hikvision is partially-owned by 2 SOEs (CETC and the 52nd Research Institute at China Electronics Technology Group Corporation).

Figure. Hikvision's shareholdings in 2017

Shareholders	% of shares
The 52nd Research Institute	1.96%
CETC	39.59%
Gong Hongjia	15.01%
Xinjiang Weixun Investment	5.74%
Xinjiang Pukang Investment	2.08%
Public investors	35.62%
Total	100%

Source: Company data, CASH

Hikvision's second customer is the No.52 Research Institute under CETC. Leveraging its SOE background and relationship with the public sector (i.e. public security, transportation, judicial, etc.), we expect Hikvision is positioned well to provide surveillance solutions in a large lot, including catching alleged suspects more efficiently, monitoring drivers using phones or pedestrians running a red light). Its products have been adopted by Nanchang City's SkyNet project, effectively improving the accuracy and speed of identifying potential suspects. We think Hikvision has a strong pricing power given its expertise in solution business as these government-related projects focus more on technology and delivery rather than pricing.



Source: Hikvision, CASH

7. Hardware-software integrated solution

Most mobile robots (AGV, drone, industrial cameras, autonomous vehicle, etc) (which are classified as hardware) use the same key machine vision algorithm (software), which enables the extraction of depth information, navigation and obstacle avoidance. Sensors are the foundation from which information is collected and then fed into the algorithm. For instance, programming makes up at least 40% of the total integration cost inside industrial robots. We believe this is similar to Hikvision's existing business model in surveillance - customized solution and integration of the platform is the key for customer acquisition, rather than product based (separate hardware or software) which has a lower GPM.

Introduction

Front-end products: As of 2017, 50% of Hikvision's revenues was from front-end products, i.e., cameras, access cards, video intercom and security alarm products. Over the past 7 years, front-end products have been a strong revenue driver for Hikvision, growing at a CAGR of 50.7% (2010-2017), replacing back-end products as the largest revenue contributor in 2013. Along with technology upgrade from analog to digital and now to AI cameras, Hikvision expanded its market share and consolidated its dominance, given its high quality products and time-to-market advantage. In 2016, Hikvision launched **DeepInview** camera series based on GPU/VPU and deep learning technology, enabling much more complicated facial, traffic, vehicle recognition and analysis. It is the first and only AI-enabled front-end product in the market, demonstrating its leading position. Hikvision also launched **Super Defog, Darkfighter+ and DarkfighterX3 camera series** in 2016, leading the industry in terms of capturing clearer, and brighter color images in foggy, starlight and darker environments.

Note: Vision processing unit (VPUs) is an emerging class of microprocessor mainly used in front-end cameras for relatively simple and standard analysis like tagging and labelling the video content, leveraging their low power, low latency characteristics.

Figure. Traditional low-light cam (left) vs Hikvision Darkfighter network cam(right)



Source: Hikvision, CASH

Figure. Hikvision's front-end products



Source: Hikvision, CASH

Front end products - industrial camera overviews: Machine vision is an integrated system that allows robots to identify and analyze objects. It requires hardware (such as industrial cameras and vision controllers) and software to function. Its main applications include surface inspection, product defect detection, product traceability, bar code recognition, dimension measurement, sorting and screening, and robot positioning (See figure). Hikvision launched its first industrial camera in June 2015 and can provide area scan cameras, line scan cameras, industrial smart cameras, vision box (vision controller), etc.

