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Vispera: Visual Intelligence for Retail

I set out to create the first high-tech unicorn, the top image processing company in retail, to come out of Turkey.

— Aytul Ercil, Vispera Co-founder and CEO

Sitting in her office in Istanbul in March 2019, Aytul Ercil, PhD, co-founder and CEO of Vispera, a computer vision technology provider for retail, was reviewing her schedule for the day. Together with her co-founder and Vispera's CTO Ceyhun Burak Akgul, PhD, she needed to review the results of a new pilot study, discuss lists of partners and customers, attend a research and development (R&D) team meeting, and reconcile plans for the next round of fundraising. Knowing there was no way she could possibly get to all the items on her agenda, she was deciding how she would prioritize.

Vispera's technology^a and its automated visual analysis enabled retail and fast-moving consumer goods (FMCG) companies around the world to track "share-of-shelf," "speed-to-shelf," visible out-of-stock, and to monitor everything from the position of product displays, to sales correlations, competitor moves, and store ranking. Vispera's customers sought to use these indicators to minimize stock-outs, increase sales, reduce personnel costs, and improve operational efficiency. At the end of 2016, Amazon had rolled out the first Amazon Go brick-and-mortar store in the U.S., allowing customers to see how computer vision, Artificial Intelligence (AI), and sensor fusion would create a frictionless, cashier-free shopping experience. FMCG players and retailers worldwide had rushed to up their game with use of technology. As of 2019, however, there were still only a handful of computer vision players servicing the retail space.¹

Vispera was one such player, and it had recently debuted its fixed-camera shelf monitoring technology in addition to its image recognition technology for in-store cabinets and hotzones. (See **Exhibit 1** for Vispera's major milestones). The time spent on customer pilots and onboarding processes seemed to be paying off, albeit slowly. The market was becoming a land-grab opportunity, and the main competitor had deep pockets, having recently closed a three-digit funding round. To increase traction, Vispera was trying to meet customer needs and answer questions on a daily basis. At the same time, Vispera needed to keep investing in R&D to keep its technology relevant in the digitalizing retail

^a For a video of how Vispera's technology works: <https://www.youtube.com/watch?v=bzePuntHh2w>

Professor Yael Grushka-Cockayne and Assistant Director Gamze Yucaoglu (Middle East & North Africa Research Center) prepared this case. It was reviewed and approved before publication by a company designate. Funding for the development of this case was provided by Harvard Business School and not by the company. HBS cases are developed solely as the basis for class discussion. Cases are not intended to serve as endorsements, sources of primary data, or illustrations of effective or ineffective management.

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environment and to remain competitive while many new technology players were popping up around the world.² On top of all this, the co-founders needed to step back to think about the big picture for their company. Ercil and Akgul had set up Vispera with the intention of making it a leading global player. To actualize this vision, should the team focus on developing shelf availability and out-of-stock prediction capabilities or focus on dynamic pricing, customization, and real-time campaign management? Or should Vispera pivot to provide insights beyond the shelf as a number of players were entering its space already? How should the team think about data ownership: could Vispera leverage the data to drive cross-industry insights or a market level perspective? What did Ercil need to prioritize today that would set Vispera up to achieve the vision she had for the company?

From Academia to Entrepreneurship: Aytul Ercil

After graduating with a double major in electrical engineering and mathematics from the esteemed Bogazici University in Turkey, Ercil went on to Brown University in the U.S., where she pursued a master's and PhD in applied mathematics with a minor in pattern recognition and control theory. In 1995, she returned to Turkey, to Bogazici University, this time as a faculty member to teach computer vision and pattern recognition. She recalled, "The link between industry and academia was not developed, so I cooperated with local and European research institutes, sought out funding, and developed award-winning projects. But I wanted my work to go beyond research and prototypes." In 1997, while she pursued her academic career full-time, Ercil, together with two of her former students, founded Vistek, a machine-vision technology company aimed at manufacturing and industrial facilities, especially those in the automotive industry, helping them detect defects parts in assembly lines or match parts to specific models during production. Much to Ercil's disappointment, her solution was not enthusiastically embraced in Turkey. Ercil refused to give up; she shifted her focus to finding customers abroad. In 2001, Ercil transferred to Sabanci University (Sabanci) to teach statistics, computer vision and machine learning. She remarked: "I was trying to grow Vistek on the side, but it had not been easy. With no venture capitals (VCs) or angel investors in Turkey, we were really struggling to get funding. Sabanci had an incubator and wanted to support Vistek. As one of the largest industrial and financial conglomerates in Turkey, the Sabanci name carries weight in Turkey, so that opened a lot of doors for us." Vistek grew faster during this time and developed many new projects abroad. In 2008, as one of the few of its kind, Vistek's machine vision technology captured the interest of ISRA Vision (ISRA), a Germany-based provider of machine vision technology for industrial inspection.

In 2009, when Vistek's revenues were approaching \$300,000, Ercil sold 24% of Vistek's shares to ISRA with an agreement to sell the remainder over the next four years.³ Vistek took off fast with ISRA's support. Several angel networks and incubators appeared. In 2013, Ercil was selected both as "Woman Entrepreneur of the Year" and "Endeavor Entrepreneur" by Endeavor Turkey, an international non-profit organization that aimed to expand its high-impact entrepreneurship model globally, for "putting Turkey on the map for computer pattern recognition and machine vision systems."⁴ The same year, she sold the remainder of her shares and fully exited Vistek.

Founding Vispera

In 2014, together with Akgul, who had joined Vistek in 2010 as its R&D manager, Ercil set up Vispera.⁵ Akgul said, "During my job interview for Vistek, I had shared my dreams of founding a computer vision and machine learning company with Aytul, and we had a great experience at Vistek together. We share the same passion and ambition to develop world-class technology." The co-founders wanted to center Vispera's business around computer vision technology, but the non-compete agreement with ISRA stipulated that they could not focus on the same industries. Therefore,

Ercil and Akgul worked to develop the value proposition for Vispera's technology. Exploring the potential usage of the technology, they decided to focus on uses for retail automation, monitoring product counts and shelf positioning, which would not only improve inventory management but would also allow the companies to monitor their competition's shelves. Akgul said, "Our research showed that retail players lost \$1.1 trillion per year due to stock-outs and inefficiencies in the shelving of the products."⁶ Ercil and Akgul were certain Vispera's technology could help.

Retail Audit and Computer Vision

For decades, FMCG companies such as Unilever or P&G had relied on hundreds of field agents, sales reps, and market research companies that conducted retail audits to ensure that their products and brands were positioned on the right shelves, in line with the instructions of their marketing departments, and that price tags and promotional material were easily visible. Also, stocking and shelving had to be done efficiently to ensure the products were available to customers at all times. Typically, the retail audit process worked as follows: in-house reps or employees of market research companies would plan randomized store visits to compile data: manually count the products on the shelves, check the availability of their brand and that of the competition, monitor compliance with the company's planogram, and report back to the head office.⁷ (See **Exhibit 2** for a sample planogram.) Although brands did not typically impose penalties when retailers departed from the planogram, they did task their (audit) employees to ensure that retailers adhere to planogram compliance. A benchmark study in 2010 found that retailers that achieved compliance saw a 7.8% increase in annual sales (an estimated \$3.8 million increase for a 200-store chain) and an 8.1% increase in profits.⁸ Another study estimated that the total cost of non-compliance was approximately 1% of gross product sales in the industry, which was roughly between \$10 billion and \$15 billion of lost sales in the FMCG channels.⁹

Retailers also spent millions of dollars to optimize inventory and manage orders to be able to maximally monetize the physical space in their stores,¹⁰ and their in-house teams were on the ground to ensure the best results as well. These methods were labor-intensive and inefficient, because large teams were needed to visit thousands of stores every month,¹¹ and it took weeks to compile and interpret data. Real-time or actionable feedback was not available and store personnel were not fast or accurate enough to keep up with the necessary level of detail and replenishment.

A 2002 study that examined the extent, causes, and customer response to stockouts found the average worldwide out-of-stock rate to be 8.3% and sales losses due to stockouts to hover around 3.9% globally which corresponded to a reduction in average shopper's basket (per trip) from \$43.25 to \$41.52.¹² A 2018 report by the same authors found similar levels of stockout levels (8.2%) among online retailers.¹³ With omnichannel becoming more prevalent, it was more important than ever that FMCG and retail companies be able to keep close track of their merchandise and inventory.¹⁴

Since the 2000s, computer vision technology had evolved rapidly. Algorithms that used machines to understand and analyze imagery had been around since the 1960s, but now, the advent of deep learning technologies and improved computing power had enabled computer vision to become faster, less prone to errors, and reach levels that were on par with human accuracy, making it feasible to implement computer vision in retail.¹⁵ Simply defined, computer vision, a prominent subbranch of wider AI technology, was a collection of techniques and algorithms trained to process, analyze, and identify patterns and to then "label" the world around it accordingly, with the aim of automatizing what the human eye could do."¹⁶ (See **Appendix** for an overview of computer vision technology.)