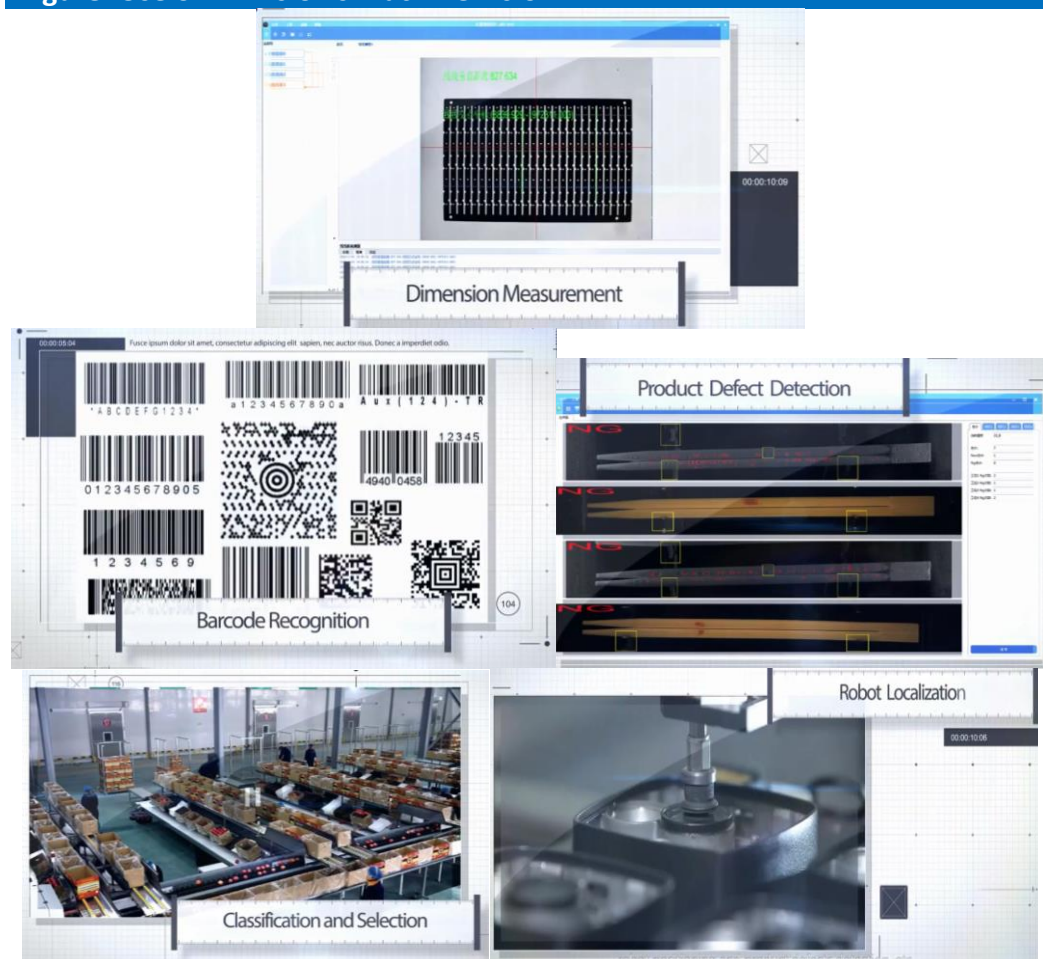
Figure. Hikvision's industrial smart camera (left) and line scan camera(right)



Source: Hikvision, CASH

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Figure. Use of Hikvision's machine vision



Source: Hikvision, CASH

Back-end products: Back-end products accounted for 15% of total revenue; these include storage products such as **XVR (Hybrid Video Recorder)**, **NVR (Network Video Recorder)**, **CVR (Central Storage Video Recorder)**, cloud storage system products, SD memory card and SSD (Solid State Disk), and some transmission products such as video encoders, video decoders, video optical transceivers, network optical transceivers, and network switches. Over the past 7 years, back-end products have been growing at a CAGR of 16.1% (2010-2017), lower than that of front-end due to its large base and also relatively longer depreciable life of back-end products. In 2016, Hikvision launched **Deepinmind NVR** with embedded deep learning algorithms, enabling more accuracy in facial recognition and analysis. We think continuous market share gain, replacement demand, and product upgrade will be the catalyst for both front-end and back-end products.

Figure. Hikvision's back-end products



Source: Hikvision, CASH

Central controlling equipment: Revenue accounted for 12% of total revenue in 2017. Products include **servers, multi-function video center, large screens, controlling keyboards, other controller products and software**. The strong revenue growth was mainly driven by server products with AI capabilities launched in 2015-2016 and big screens. Hikvision launched **video structuring server “Falcon”** and **vehicle image structuring server “Blade”** in 2015, both based on GPU and deep learning technology. In 2016, Hikvision launched **intelligent traffic product “Divine Captor”** and **facial analytics server “Hikface”**. Falcon, Blade, and Hikface are all used in the Nanchang Sky Net project. This segment grew at a CAGR of 45.7% for the past 3 years. Over the next several years, we expect control center equipment may become one of the main revenue engine with its AI product suites given higher server demand for data analysis to improve the task speed and accuracy*.

*Note: Hikvision's Falcon AI server is capable of creating structured data of vehicles and suspects in the event of a security breach, including labeling of the image by vehicle type, vehicle brand, license plate, color of clothes etc. Falcon also helps in searching for images of the alleged suspects over a period of time around a particular area. We note that public sector clients could benefit from Hikvision's technology with improved speed and accuracy of data analysis. For example, for video footage from 500 cameras spanning 250 hours, Hikvision stated that Falcon can shorten the time for data analysis **significantly to a few seconds that could have otherwise taken days to analyze**. On the other hand, **facial recognition error rate was 10%-20% previously; now with deep learning, the error rate has improved to 1%, according to Hikvision.**

Figure. Hikvision's vehicles detection algo (left: traditional vs right: deep-learning)



Source: Hikvision, CASH

Innovative business including smart home: Revenue from Hikvision’s innovative businesses including smart home grew by 152% in 2017, with 4% contribution of overall revenues. EZVIZ is Hikvision’s largest innovative business segment with Rmb1.1bn revenues in 2017, up 115% YoY. Sum of the other innovative businesses are much smaller than smart home business, but they record a higher revenue growth rate (+275% YoY vs +114%) and gross margin is higher (39% vs 35%).

(A) EZVIZ

EZVIZ is Hikvision’s B2C brand offering products for home security and SME security. It also provides a cloud service for monthly subscription. Subscribers exceed 20mn. In addition to a consumer client base, it has business clients, such as retail chain and property management companies which utilize the EZVIZ cloud to track client traffic and monitor premises

Figure. EZVIZ Smart Home Security Camera System



Source: Hikvision, CASH

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Figure. Internet-based innovative business



Source: Hikvision, CASH

The other four innovative businesses are robotics, automotive electronics, storage, Weiyang. Hikvision Weiyang (海康微影) is a provider of far infrared (IR) sensors centered on MEMS (Micro-electromechanical Systems) technology. Based on the deep understanding of security applications, Hikvision lays out the uncooled infrared (IR) sensors, and has launched thermal imaging sensors applicable to multiple fields such as security surveillance, driving assistance, disaster forecast, industrial temperature measurement, medical inspection and quarantine, consumer electronics, etc.

Figure. Four other innovative businesses



Source: Hikvision, CASH

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(B) Robotics

Hikvision introduced the 'Qianmo' intelligent warehouse storage system in early 2016 and expanded its business line into robotics including **automatic guided vehicle (AGV), intelligent sorting robots and intelligent parking robots**. The system aims to enhance current warehouse storage efficiency through automation and Big Data technology. The system is composed of three main parts: Intelligent Warehouse Robot, RCS (Robots Control System) and iWMS (Intelligent Warehouse Management System).

Figure. Hikvision's robots

Source: Daily Mail, Hikvision, CASH

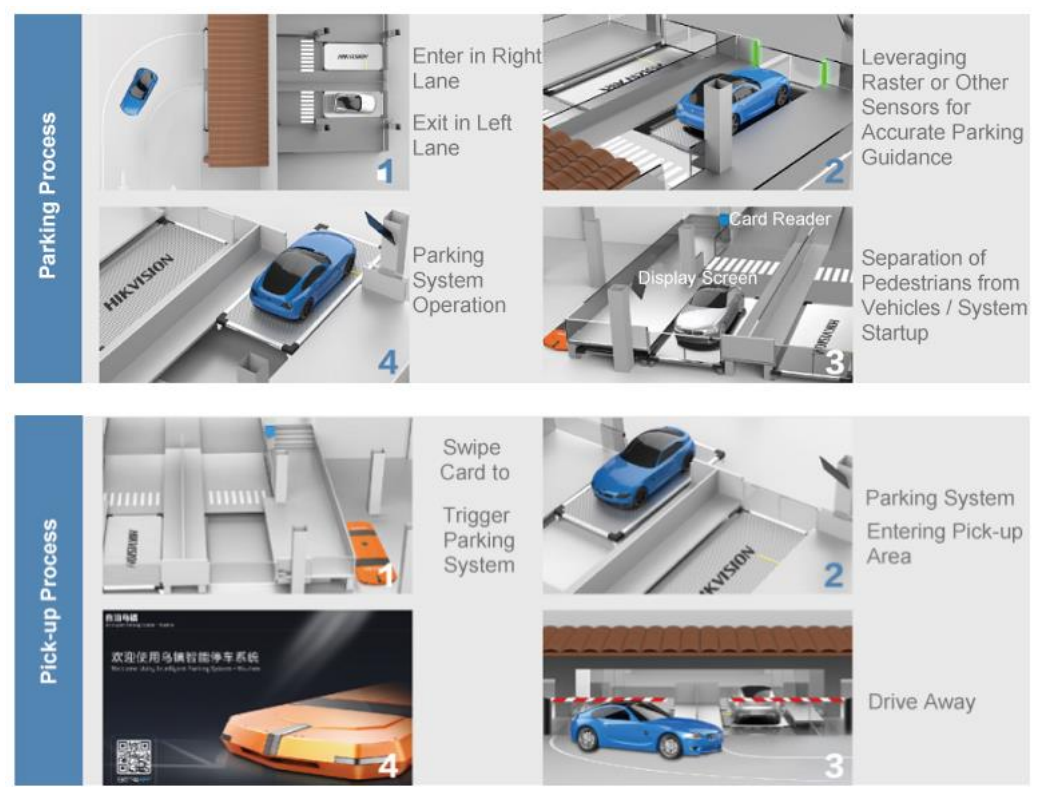
AGV: AGVs are mobile robots used to move materials around a manufacturing facility or warehouse (able to carry goods up to 3,000kg). The competitive landscape in the Chinese market for robots (especially AGV, sorting robots) is fragmented with no dominant supplier. **Siasun (300024.SZ)** is the largest supplier currently (~13% market share in 2016, followed **Yonegy** and **Jing Yuan** according to data from ResearchInChina) and reported Rmb716mn in revenue from logistic robots in 2017. According to ResearchInChina, China saw a substantial rise of 88.5% YoY in AGV sales to 9,950 units in 2016 and AGC products were in the majority in Chinese AGV market, making up around 43% in 2016. It is expected that China's AGV sales will grow at an average annual rate of 43.0% during 2017-2021, achieving 61,000 units in 2021. As a new entrant to this emerging market, Hikvision's extensive local sales network from its traditional surveillance business can help it gain market share and capture the high-growth China market.