Vispera: Intelligence in the Store

Having agreed to focus on retail, the Vispera team set up shop in a small office in Istanbul and got to work. Ercil and Akgul talked to market research companies, FMCG companies, and retailers to thoroughly understand their pain points. The co-founders concluded that a successful technology would need to “see,” or recognize, thousands of different products (or Stock Keeping Unit, SKUs), which at times differed from each other only slightly, and to track planogram compliance. Ercil said:

Talking to various players, we found out that if a planogram is perfectly applied in a store as designed by the marketing department, profits increased and stock outs decreased. From a pilot we did, we saw that, on an average day, more than two thirds of all missing products were actually available in the store but were not on the correct shelf – an example clearly illustrating how much shelf out-of-stocks weigh over store out-of-stocks.¹⁷ This number hovers around 25% globally.

Akgul said, “Our focus at Vispera was completely different than what we had built at Vistek. We started with zero lines of software code. Our advantage was that we had a great team that had worked together and was very eager to get the product out onto the market. It took us a year of hard work to develop the proprietary computer vision technology specific to retail.” In 2015, Ercil left academia to dedicate herself full-time to the growth and success of Vispera.

The Technology

Vispera’s technology worked in two stages to convert an image into data. First, Vispera’s engine was fed a training set of images and labels (provided by the customer) “to learn” the visual model—using deep learning, the algorithm learned to extract a model that would map what it “saw” in the image to the label (the specific SKU or classification e.g. “Coca Cola 2 liter bottle”). Vispera used domain specific data for training its recognition engine and leveraged its prior learnings from past projects, which enabled its models to learn quickly. Akgul explained with an analogy, “When human beings need to learn a new object, they do not start from scratch. We already have some visual models in our mind and when a new task arrives we just adapt.”

Next, the model applied an optimization algorithm and some adaptation of the topology of the state-of-the-art neural networks to the data to produce a “confidence” mechanism. As a result, Vispera’s engine not only associated the image with the label but it could also generate a confidence level associated with each prediction. Akgul commented, “We train the engine with a computational procedure to make the algorithm more effective and efficient. The confidence mechanism provides us with accuracy guarantees and helps us manage our workload when it comes to quality control.”

Once the engine was trained for a new customer/product group, it could be put to test on real store data. Next, Vispera could start in-store audit and data analysis. In order to collect images from the stores, an employee of the store or market research company entered the stores and photographed the shelves (where the company’s products were located) using a smartphone. Using the Vispera app, the rep then uploaded the images from each store onto the Vispera cloud-based platform. Although the images were stored in the cloud (unless otherwise requested by the customer), Vispera’s engine fetched the images to its own servers when it processed them. The engine first parsed the retail scene (the photo captured) into shelves, sections, shelf lines, etc. to create a realogram (a virtual layout) to apply the compliance metrics. (See **Exhibit 3** for a technology-stitched image by Vispera.) The engine then detected the different objects (SKUs on which it had been trained) and identified the corresponding labels. Akgul said:

Object detection and recognition are our standard capabilities. On top of that, we are also able to perform property recognition such as recognizing arbitrary promotional display equipment or any element that pertains to the display policy of a customer. We are also able to provide price tag readings. Our engines are organized in the so called micro-service architecture that enables us to address the needs of a particular customer very efficiently from the same stack. You can think of these engines like Lego blocks and we can configure our architecture and adjust blocks to put together a solution very easily. (See **Exhibit 4** for Vispera's image capture.)

It typically took Vispera two months to optimize its engines and establish accuracy levels for a new customer/project. Using automatic processes, Vispera was able to provide above 96% accuracy levels at the SKU-level. It could guarantee 99% accuracy using manual operators that would verify that the images were correctly recognized. Every two weeks, Vispera's engine was retrained as new SKUs or new images for existing SKUs were collected. The engine processed close to 250,000 images per month (8,000 photos per day). Akgul commented, "From the get go, we were able to report data with over 96% accuracy, far better than human reporting and superior to what was available on the market. And the more SKU images we fed out engine, the quicker and more accurate it became."

In 2016, Vispera was ready to pilot its technology with Unilever Turkey, which had previously outsourced its retail audit and had even tried using third party technology without success.

The Reporting

Vispera's image recognition technology was fully integrated into a reporting system that included a customized dashboard. The system modularized and analyzed the shelf images in line with the KPIs the customer wanted tracked (such as planogram compliance, product availability, share-of-shelf and speed-to-shelf) and generated a full report within 24 hours. (See **Exhibit 5** for an overview of Vispera's reporting.) Akgul elaborated:

Vispera is the fitness app for retail: we help retail companies measure their performance so they can take the right actions. From their dashboard, customers can filter data by location, SKU, hour, and so on—it's very granular and quite fast. This gives them the ability to take immediate action, without having to wait for a report at the end of the month.

By the end of 2016, Unilever declared the pilot a success, and looked to expand Vispera's coverage. Commenting on their experience with Vispera, Riza Gulluoglu, customer development excellence director at Unilever, said, "We did a pilot with Vispera covering 20,000 locations where our field agents took pictures using the Vispera app. Our field agents used the time saved from taking pictures to develop a better relationship with the customers. The insights provided by Vispera also helped us to make better operational decision such as guiding the retailers to stock the items that sold well and negotiating with retailers for appropriate shelf space."

The Go-to-Market Strategy

Business-to-Business (B2B) In 2016, Didem Celikkanat Ozan joined Vispera as its global account manager. She had previously spent a decade at TUBITAK, Turkey's leading research agency, and then at Unilever Turkey as R&D technical project leader. She recalled, "When I joined, Vispera was reaching out to big FMCG players; Aytul and Ceyhun were pitching to multinationals and offering pilots themselves. I took over this part of the process and made it my job to understand these companies' existing methodologies and their approach to digitalization and technology." Celikkanat

Ozan began by compiling the business cases to illustrate the benefits of working with Vispera. (See Figure 1.)

Figure 1 Benefits of Working with Vispera

	Self/3 rd Party Audit		Audit w/ Vispera app	
	Classic Channel (Mom & Pop Stores)	Modern Retail	Classic Channel (Mom & Pop Stores)	Modern Retail
Cost of human labor ⁺ /visit	20 TL	60TL	5 TL	15TL
Time spent (minutes)	15	45	5	15
Coverage (Number of stores visited/day)	20	5	60**	15**
Level of accuracy***	70%	70%	Minimum 93%	Minimum 93%
Number of photos taken/store	N/A	N/A	3	25

Source: Case writer interviews.

Note: * Figures indicate cost of labor in Turkey in 2019. Minimum hourly wage plus transportation costs should be assumed for other geographies.**Number of stores covered does not indicate the maximum coverage possible through Vispera, as some clients preferred to downsize the field team instead of maximizing the coverage.*** 70% accuracy assumed via human labor.

The team had also segmented the customer pyramid into three main groups based on each group's familiarity with vision recognition technology to see which groups to target. Celikkanat Ozan said:

We saw that we needed to create awareness and educate the wide segment at the bottom. The middle of the pyramid had heard of vision recognition technology; some had even tried earlier versions but were not happy – Vispera needed to win them over. The ones at the top were already doing in-store monitoring and wanted to advance. Among these, global customers with a digitalization agenda were already motivated by their own headquarters, so these were easier to win over but competition was higher.

Together with Ercil and Akgul, Celikkanat Ozan next created a pipeline of leads from the mid-segment and offered pilots to persuade the potential customers. Vispera was expanding the coverage with Unilever and initiating talks with Coca-Cola Icecek, the Coca-Cola multinational bottler, P&G, and Ulker, the Turkish confectionary giant. The team also began compiling a list of supermarket chains that could use Vispera's technology to optimize their inventory management.

Partners It took Vispera, on average, 12 months to sign a formal contract with a new customer. Celikkanat Ozan explained, "Once a pilot was deemed successful, the results would then need to be presented higher up in the organization to get approval and expand the coverage. And with each new person, we needed to gain their trust and get buy in." The team realized they needed to widen their go-to-market routes and approached partners through channels other than direct B2B. Vispera had already been contacted by several retail solution providers (companies that helped brands with services such as consulting, analysis, processing etc.) who wanted to include Vispera's solution into their offering in their own country or region.

The Business Model

Vispera positioned itself as a technology company and adopted a software-as-a-service (SaaS) business model whereby Vispera hosted and maintained the servers, the photos database (unless otherwise requested) and the algorithm. Customers were able to access the data online anywhere, anytime. For this service, Vispera charged customers an initial set-up fee (ranging from \$1500-6500

depending on the project size) and a one-time fee for software customization if requested (based on development time). Vispera also handled the customer support and maintenance functions and this was billed on a monthly basis as a fraction (hovered around 15% in total) of the total project cost. While Vispera started off offering a single pricing package with a 99% accuracy guarantee, the company then segmented its offering by level of accuracy (93%, 96% and 99% accuracy^b) and number/types of KPIs reported. Accordingly, at the end of each month, the company charged a total amount where the analyzed photos were priced based on the contracted accuracy level. (See **Exhibit 6** for pricing options.). Ercil explained:

We realized that when companies made the switch from manual audit to auditing with technology, their benchmark for accuracy was not necessarily 99%. For years, they were used to getting at best 70% accuracy. Our market intelligence told us that, with 99%, we were way above the accuracy levels promised by the competition. So, we decided to segment our offering to be able to provide better prices to those companies who were happy with a marginally lower accuracy levels. Our ability to do this, price our offering based on accuracy level and KPI sophistication, also helped set us apart from competition.