Sorting robots: The manufacturing know-how of sorting robots is similar to that of AGVs, But they are mainly used in transfer centers to sort parcels in the

express industry (relatively small and fast among Hikvision’s robot universe but able to carry parcels below 5kg, suitable for the express industry given the trend of smaller parcels and higher volumes). Hikvision has developed a system so that the sorting robots can transport the sorted parcels to the related unloading dock for delivery through the best path (Since they are able to run at 3m/s and identify the QR code to achieve accurate positioning via camera linkage). An STO Express spokesman told the South China Morning Post that the robots had helped the company save half the costs it typically required to use human workers with improved efficiency by around 30% with sorting accuracy. The machines can sort up to 200,000 packages a day on 24/7 mode with self-charging. Given first mover advantage into express industry, we think Hikvision embraces bright future into this new market.

Intelligent parking robots: In light of the large parking demands in urban areas, Hikvision smart parking robot system can automatically guide vehicles to park in a more efficient, standard and compact way, reducing vehicle scratch accidents and static traffic conflicts.

Figure. Hikvision’s parking robots



Source: Hikvision, CASH

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Another bright spot – Drones: Another name for drones is unmanned aerial vehicles (UAVs). Drones are a flying robot, which can be remotely controlled through embedded systems along with sensors and GPS. Drones are widely used in consumer market (aerial photography), parcel delivery in logistics/express, rescue missions during disaster management, surveillance monitoring, crop spraying, mapping in construction, and data gathering in research. Among the market, DJI is currently the largest player in the consumer drone sector with over 60% market share. Hikvision entered this market in 2015 and started to manufacture drones for public services, such as monitoring floods and rescues during disasters. Hikvision has also developed its own UAV jammer, which can be used to stop drones from entering restricted areas such as airports. Fire departments in China have started to use Hikvision's drones and train firemen to pilot drones.

In 2016, 35% of the drone market was controlled by the US, followed by Europe (30%) and China (20%). There were 390,000 drones fly in China in 2016, but this number could increase to 3 mn by 2019 according IDC's forecast (2016-2019 CAGR:97%). We think Hikvision can be benefited by the trend with its expertise/big data in surveillance and security sector.

Figure. Hikvision's UAV and UAV Jammer (to drop/deviate intrusive UAV)



Source: Hikvision, CASH

Figure. Use of Hikvision's UAV in Routine Patrol



Source: Hikvision, CASH

Figure. Use of Hikvision's UAV in Emergency Command



Source: Hikvision, CASH

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Figure. Top 20 players in drone industry in 3Q2016

Source: Droneii.com, CASH

(C) Automotive electronics

Hikvision sets Mobileye as its benchmark for the automotive electronics business in the long run, and has introduced related products such as dashcam, intelligent rearview mirrors, other vehicle-mounted monitoring cameras and related accessories. Existing customers include local EV firms and some JVs, according to management.

(D) Cloud Storage

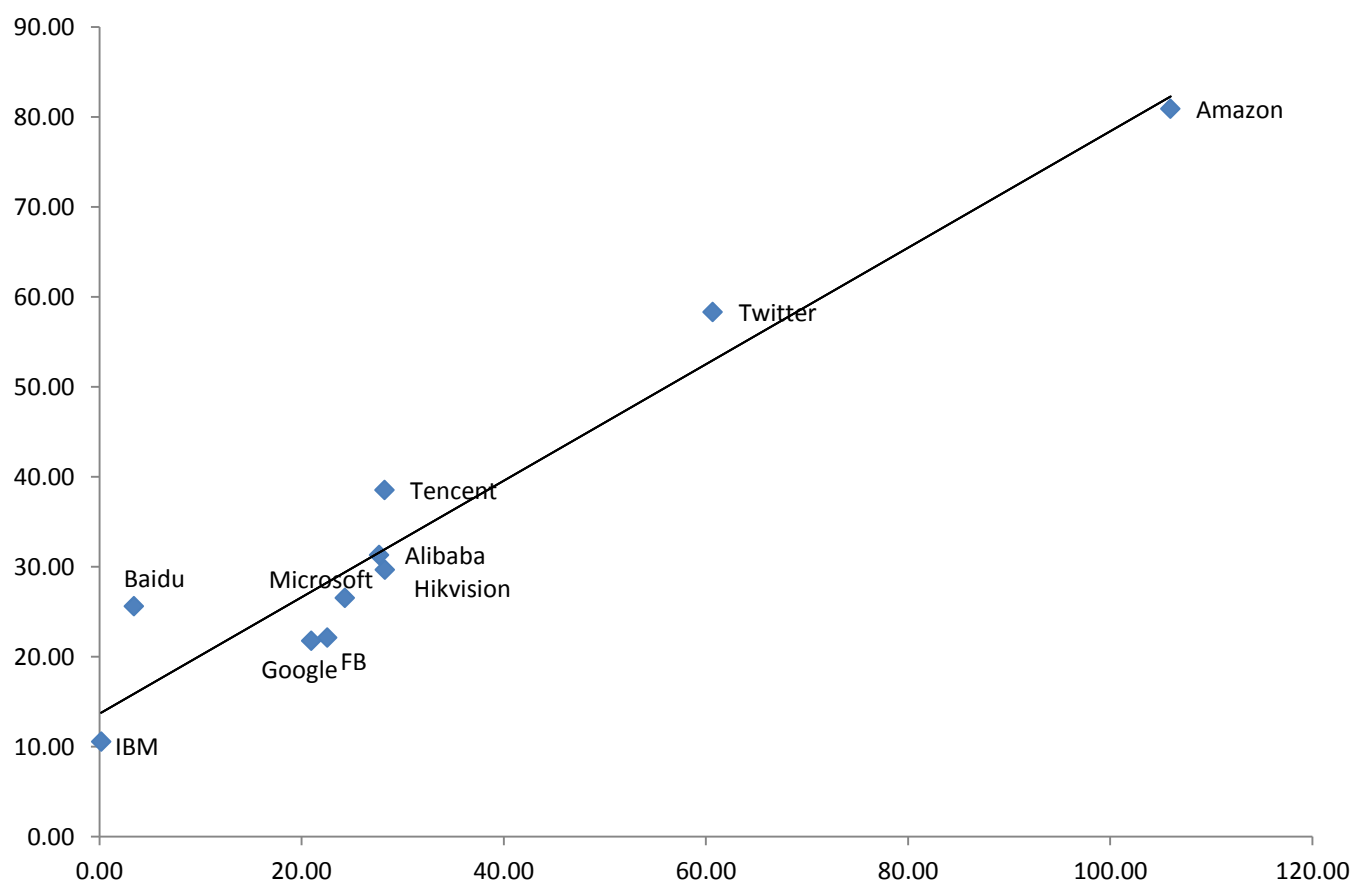
The cloud video storage can help store multiple copies of a single video within a cloud storage system. Multiple devices are able to respond simultaneously to data read/write services, finish massive data search, download data at high speed.

Valuation

Given Hikvision's leading edge in big data, we compare it to Global AI big data plays and find that it is inexpensive. **We revise up our TP from RMB42.30 to RMB45.85 based on 2018 P/E target of 36.7x and 2018-2020E EPS CAGR growth of 26% (PEG=1.4), implying a 17% upside.** We like Hikvision due to (1) robust growth of smart surveillance industry, (2) bright future of machine vision during AI/IoT/Industry 4.0 era, (3) riding along the growth of edge

computing, (4) strong scale advantage and (5) attractive valuation.

Figure. Leading players in big data



Source: Bloomberg, CASH

Downside Risk

Competition with more potential entrants

There are over 1,500 surveillance product providers in China, especially in the relatively low-end. Hikvision expects pricing of AI products to come down as the technology becomes mature given more chip suppliers enter the market. But when AI adoption penetrates into more sectors, the market expansion can offset some of the negative impacts.