Since the inception of Vispera, apart from a \$500,000 EU-backed funding, Ercil had been self-financing Vispera. In time, as the team and the customer base grew, so did costs. The long pilot periods were also putting a strain on the company's financials. In 2016, Ercil and Akgul decided to raise a small round of financing. Ercil said, "We weren't yet ready for institutional investors, and we didn't have the bandwidth to go for a very structured fundraising for a large sum. So, we reached out to angel investors and angel institutions." In a couple of months, the co-founders raised \$750,000 at a \$6-million valuation with the participation of Keiretsu Forum Turkey, one of the preeminent private equity/angel investment organizations in Turkey; Keiretsu in the U.S.; and a number of Turkish angel investors.¹⁸ Vispera became the first investment outside the U.S. for Keiretsu Capital.¹⁹

Future of Retail: Amazon Go

While Vispera was making the rounds trying to convince retailers of the role of computer vision in the future of retail, Amazon opened its first human-less store, Amazon Go,^c in Seattle in 2016, marking its entrance into brick-and-mortar retail. The store itself was a showcase of computer vision, AI, and sensor fusion.²⁰ Deep learning enabled Amazon Go's system to obtain in-depth knowledge about all items in the store, and AI identified consumer behavior and preferences in the store, vital information that was to be used in making strategic decisions about product mix and marketing.²¹ In Amazon Go, each shelf was tracked by sensors and cameras, and payment was automatized. When a customer took products from the shelf, sensors registered the selected products and transmitted the information about the purchases to the store's online processing system, charging the total amount directly to the customer's Amazon Prime account before the customer even left the store.²² The experience was seamless: customers entered the store, picked up the products they wanted, and left the store without having to queue to process payments.²³ Essentially, Amazon Go was a glimpse into the future of retail: the comprehensive camera and sensor systems could eventually send out automatic alerts for re-shelving, dynamic pricing, and instant promotion capabilities for brand owners, and personalized

^b Vispera employees went through the images to ensure higher accuracy for packages with 96% and 99% level accuracy.

^c To watch a video of how Amazon Go functions, visit <https://youtu.be/NrmMk1Myrxc>

shopping suggestions to customers.²⁴ Based on the success of its store in Seattle, Amazon announced plans to open 2,000 more such stores across the U.S. by the end of 2018.²⁵

The future Ercil and Akgul had imagined for Vispera seemed to have arrived. They felt this was the time to take advantage of the hype around retail technology. The duo went for another round of financing and before the end of 2017, they had raised \$1.2 million from Logo Ventures, a Turkish corporate VC firm with a focus on deep technology know-how and R&D, at a valuation of \$12 million.²⁶ Orhan Ayanlar, an investment committee member at Logo Ventures, said:

We were now looking to invest in retail technology, something with a proof of concept and a good team that could be scaled globally. We met Aytul and did a thorough technical due diligence to make sure that the company had best-in-class R&D and that there was real content. Vispera passed with flying colors. The timing was also right; technology was still very new in physical retail and we saw how Vispera could transition companies from a people-heavy model to AI.

Competitive Environment

Traditionally, retail audit was done through manual labor. Acosta, a 90-year old U.S. based company with over 100 offices around the world, was one of the major players that serviced this market with its over 35,000 sales and marketing agents who visited 200,000 outlets around the world every month.²⁷ The privately held sales and marketing agency worked across channels including convenience stores, drugstores, e-commerce, as well as grocery and mass merchandisers²⁸ and provided services including business intelligence, retail merchandising, retail marketing and frontend activation to the top global consumer packaged goods (CPG) players.²⁹ Then, in the late 2000s, players using technology entered the market. In 2017, the global AI market for the retail sector was valued at \$112.0 million, and estimates indicated it would reach \$1.2 billion by 2023, growing at a CAGR of 48.6%.³⁰ Patent applications for computer vision technology were on the rise. (See **Exhibit 7** for patent application growth.) In addition to companies such as WorkFusion and Accenture, which offered a mix of retail, audit, and automation solutions, there were a few companies like Vispera that offered pure computer vision and analytics services to the retail sector. The two largest competitors, Planorama and Trax Retail, had been around longer than Vispera.

Planorama

Founded in 2009, Planorama was based in Paris with satellite offices in North America, South America, Europe, and South-East Asia.³¹ From the get go, the mission of the company had been to enable FMCG companies “to leverage the power of image recognition to improve their retail execution.” Planorama provided three main solutions: PlanoCheck for retail execution, PlanoConvert for planogram compliance, and PlanoManager for space planning.³² (See **Exhibit 8** for an overview of solutions offered.) In 2017, the company employed 110 professionals and serviced over 250 customers, including leading multinational such as Unilever and Danone.³³

As of 2017, the company was privately held and had received investments from the Smollan Group and the Kantar Retail Group, both part of WPP, a British multinational advertising and public relations company.³⁴

Trax Retail

Founded in 2010, Trax Retail (Trax) was headquartered in Singapore with offices throughout the world and had an R&D base in Israel.³⁵ The company defined its mission as “delivering a fast, accurate and consistent way for customers to optimize how their products are executed on the shelf.”³⁶ Trax offered three main products: Retail Execution to facilitate auditing of CPG companies, a Shelf Intelligence Suite (by Trax and Nielsen) to provide analysis, and Retail Watch to deliver real-time store monitoring analytics. Trax announced that it analyzed an average of over eight million images every month³⁷ for its customers that included global brands such as Coca-Cola, ABInBev, Heineken, Nestlé, and Henkel.³⁸

During the eight years since its founding, Trax’s founders had raised over \$160 million from investors, including the global private equity firm Warburg Pincus³⁹ and Investec Bank plc, a member of an international specialist banking and asset management group.⁴⁰ In 2018, Trax announced that, with the help of Warburg Pincus, it would be entering the Chinese market.⁴¹

Competition Heats Up

As the technology became more widely known and the number of players grew, demand on the customer side also increased. A 2017 survey reported that in global retail, an estimated 1.9 billion photos per month required image recognition, a figure that was expected to rise to about 3.5 billion over the next couple of years.⁴² Vispera was keen to grab as much of the market as possible.

In mid-2017, Vispera approached Coca-Cola Icecek. Sevi Sidar, then the international research manager at Coca-Cola Icecek, recalled:

We had been searching for technology partners to track in-store execution KPIs as per Coca-Cola Icecek’s RED (right execution daily)^d initiative. We had done pilots and/or assessed the capability of available solution partners such as Trax, Planorama, Accenture, and Nexium. With some, the accuracy was low; with others, we weren’t happy with the reporting. And most importantly, we didn’t feel that any of them were flexible enough as desired: to act not only as a technology solution partner but as well as a market research agency. We frequently sent thousands of new images and asked for complex calculations. So, it was crucial that our counterpart had business acumen and flexibility.

Sidar gave Vispera a try and compared the results with those of previous pilots. She was pleasantly surprised, recalling, “The Vispera team was very engaged and proactive and they integrated our master data and routing lists into their system and understood the depth we wanted see in the data. We were able to go into store-level data to see the results of analyzed pictures and planogram, and on the same page, to verify calculations.” Sidar decided to work with Vispera for the company’s Kazakhstan and Iraq operations. Meanwhile, Celikkanat Ozan and her colleagues were making progress with other

^d RED, the tracking system, was aligned to Coca-Cola’s commercial strategy, and was created to monitor and define flawless execution in the market, turning strategy into measurable action on an individual outlet level. The RED initiative helped Coca-Cola monitor the mix of products on store shelves in each store. For example, it could track how many 1-liter containers of Diet Coke were on store shelves compared to the number of 12-ounce cans, making it possible for the company to manage supply and build sales and to see what position Coca-Cola occupied in each market. Source: Phil Patton, “Drive to Optimize: Coca-Cola’s Commercial Innovations, Large and Small,” November 11, 2014, <https://www.coca-colacompany.com/stories/the-drive-to-optimize-coca-colas-large-and-small-innovations>, accessed April 2019.

retailers and were now able to show the benefits of working with Vispera via the company's own case studies. (See **Exhibit 9** for Vispera use cases.)

Vispera Forges Ahead

In 2018, while growing its customer base, Vispera unveiled three new technologies it had developed and successfully piloted. The first was Shelvesight, Vispera's fixed-camera^e shelf monitoring solution that eliminated the need for store visits to capture images via smartphones, thus enabling continuous real-time analysis of customers' operations. The company would charge a set-up cost for the cameras (priced at dollars per meter shelf space), and instead of monthly chargebacks based on number of images analyzed, Vispera would charge a monthly licencing fee. Second, Vispera debuted the technology it had initially developed for Unilever that was able to capture data from overhead cameras positioned above outdoor ice-cream cabinets. Ali Coskun, then the customer development director at Unilever, said:

In Turkey, seasonality in ice cream sales was significant: Majority of our turnover was in the summer, so every day counted. We couldn't afford to run out of stock. We needed a tool that would help us see whether we needed to replenish the cooler, whether there were non-Unilever products in our cooler, and if our promotional material – an umbrella and a trash can that were Unilever-branded – was in fact positioned as per our instructions next to the cooler. Vispera developed a solution that enabled us to track our stock levels without having to visit the stores every day.

By the third quarter of 2018, Unilever had onboarded Vispera both for its personal care line and ice cream and was using the technology in line with its worldwide Perfect Store^f initiative, where Unilever aimed for each store to look and feel the same (to streamline the customer experience and increase profitability). Coskun commented, "We were already scoring parameters such as availability, stock-outs, and shelving across all stores. Yet the process was cumbersome. Vispera helped us optimize this effort. Once we were able to rely on their technology and the reporting, our reps efforts became less about the perfect score, and they began to focus more on getting to the perfect store."