Trade war may affect overseas growth outlook

Given the rise in geographic and political risks increase (recent trade dispute between US and China), we think this year overseas growth will be highly uncertain. However, (1) since surveillance camera consists less number of components compared to complex telecommunication system, and Hikvision

also has competent domestic substitutions along its supply chain, we think Hikvision's reliance on certain foreign key component suppliers should be low. Trade war will not dampen its long term investment value. For example, per our understanding Hikvision is currently using lots of lens, application processor and CMOS from competent local suppliers, though Hikvision currently uses lots of AI chips from Nvidia but it has been developing solutions using domestic ASIC (with some ASIC solutions seen small volume shipment). Most importantly, US sales accounted for only 5-6% of total sales with none of it coming from US government agency.

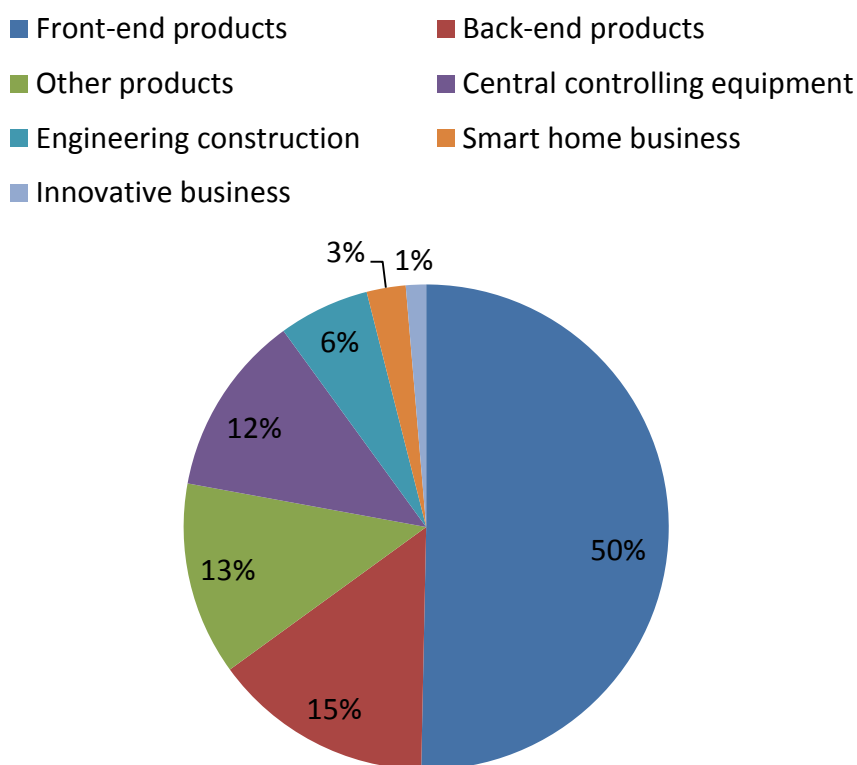
Slowdown of PPP

In order to prevent local government debt risks, China has recently stopped some of its public-private partnership (PPP) projects. Among the projects which are told to stop, the municipal engineering, transportation, and urban comprehensive development projects rank the top three. China is recently halting large amounts of PPP projects nationwide. China's "Skynet" plan may see some short-term slowdown, as the government is restructuring its relevant departments. However, given management's high confidence and limited exposure with risk management to PPP, the related risk should be limited.

Background

As a provider of Internet of Things (IoT) solutions and data operation service based on the video, Hikvision (002415.SZ) provides security, visual management and big data services to customers around the world. We think Hikvision is not only a global video surveillance leader, but also an early starter in computer vision and commercialization with its strong database and deep learning system. The company extended its business to smart home, industrial automation and automotive electronics industries based on video technology to explore potential for long term sustainable development.

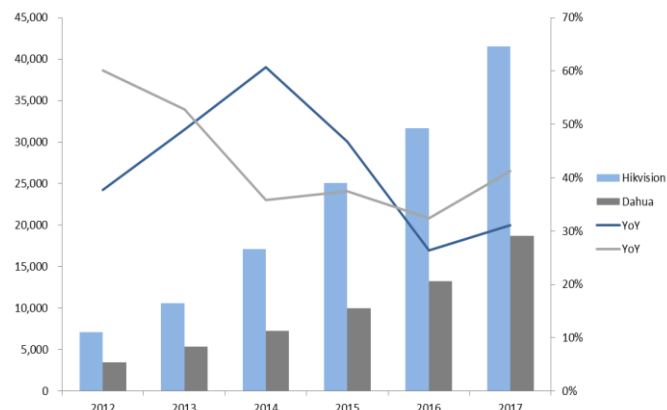
Figure. Hikvision’s revenue breakdown in 2017