The third new technology Vispera developed was a solution for supermarket "hotzones," areas near the check-out counters and at aisle ends; it would allow brands to check whether their product was indeed positioned near the cashier and within easy reach.

The new offerings brought two additional types of partners into Vispera's portfolio: technology (hardware) partners such as Intel and Cisco, who helped Vispera with their fixed-camera solutions, and system integrators, who supported Vispera by installing and maintaining the cameras.⁴³ (See **Exhibit 10** for an overview of Vispera's product offering.) Keen to maintain the momentum, Ercil and Akgul went for another round of financing. Before the end of 2018, Vispera closed the round, having raised \$250,000 (with an additional \$450,000 to be transferred in 2019) at a \$25-million valuation from

^e Vispera partnered with Intel AI builder, with Intel selling the infrastructure and Vispera providing the data analysis to the customer.

^f Unilever kicked off its PerfectStore initiative in the late 2000s and rolled it out globally. Among FMCG companies, the goal of the "Perfect Store" was to correctly merchandise and place products based on insights about shoppers in every store and to have the relevant assortment available and visible. Proper in-store tools and communication would also be in place to close the sales to improve business performance and achieve growth. Source: Othilie Nicod, "How Unilever Portugal reduced their audit costs for store checks by 80%," Planorama (blog), February 8, 2019, <https://blog.planorama.com/how-unilever-portugal-reduced-their-audit-costs-for-store-checks>, accessed April 2019.

the Technology Development Foundation of Turkey (TTGV), which managed Turkey's first public-private funded program to support R&D in the private sector and technological innovation projects.

Looking Ahead: Challenges and Opportunities

By January 2019, Vispera had grown to 50 people in operations, sales and R&D, and Vispera had signed agreements with six new sales partners to cover different geographies. The team was aware that one of its major competitors had recently made a big leap: in the second half of 2018 Trax had closed a \$125-million round from Boyu Capital, one of the largest private equity investment firms in Greater China, and DC Thomson, a leading UK media organization, bringing its total raised funds to \$235 million.⁴⁴ In the meantime, computer vision technology was becoming more visible to retailers: the number of Amazon Go stores in the U.S. reached 12.⁴⁵

In early 2019, Jon Stine, a former consultant for industry sales and strategy for the Intel Corporation and Cisco Systems, joined Vispera's advisory board. Stein, who also advised top-tier retailers and CPG brands worldwide, believed in Vispera and was confident that its technology was at the core of the future of retail. He said:

[In the future,] the purpose of the store will change. The size of the store will change. The tasks within the store will change, and the capabilities of the store will change. But the store will still be there. There will be multiple touch points for the customer and numerous points for fulfillment. The physical store will definitely be one node in this complex network – a fulfillment center. And for that reason, it is absolutely essential that the retailers know their inventory down to the last eyelash. That's why computer vision is so important, especially in FMCG. For reasons of cost, they cannot adopt any other technology that enables real-time inventory accuracy. And they need technology to help them avoid overstock while still keeping reasonable levels of stock as a cushion – just in case. For them to be able to do this, to improve the stores' connections to the customer and all along the supply chain, computer vision needs to be at the center of their transformation.

Raising Capital

The pace of change was fast and the competition had deep pockets. It was becoming increasingly clear that, without a comfortable finance engine, Vispera might not scale fast enough. Ercil and Akgul knew that a new roadshow for the next round of financing was imminent, and for this she wanted to approach global venture capitals. Ayanlar fully agreed with this plan: "The value that a shareholder brings is crucial; if only we had the Sequoia Capitals⁸ of the world in this geography, Vispera would benefit greatly from a global investor base to go further and faster." Ronen Yemini, CEO of EYEDO, a SaaS company for field performance optimization and Vispera's partner in Israel since 2017, agreed. He said, "In a couple of years, computer vision will be everywhere in retail. Vispera has a chance to be

⁸ Established in 1972, Sequoia Capital was a U.S.-based venture capital focused on technology companies. It was estimated that Sequoia-backed companies accounted for more than 20% of NASDAQ's total value. Source: Sequoia Capital, LinkedIn, <https://www.linkedin.com/company/sequoia/about/>, accessed April 2019.

the “Intel-inside”^h of this technology. It’s a market-grab, market-share business now, and the variety of solutions is on the rise. Vispera needs to get funding to scale up fast, deploy globally.”

Customer Acquisition

In the meantime, Vispera was also contemplating a new strategy for customer acquisition. For now, Turkey, a relatively large grocery retail market,ⁱ remained an untapped market. The customers needed a lot of hand-holding and persuading, given that the technology had not yet penetrated retail, with the exception of a few international players. Should the sales team keep its focus on grabbing whitespaces like Turkey, or should it shift its attention to the U.S. and Northern Europe and go after the big global players before it was too late? Stine said, “The market, the Tier 1 companies who are ready to adopt the technology, is in Germany, in France, and in the U.S. Vispera needs a sales organization that speaks the language of these players to show them the math—how the savings provided by the technology translate across thousands of square meters. We need to find one or two deals and publicize the hell out of them, get the word out, create a snowball effect.” The team knew that Vispera would be up against the likes of Acosta in these more mature markets. Was that the right strategy?

Enhancing the Technology

It was vital that Vispera’s technology remained cutting-edge. The company’s 14-person R&D team was working on further developing Vispera’s offering, but how could Vispera know if it was on the right track when they were trying to build for a market where the customer could not foresee how to best take advantage of technology? Going forward, should the team focus on prediction capabilities, data analytics, accuracy? Should Vispera expand its services to also analyze consumer behavior (e.g. tracking eye movement)? In touch with customers on a daily basis, Celikkanat Ozan was a proponent of going further into data science, “Customers are not necessarily equipped to make sense of all the data we provide.” Akgul thought customers would find prediction capabilities valuable: “We could help customers predict stock-outs, not only geographically but on a larger scale within their supply chain. We could provide insights on what had happened at about the same time the previous year, give customers a heads-up on what they could expect this time around. We could even integrate prediction capabilities into mobile or onto the dashboard that would alert the customer of stock-outs immediately and recommend action plans.” Should Vispera pivot to tackle theft and waste? Bringing in the investor perspective, Ayanlar said: “There are other AI players in prediction. In five years, this technology will be the norm in retail. Vispera should be positioned as a hardware-agnostic software company that allows customers to track their products from warehouse to sales. It should enable dynamic pricing, customization, and real-time campaign management.” Then, there was the big picture question: With Tensorflow, an open source machine learning library for image recognition, becoming so easy to run, many competitors were rushing into the computer vision space. Should Vispera instead think beyond the image recognition of the shelf, and set its eyes on the Amazon Go technology?

^h Intel Inside was Intel’s marketing slogan and trademarked logo that indicated that a computer displaying that logo had an Intel CPU chip inside. Source: Intel, “Intel Inside Trademark Usage Guidelines,” <https://www.intel.com/content/www/us/en/trademarks/intel-inside.html>, accessed April 2019.

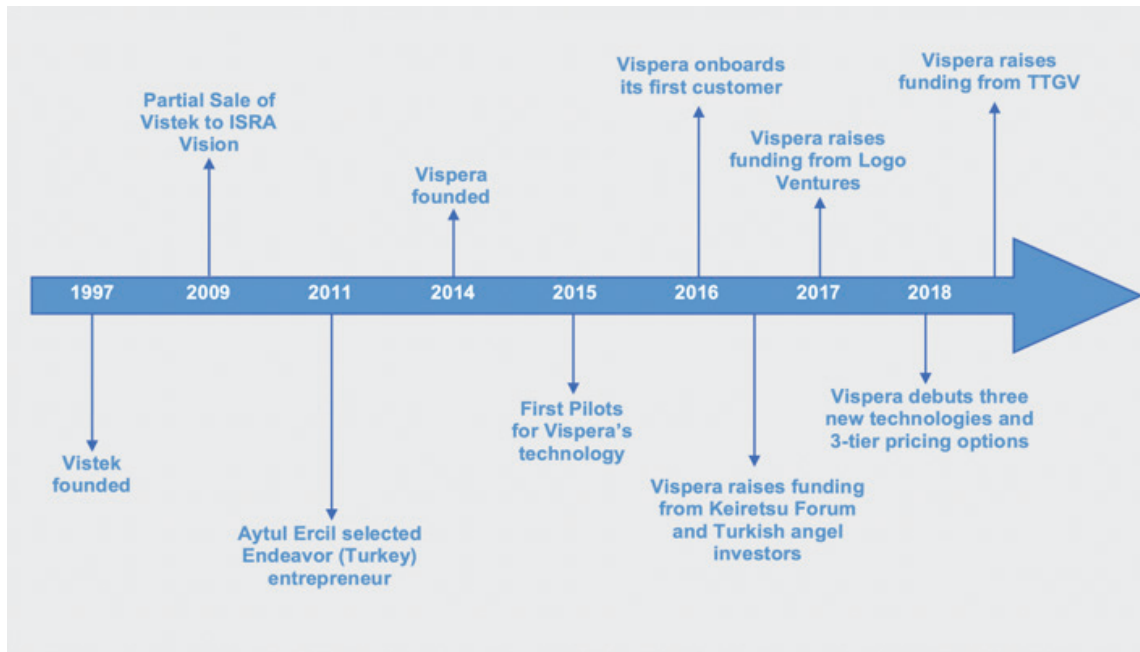
ⁱ At the end of 2017, modern grocery retail sales in Turkey had reached \$43.4 billion, with total grocery sales of \$90.5 billion. Source: Caglar Erdogan, “Turkish Food Retail Industry,” Global Agricultural Information Network, February 28, 2018, https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Retail%20Foods_Ankara_Turkey_2-28-2018.pdf, accessed April 2019.

Data Ownership and Privacy

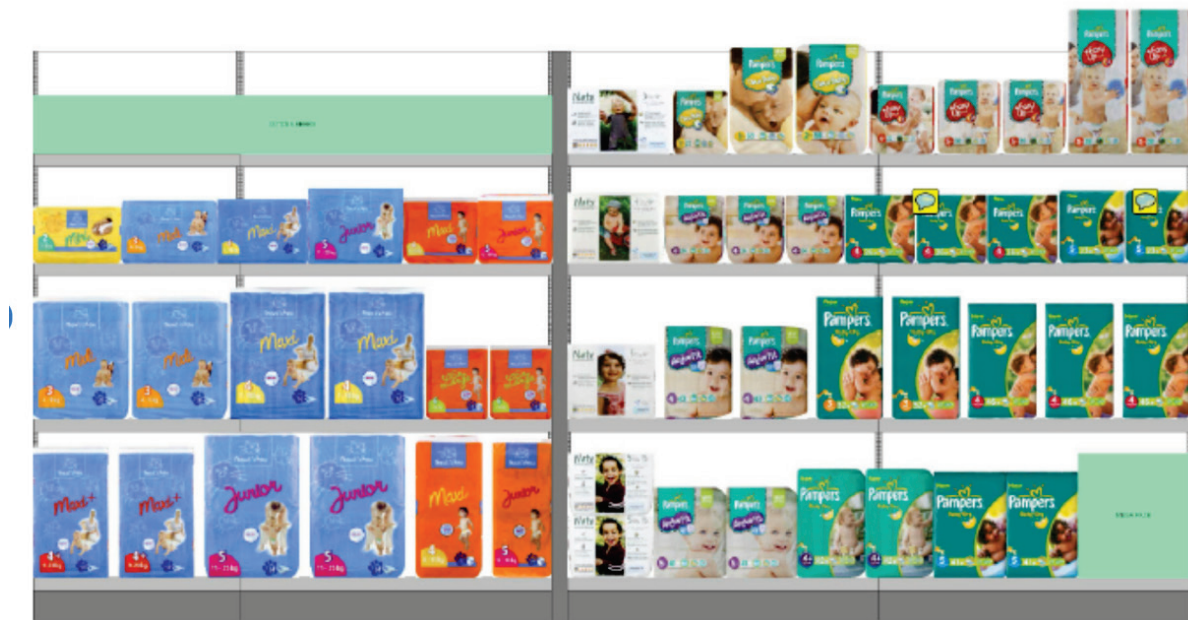
Between signing up new customers and partners and sharpening the technology, not many on Vispera's team had time to think about what the data the company was sitting on could mean for Vispera. Akgul said, "We started off with processing 250,000 images per month and are now at 500,000. We target reaching the 1 million image per month by the fall of 2019." Ercil commented:

The technology is new and the market is just being created. Retailers are rushing to compile and make sense of the data. Not many have stopped to ask about the ownership of the data. It is also not easy to do so. First of all, what is the best way to define data: is it only the images or also the KPIs we extract from it? And who owns the data: If a customer rep captures the images with a smartphone, does this mean the data belongs to the customer? What if it is a research firm's rep acting on behalf of the customer? If we [Vispera] capture the data via fixed cameras in a supermarket, does the data belong to the supermarket, us, the brand or a combination of these?

With data privacy concerns on the rise globally, Ercil could also see that they may in fact need to prioritize thinking about this issue. Should Vispera act proactively to address the data ownership issue and structure its business (model/pricing/etc.) accordingly? What would data ownership mean for the business model? Should Vispera aim to capture data itself to preserve the flexibility to sell it to multiple parties? Or could Vispera segment its offering where it priced its packages also based on the ownership of the data?

Exhibit 1 Vispera-Major Milestones

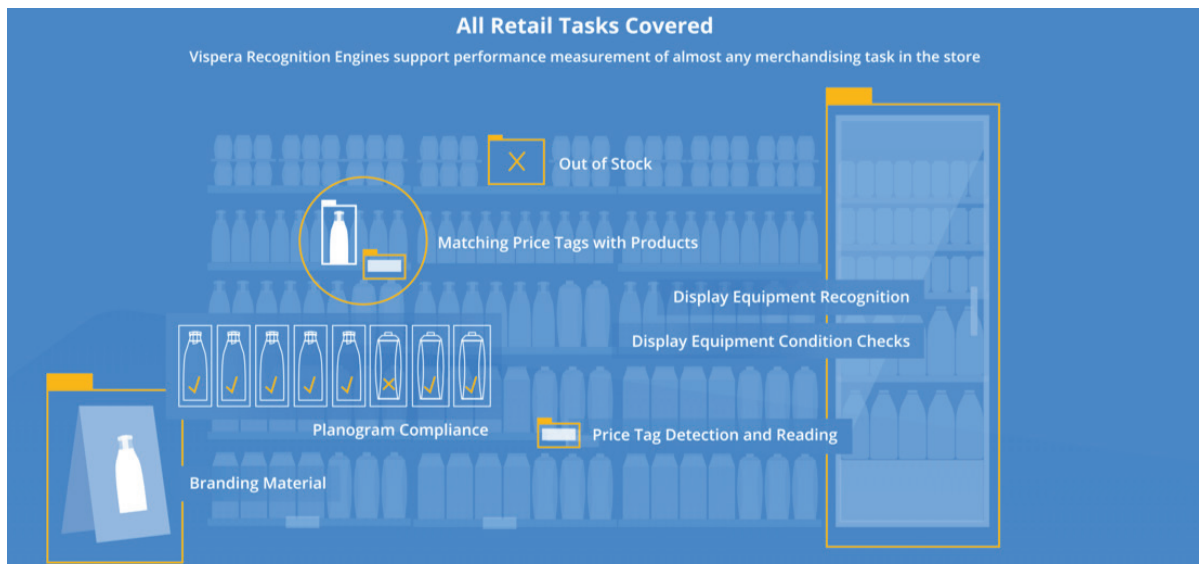
Source: Compiled by case writers from interviews.

Exhibit 2 Sample Planogram

Source: Frontoni, Emanuele & Mancini, Adriano & Zingaretti, Primo, "Embedded Vision Sensor Network for Planogram Maintenance in Retail Environments," August 2015, *Sensors*, <https://www.researchgate.net/publication/281564354>, accessed January 2020.

Exhibit 3 Example of Vispera's Technology-Stitched Image

Source: Company documents.

Exhibit 4 Overview of Vispera's Image Capture

Source: Vispera, "Technology," <https://vispera.co/technology>, accessed April 2019.

Exhibit 5 Examples of Vispera's Reporting Screens

Imageset Detail

Reported

Time

Start
Apr 10, 2019 15:33

End
Apr 10, 2019 15:34

Report
Apr 10, 2019 16:17

Type:
Shell

Imageset ID :
0963f272-003e-427d-8ac6-405462b2d283

Image Set Info

Display Type

Unrecognized Item Statistics

Undefined Count
0

Unresolved Count
0

SKU List 92

Out of Stock 71

In Stock 10

Facing Share

Realign

Images 3

Export **Add/Remove Columns**

Vispera ID	Category	Sub Category	Producer	Brand	Barcode	Name	Available	Must Have	Competitor	Realign Count
8298	BABY CARE	META	COMPETITOR	JOHNSON	META_WIPES_JOH...	META WIPES JOHNSON	✓	-	✓	20
8304	BABY CARE	META	COMPETITOR	UNI	META_WIPES_UNI	META WIPES UNI	✓	-	✓	20
8295	BABY CARE	META	COMPETITOR	WIPES ALL OTHER BRAND	META_WIPES_ALL...	META WIPES ALL OTHER BRAND	✓	-	✓	6
8299	BABY CARE	META	COMPETITOR	KOMILU	META_WIPES_KO...	META WIPES KOMILU	✓	-	✓	8
8300	BABY CARE	META	COMPETITOR	MOLFIX	META_WIPES_MO...	META WIPES MOLFIX	✓	-	✓	1
8196	BABY CARE	META	COMPETITOR	CAN BEBE	META_DIAPERS_C...	META DIAPERS CAN BEBE	✓	-	✓	2
8369	BABY CARE	PRIMA/SLAK HAVLU	P&G	PRIMA	4015400517276	PRIMA SLAK HAVLU TEKLI FRESH	✓	✓	-	5
7970	BABY CARE	PRIMA/SLAK HAVLU	P&G	PRIMA	4015400517306	Prima 3'lu Firsat Paket! Baby Fresh 3x3x64	✓	✓	-	7
8302	BABY CARE	META	P&G	PAMPERS	META_WIPES_PA...	META WIPES PAMPERS	✓	-	-	3
8303	BABY CARE	META	P&G	PRIMA	META_WIPES_PRL...	META WIPES PRIMA	✓	-	-	1
8193	BABY CARE	META	COMPETITOR	DIAPERS ALL OTHER BRAND	META_DIAPERS_A...	META DIAPERS ALL OTHER BRAND	✗	-	✗	0



Source: Company documents.