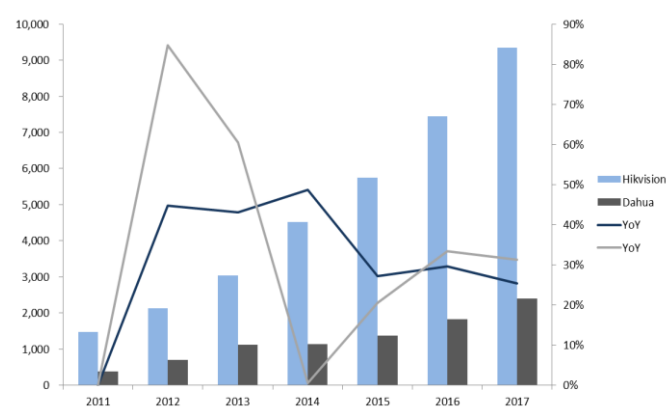
Source: Company data, CASH

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Hikvision revenue (in RMB mn) and YoY

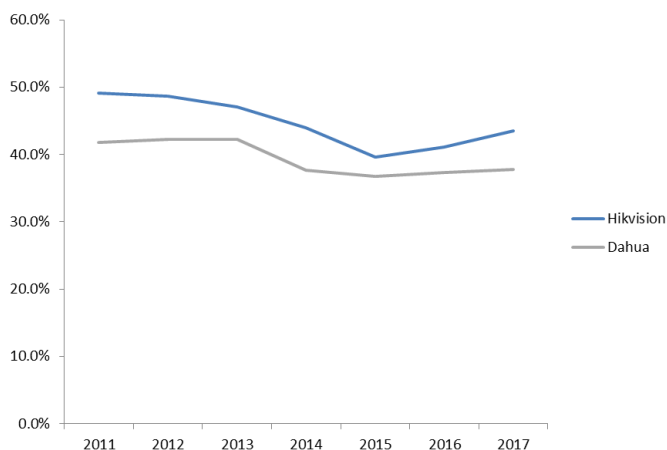


Hikvision net profit (RMB mn) and YoY

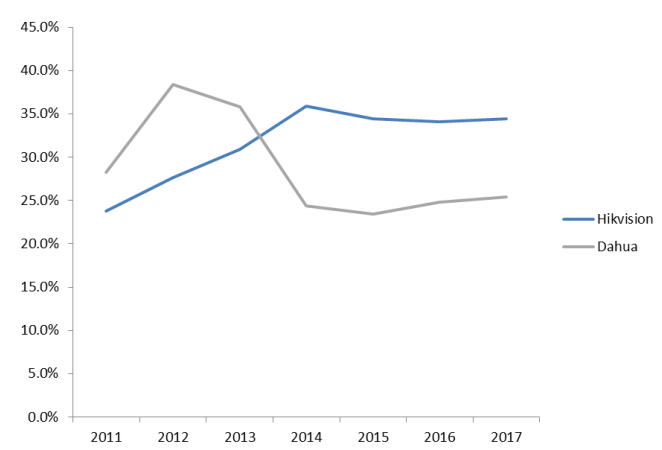


Source: Hikvision, CASH

GPM (Hikvision vs Dahua)



ROE (Hikvision vs Dahua)



Source: Hikvision, CASH

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Hikvision**Income Statement (million RMB\$)**

Year-end 31 Dec	FY16	FY17	FY18E	FY19E	FY20E
Revenue	31,935	41,905	52,817	68,872	87,975
Cost of goods sold	-18,908	-23,838	-29,934	-37,987	-47,744
Gross profit	13,027	18,067	22,883	30,884	40,231
SG&A	-6,101	-8,636	-11,043	-15,093	-20,174
R&D	-2,433	-3,194	-3,823	-4,920	-6,213
Operating profit	6,926	9,432	11,840	15,791	20,057
EBITDA	7,167	9,773	12,254	16,332	20,747
Depreciation	-212	-302	-366	-477	-609
Amortization	-29	-39	-49	-63	-81
EBIT	6,926	9,432	11,840	15,791	20,057
Net interest expense	41	126	86	150	160
Associates & JCEs	0	-3	-3	-3	-3
Other income/other adj	1,347	932	932	932	932
Earnings before tax	8,314	10,487	12,855	16,871	21,146
Income tax	-890	-1,109	-1,368	-1,795	-2,250
Net profit After tax	7,424	9,378	11,488	15,076	18,896
Minority interests	-1	33	33	33	33
Other items	0	0	0	0	0
Preferred dividends	0	0	0	0	0
Normalised NPAT	7,423	9,411	11,521	15,109	18,929
Extraordinary items	0	0	0	0	0
Reported NPAT	7,423	9,411	11,521	15,109	18,929
Dividends	-2,931	-3,800	-4,600	-6,067	-7,580
Transfer to reserves	4,492	5,611	6,920	9,042	11,349