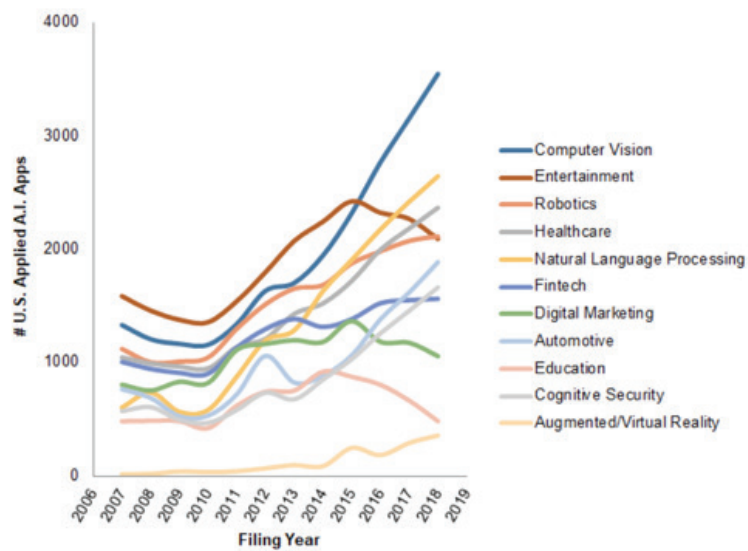
Exhibit 6 Vispera's Three-Tier Pricing Strategy

	Starter	Regular	Advanced
Shelf & Cooler Service			
Accuracy (avg.)	93.00%	96.00%	99.00%
Speed (24h)	✓	✓	i
Reporting (5-15 min)	+	+	x
Facing Counts & Positions (SKU & brand-level)	✓	✓	✓
In-stock and Out-of-stock lists	✓	✓	✓
Facing Count Score	✓	✓	✓
Facing Share (SKU & brand-level)	✓	✓	✓
Shelf Share	x	✓	✓
Planogram Compliance Score	x	+	✓
Pricetag Detection	x	+	✓
Cabinet Service			
Accuracy (avg.)	93.00%	96.00%	99.00%
Speed (24h)	✓	✓	+
Reporting (5-15 min)	+	+	x
In-stock and Out-of-stock lists	✓	✓	✓
Program Compliance score	x	+	✓
Pricetag Detection	x	+	✓
Hotzone Service			
Accuracy (avg.)	93.00%	96.00%	99.00%
Speed (24h)	✓	✓	+
Reporting (5-15 min)	+	+	x
In-stock and Out-of-stock lists	✓	✓	✓
Facing Share (SKU & brand-level)	✓	✓	✓
Pricetag Detection	x	+	✓

Source: Vispera, "Product Features and Subscription Options", <https://vispera.co/pricing>, accessed April 2019.

Note: The basic package promised 93% accuracy at a price of 9 cents per photo and only reported out-of-stock items. The standard promised 96% accuracy for 15 cents per photo, and the premium package promised 99% accuracy at 20 cents per photo.

i: Delays may occur depending on project loads.			
✓: Included			
x: Not included			
+: Add on-Additional setup, software development and/or image recognition fees apply			

Exhibit 7 Artificial Intelligence Patent Applications (U.S.)

Source: "Trends in Artificial Intelligence," Kilpatrick Townsend, https://www.kilpatricktownsend.com/-/media/Feature/Insights/Publication/2019-Patenting-Trends-Study_Artificial-Intelligence.ashx?la=en&hash=19A678567CC84E77AAB5004A7FAD5FC5B3C18BB4, accessed July 2019.

Exhibit 8 Overview of Solutions Offered by Key Players in Retail Image Recognition

Trax	Sales	Enables sales reps to access field data with image recognition-based mobile solutions, in turn ending manual store visits and improving accuracy, objectivity and trustworthiness of data.
	Marketing	Ensures that promotions are executed properly, maintains ready availability of channel selling materials for key accounts and follows up on retailer contract compliance and secure returns on trade promotion investments.
	Category Management	Provides insight to overall category performance by visualizing aspects of distribution, price, assortment and space in the respective categories.
	BI Analysts	Gives access to real shelf images and integrates raw data into various reporting tools. Also, provides a unified flexible platform that allows choosing from a wide range of shelf KPIs, and recutting data by store, product, sales rep and more.
	Store Operations	Utilizes its image recognition-based mobile and IoT system to capture store reality and send real-time alerts to store staff regarding risk measures. Leverages smart shelf labels that display stock levels and planogram compliance issues for store staff to fix. Provides task based reward system to enable store associates track their own performance and compare their score with other team members.
	Category Management	Facilitates mutual profitability with manufacturer by tracking execution of promotions, price changes and supplier shelf share contracts, and share space-based store-level insights. Provides access to comparative data on supplier shelf execution that points out the best and worst performing suppliers.
Planogram	Retail execution	Through deep learning and image recognition, customers can measure their shelf KPIs from a single shelf photo and creates instant reports while sales rep's are in the store. Enables central access up-to-the-minute consolidated data for all SKUs, stores, chains and channels.
	Planogram Automation	Transforms shelf pictures and pdf plans into planograms in any format within 48 hours.
	Space Planning	The planogram library enables customization of existing planograms to avoid wasting time on creating new POGs, PlanoManager's central library allows the customers to search, clone and modify planograms.
Vispera	Perfect Store Solution	Customized VIRS products enable the monitoring and measurement of the store that Vispera helps its customers build. With the insights the customers gain from VIRS, they can have full control over the execution of the ideal store that optimizes shopper experience.
	Productivity Solution	Through pictures taken at the store, Vispera provides its customers and their merchandise teams with to-do lists; in order to improve in-store appearance and insights on team performance. The process takes place while the merchandise team is in the store.
	Third Party Solution	Third-party auditing, mobile CRM and crowdsourcing companies serving their FMCG supplier and retailer clients are able to strengthen their data collection and reporting suite with accuracy and speed offered by Vispera Image Recognition, enabled by Vispera's easy RestAPI integration options.
	Auditing Solution	VIRS provides products for delivering the speed and accuracy customers need for auditing their stores and managing their teams. VIRS products also offer self-auditing for the teams as soon as they complete their tasks at the store. Simultaneous self auditing and third party auditing systems are also possible, as VIRS powers both.

Source: Compiled from company websites. Trax, "Solutions," <https://traxretail.com/solutions/>; Planogram, "Solutions", <https://planorama.com/retail-execution/>; Vispera, "Solutions", <https://vispera.co/solutions>, accessed April 2019.

Exhibit 9 Overview of Vispera Use Cases

Category	Gross Revenue Growth	In Store Time Reduction	Increase in Availability	Accuracy Level	How
Confectionary Brand (Modern Trade)	12.00%	50.00%			Increase in average on-shelf availability score from 75% to 85% and average planogram compliance score from 35% to 75% within 4 months.
Supermarket (Snacks Category)	9.00%				Increase in average on-shelf availability score from 61% to 86% and average planogram compliance score from 43% to 84% within 1 month.
Tobacco Brand (Traditional Trade)		85.00%			Decrease in the average in store time from 33 seconds to 5 seconds.
Ice-Cream Brand (Traditional Trade)			400.00%		Switching from 3rd party auditing to using Vispera IRS as self-auditing tool, the coverage has increased from 5k to 25k POS.
Carbonated Soft drinks Brand (Traditional Trade & On Premise)				>96.00%*	In a side-by-side pilot: Competitor system consistently confuses SKUs differing only in capacity (e.g. 330 ml vs 200 cans), while our error margin (<4%) is valid for those SKUs as well. Custom visual tasks delivered not supported by competitor system.

Source: Company documents.

Exhibit 10 Overview of Products Offered by Vispera

Shelf & Cooler Service <i>Shelf Sections, Coolers, Promotional Display Areas</i>	Vispera Shelf & Cooler Service can be used on structured display equipments such as regular shelf sections, coolers, promotional displays in both modern and traditional trade. Through pictures taken by a mobile device that capture the whole breadth of the equipment, VSCS delivers the following data and KPIs: SKU availability, product facings and positions, stock availability KPIs with respect to multiple reference lists, share of shelf by SKU, by brand, and by firm based on facing counts and/or meterage, competition KPI, planogram compliance KPI, promotional and branding material visibility, compliance and equipment conditions KPIs, price tag availability and readings, and related KPIs.
Cabinet Service <i>Horizontal Display Equipment</i>	Vispera Cabinet Service can be used on horizontal display equipments such as ice cream cabinets in both modern and traditional trade. Through pictures taken by a mobile device capturing the whole breadth of the cabinet, VCS delivers the following data and KPIs: SKU availability, stock availability, KPIs with respect to multiple reference lists, planogram compliance KPI, promotional and branding material visibility, compliance and equipment conditions KPIs, pricing material availability and readings, and related KPIs.
Hotzone Service <i>Unstructured Display Areas</i>	Vispera Hotzone Service can be used on unstructured display areas found in cashier zones in both modern and traditional trade. Through pictures taken by a mobile device capturing the whole zone, VSS delivers the following data and KPIs: SKU availability, stock availability KPIs with respect to multiple reference lists, promotional and branding material visibility, compliance and equipment conditions KPIs, pricing material availability and readings, and related KPIs.
ShelfSight <i>Real-Time Shelf Monitoring and Management System</i>	Learning Technology developed by Vispera enables to ShelfSight product to analyze retail shelves for out-of-stock detection, planogram compliance and empty space detection. The system utilizes IoT cameras mounted on the aisle to detect and recognize individual products, allowing highly accurate shelf measurements in real-time.

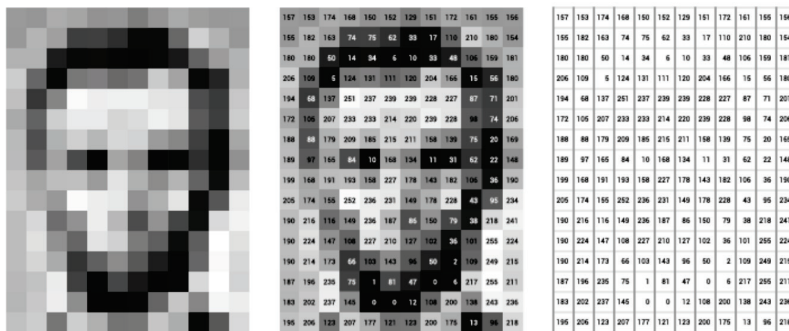
Source: Vispera, "Products," <https://vispera.co/products/>, accessed April 2019.

Appendix: Evolution of Computer Vision Technology

In the 1960s, simple object recognition defined the start of visual recognition, and it would take until the 1980s for the technology to be used outside the lab in real-world situations.⁴⁶ Advances in artificial intelligence (AI) contributed to developments in computer vision, especially when in relation to the Internet of Things (IoT). At the same time, advances in convolutional neural networks (CNN), a type of deep neural network (DNN), led to great improvements in accuracy.⁴⁷ Computer systems learned from examples, so the resulting deep learning led to much quicker product development cycles.⁴⁸

Computer vision was the broad parent name for any computations involving visual content; it referred to the process of using machines to understand and analyze imagery.⁴⁹ By the early 2000s, artificial neural networks mimicked the brain's working, captured images, and then interpreted those images as a series of pixels, each with its own set of color values.⁵⁰ The computer assigned a numerical value to each pixel to represent the brightness of its red, green and blue and classified the numbers with special algorithms.⁵¹

Exhibit A.1



Source: Golan Levin, "Image Processing and Computer Vision," Openframeworks, https://openframeworks.cc/ofBook/chapters/image_processing_computer_vision.html, accessed April 2019.

Then, once tens of thousands of images had been fed into the algorithm, the algorithm could be "trained" to recognize images with high accuracy.⁵² The range of applications of computer vision was vast. For example, combined with machine learning, computer vision enabled Google to use maps to identify street names, businesses, and office buildings and made it possible for Facebook to identify people in photos.⁵³

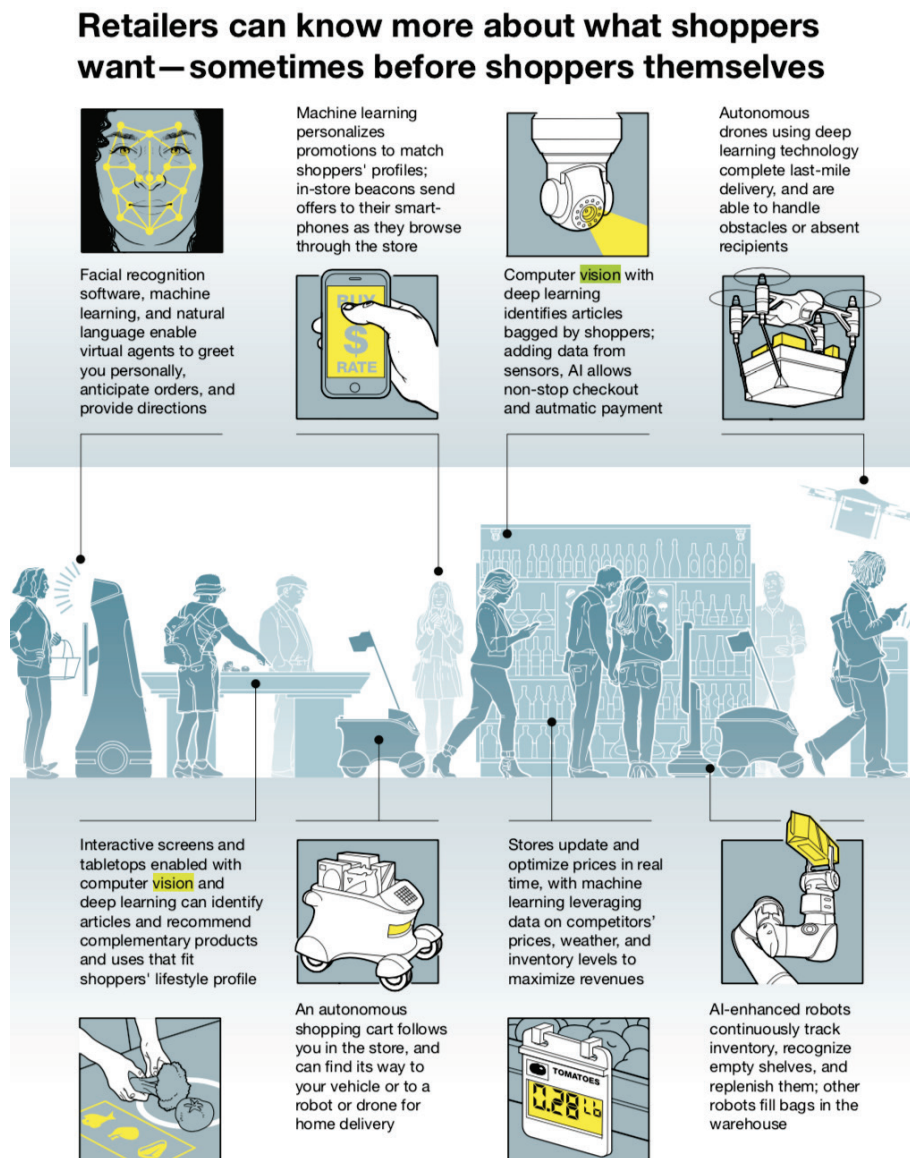
Retail applications In physical retail outlets, computer vision technology was able provide information on footfall data,^j customer reactions, and promotions (for example, how long shoppers stood in front of a promotion and whether they took the product) and to support automatic checkout.⁵⁴ The technology was also used to optimize stock availability and shelf compliance. The algorithms were trained to recognize ranges of products based on their packaging. Then, once a shelf image was fed into the engine, it would be able to compute how many units there were, and so on.⁵⁵

Once a sufficient number of clean images was fed into the algorithm to train the engine, the engine would first "learn" the specific stock keeping unit (SKU), and once photos of the shelf space were fed

^j Footfall data referred to the number of people entering a shop or shopping mall.

into the algorithm, the algorithm would analyze the data and report on SKU counts, how the products were placed on the shelf, and the movement of products in any given store (not only in the randomly visited ones) in almost real time. The system could then generate comprehensive reports based on the images captured. In the context of retail, by feeding this actionable data into AI, companies could analyze their sales, gather shelf insights, and optimize inventory performance down to the level of SKU.⁵⁶ Product availability could be improved and key performance indicator (KPI) tracking would be easier and more accurate, resulting in an enhanced shopper experience.

Exhibit A.2 Examples of Computer Vision Applications in Retail:



Source: Exhibit from "How artificial intelligence can deliver real value to companies", June 2017, McKinsey Global Institute, www.mckinsey.com. Copyright (c) 2019 McKinsey & Company. All rights reserved. Reprinted by permission, accessed April 2019.

Glossary

Unicorn	A start-up that has reached \$1 billion valuation.
Share-of-shelf	The percentage of space in a store allocated for a particular good.
Speed-to-shelf	The rate at which new products are placed and replenished on a shelf at a retail store.
Stock Availability	The availability of the item on the shelf.
Machine learning	The concept of machines learning by experience and acquiring skills without human involvement.
Planogram	A visual diagram that provides a sheer amount of detail on the placement of every product on the shelf, checks the integrity and position of price tags, and ensures promotion actions. Planogram compliance covers the following areas: (a) distribution: the degree to which the items on the shelves matched the items that were supposed to be on the shelf; (b) space: the degree to which the space allocated to the item on the shelf matched the planogram. This is operationalized as the number of facings for each SKU; and (c) arrangement: the degree to which the arrangement of the items on the shelf matched the arrangement specified on the POG. ^a
Omnichannel	A type of retail which integrates the different methods of shopping available to consumers (e.g. online and offline).
Deep Learning	A subset of machine learning, where artificial neural networks, algorithms inspired by the human brain, learn from large amounts of data, which then allow machines to solve complex problems. The deeper learning algorithms “learn,” the better they perform. ^b
Sensor Fusion	A software that intelligently combines data from several sensors to correct for the shortcomings of the individual sensors, to calculate accurate position and orientation information to ultimately improve application or system performance. ^c

Source: Compiled by Casewriter.