Cashflow statement (million RMB\$)

Year-end 31 Dec	FY16	FY17	FY18E	FY19E	FY20E
Net income		9,411	11,521	15,109	18,929
Depreciation		302	366	477	609
Amortization		39	49	63	81
Change in Net Working Capital		-288	-5,137	-5,424	-6,371
Cashflow from operations		7,373	6,798	10,225	13,248
Capital expenditures		-1,692	-1,820	-2,373	-3,031
Other non current assets		-1,912	0	0	0
Other non current liabilities		261	0	0	0
CF from investing acts		-1,209	-1,820	-2,373	-3,031
CF after investing acts		6,164	4,979	7,852	10,217
Equity issue		4,388	33	33	33
Debt issue		-1,167	133	174	218
Convertible debt issue		0	0	0	0
Dividends		-3,800	-4,600	-6,067	-7,580
CF from financial acts		-3,402	-4,434	-5,860	-7,328
Net cashflow		2,763	545	1,993	2,888
Beginning cash		13,638	16,468	17,013	19,006
Adjustments		68	0	0	0
Ending cash		16,469	17,013	19,006	21,894
Ending net debt		-15,881	-16,293	-18,111	-20,781

Source: Company data, CASH

002415.SZ, Buy, TargetPrice: 45.85**Balance Sheet (million RMB\$)**

Year-end 31 Dec	FY16	FY17	FY18E	FY19E	FY20E
Cash & equivalents	13,638	16,468	17,013	19,006	21,894
Marketable securities	16	4	4	4	4
Accounts receivable	11,243	14,705	18,565	24,208	30,923
Inventories	3,830	4,940	6,133	7,783	9,781
Other current assets	7,805	8,535	11,833	15,430	19,710
Total current assets	36,532	44,653	53,548	66,431	82,313
LT investments	35	130	130	130	130
Fixed assets	2,854	3,024	4,478	6,374	8,796
Goodwill	249	249	249	249	249
Other intangible assets	410	429	381	317	236
Other LT assets	1,268	3,085	3,085	3,085	3,085
Total assets	41,349	51,571	61,872	76,586	94,809
ST debt	32	97	100	97	97
Accounts payable	7,009	10,040	11,852	15,041	18,904
Other current liabilities	5,092	7,064	8,466	10,744	13,503
Total current liabilities	12,133	17,201	20,418	25,881	32,503
LT debt	1,722	490	621	798	1,016
Convertible debt	0	0	0	0	0
Other LT liabilities	3,014	3,275	3,275	3,275	3,275
Total liabilities	16,870	20,967	24,314	29,954	36,795
Minority interest	193	246	279	312	345
Preferred interest	0	0	0	0	0
Common stock	6,103	9,229	9,229	9,229	9,229
Retained earnings	14,861	16,598	23,519	32,560	43,910
Proposed dividend	-2,931	-3,800	-4,600	-6,067	-7,580
Other equity and reserves	3,322	4,531	4,531	4,531	4,531
Total shareholders' equity	24,479	30,604	37,558	46,632	58,014
Total equity & liabilities	41,348	51,571	61,872	76,586	94,809

Key Ratios

	FY16	FY17	FY18E	FY19E	FY20E
Profitability (%)					
Gross margin	40.8%	43.1%	43.3%	44.8%	45.7%
EBITDA margin	22.4%	23.3%	23.2%	23.7%	23.6%
EBIT margin	21.7%	22.5%	22.4%	22.9%	22.8%
Net Margin	23.2%	22.4%	21.7%	21.9%	21.5%
Effective tax rate	10.7%	10.6%	10.6%	10.6%	10.6%
Dividend payout	39.5%	40.4%	39.9%	40.2%	40.0%
ROE	30.6%	30.9%	30.8%	32.5%	32.8%
ROA	18.0%	18.2%	18.6%	19.7%	20.0%
Liquidity (x)					
Current ratio	3.01	2.60	2.62	2.57	2.53
Interest coverage	N/A	N/A	N/A	N/A	N/A
Leverage					
Net Debt/EBITDA (x)		net cash	net cash	net cash	net cash
Net Debt/Equity (%)		net cash	net cash	net cash	net cash
Activity (days)					
Days receivable	128.5	128.1	128.3	128.3	128.3
Days inventory	43.8	43.0	42.4	41.2	40.6
Days payable	80.1	87.4	81.9	79.7	78.4
Cash cycle	92.2	83.7	88.8	89.8	90.4

Source: Company data, CASH

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