^a Daniel Corsten, Thom.as W. Gruen, “A Comprehensive Guide to Retail Out-of-Stock Reduction in the Fast-Moving-Consumer-Goods Industry,” https://www.nacds.org/pdfs/membership/out_of_stock.pdf, accessed April 2019.

^b Bernard Marr, “What is Deep Learning AI, A Simple Guide with 8 Practical Examples,” *Forbes*, October 8, 2018, <https://www.forbes.com/sites/bernardmarr/2018/10/01/what-is-deep-learning-ai-a-simple-guide-with-8-practical-examples/#1b3ed9f38d4b>, accessed April 2019.

^c Technopedia, <https://www.techopedia.com/definition/32842/sensor-fusion>, accessed May 2019.

Endnotes

- ¹ Owlery, "Vispera's Competitors, revenue, Number of Employees, Funding and Acquisitions," <https://www.owler.com/company/vispera>, accessed April 2019.
- ² TechVision Group of Frost & Sullivan, "Harnessing Emerging Business Opportunities Through Visual Intelligence", December 2017, Frost & Sullivan, accessed March 2019.
- ³ "ISRA Vision invests in Turkish machine-vision integrator Vistek," *Vision Systems Design*, November 10, 2009, <https://www.vision-systems.com/articles/2009/11/isra-vision-invests-in-turkish-machine-vision-integrator-vistek.html>, accessed April 2019.
- ⁴ Endeavor, "Entrepreneurs, Aytul Ercil," <https://endeavor.org/entrepreneur/aytul-ercil/>, accessed April 2019.
- ⁵ Vispera's founding team included the following individuals: Prof. Aytul Ercil, Co-Founder and CEO, Dr. Ceyhan Burak Akgul, Co-Founder and CTO, Dr. Erdem Yoruk, Chief Scientist, Kaan Oner, Product Manager, Levent Ozyildirim, Production Operations Manager, Basak Aydin, Administrative Affairs Manager, Kaan Can Fidan, Chief Architect (Senior Team), Boran Puhaloglu, Software Team Leader (Senior Team), Basak Baran, UI/UX Designer (Senior Team), Didem Celikkanat Ozan, Director, Marketing and Sales (Senior Team), Duygu Kargin, Director, Channel Accounts (Senior Team)
- ⁶ Greg Buzek, "Retail's \$1.1 Trillion Inventory Distortion Problem," IHL Group, (2015), <http://ihlservices.com/wp-content/uploads/2015/06/WeLostAustralia-Outline.pdf>, accessed April 2019.
- ⁷ Lauren Ufford, "Store Audits: What Are They And How You Can Complete One Efficiently," *Shopify blog*, <https://www.shopify.com/retail/how-to-do-a-store-audit>, accessed April 2019.
- ⁸ "Best Ways to Fix planogram Compliance," YM/Etki (blog) <http://www.ym-etki.com/blog/best-ways-to-fix-planogram-compliance/>, accessed May 2019.
- ⁹ Ibid.
- ¹⁰ Daniel Corsten, Thomas W. Gruen, "A Comprehensive Guide to Retail Out-of-Stock Reduction in the Fast-Moving Consumer-Goods Industry," 2008, https://www.nacds.org/pdfs/membership/out_of_stock.pdf, accessed April 2019.
- ¹¹ Daniel Corsten, Thomas W. Gruen, "A Comprehensive Guide to Retail Out-of-Stock Reduction In the Fast-Moving Consumer-Goods Industry," 2008, https://www.nacds.org/pdfs/membership/out_of_stock.pdf, accessed April 2019.
- ¹² Sundar Bharadwaj, Daniel Corsten, Thomas Gruen, "Retail Out-of-Stocks: A Worldwide Examination of Extent, Causes and Consumer Responses," 2002, <http://availabilitylab.com/wp-content/uploads/2018/08/2002-Study.pdf>, accessed August 2019.
- ¹³ Daniel Corsten, Thomas Gruen, "Online Availability: A Worldwide Study of Extent, Shopper Reactions, and Strategies for Non-Food Categories in Digital Retail," 2018, <http://availabilitylab.com/wp-content/uploads/2018/08/2002-Study.pdf>, accessed August 2019.
- ¹⁴ Lauren Ufford, "Store Audits: What Are They And How You Can Complete One Efficiently," *Shopify blog*, <https://www.shopify.com/retail/how-to-do-a-store-audit>, accessed April 2019.
- ¹⁵ Ceygun Akgul, Erdem Yoruk, Farhaan Mohideen, "Intel and Vispera Shelvesight : Effective On-Shelf Inventory Management for Grocers," https://vispera.co/uploads/ckeditor/attachments/5/intel_and_vispera_shelvesight_effective_on_shelf_inventory_management_for_grocers.pdf, accessed April 2019.
- ¹⁶ Adrien Book, "A Beginner's Guide to Computer Vision in Retail," *Hackernoon* (blog), December 10, 2018, <https://hackernoon.com/a-beginners-guide-to-computer-vision-in-retail-b5a31cfd5283>, accessed April 2019.
- ¹⁷ Ceygun Akgul, Erdem Yoruk, Farhaan Mohideen, "Intel and Vispera Shelvesight : Effective On-Shelf Inventory Management for Grocers," https://vispera.co/uploads/ckeditor/attachments/5/intel_and_vispera_shelvesight_effective_on_shelf_inventory_management_for_grocers.pdf, accessed April 2019.
- ¹⁸ Merve Kara, "Vispera, ABD merkezli Keiretsu Capital'den 6,5 milyon dolar değerlemele yatırım aldı," *Webrazzi* (blog), November 23, 2016, <https://webrazzi.com/2016/11/23/vispera-abd-merkezli-keiretsu-capitaldan-65-milyon-dolar-degerlemeyle-yatirim-aldi>, accessed April 2019.

- ¹⁹ Merve Kara, "Vispera, ABD merkezli Keiretsu Capital'den 6,5 milyon dolar değerlemele yatırım aldı," *Webrazzi* (blog), November 23, 2016, <https://webrazzi.com/2016/11/23/vispera-abd-merkezli-keiretsu-capitaldan-65-milyon-dolar-degerlemeyle-yatirim-aldi>, accessed April 2019.
- ²⁰ TechVision Group of Frost & Sullivan, "Harnessing Emerging Business Opportunities Through Visual Intelligence," December 2017, Frost & Sullivan, accessed March 2019.
- ²¹ TechVision Group of Frost & Sullivan, "Harnessing Emerging Business Opportunities Through Visual Intelligence," December 2017, Frost & Sullivan, accessed March 2019.
- ²² Sean Farrell, "Amazon Go Checkout-Free Stores Look Set to Come to UK," *Guardian*, December 9, 2016, <https://www.theguardian.com/business/2016/dec/09/amazon-go-stores-uk-trademark-us>, accessed March 2019.
- ²³ Andrew Melville, "Amazon Go Is about Payments, Not Grocery," *Forbes*, January 20, 2017, <https://www.forbes.com/sites/groupthink/2017/01/20/amazon-go-is-about-payments-not-grocery/#59271ec267e4>, accessed March 2019.
- ²⁴ Andrew Melville, "Amazon Go Is about Payments, Not Grocery," *Forbes*, January 20, 2017, <https://www.forbes.com/sites/groupthink/2017/01/20/amazon-go-is-about-payments-not-grocery/#59271ec267e4>, accessed March 2019.
- ²⁵ TechVision Group of Frost & Sullivan, "Harnessing Emerging Business Opportunities Through Visual Intelligence," December 2017, Frost & Sullivan, accessed March 2019.
- ²⁶ Firat Demirel, "Logo Ventures, Vispera'ya 1,2 milyon dolar yatırım yaptı," *Webrazzi* (blog), November 8, 2017, <https://webrazzi.com/2017/11/08/logo-ventures-vispera/>, accessed April 2019.
- ²⁷ Acosta, "Why Acosta," <https://www.acosta.com>, accessed July 2019.
- ²⁸ Acosta, "Channels," <https://www.acosta.com/channels>, accessed July 2019.
- ²⁹ Acosta, "Why Acosta," <https://www.acosta.com>, accessed July 2019.
- ³⁰ BCC Research Staff "Artificial Intelligence : Applications and Global Markets," November 2018, <https://www.bccresearch.com/market-research/information-technology/artificial-intelligence-applications-and-global-markets-ift041b.html>, accessed April 2019.
- ³¹ Planorama, "Our Company," <https://planorama.com/our-company/>, accessed April 2019.
- ³² Planorama, "Planogram Automation," <https://planorama.com/planogram-automation/#>, accessed April 2019.
- ³³ Planorama, "Our Company," <https://planorama.com/our-company/>, accessed April 2019.
- ³⁴ "Kantar Retail invests in Planorama," blog post, October 30, 2014, <https://blog.planorama.com/kantar-invests-in-planorama>, accessed April 2019.
- ³⁵ Trax Retail, "About," <https://traxretail.com/about/>, accessed April 2019.
- ³⁶ Trax Retail, "About," <https://traxretail.com/about/>, accessed April 2019.
- ³⁷ "Investec Bank leads a \$19.5 million investment in Trax Image Recognition," press release, February 2017, on Trax Retail website, <https://traxretail.com/news/investec-bank-leads-19-5-million-investment-trax-image-recognition/>, accessed April 2019.
- ³⁸ Trax Retail, "About," <https://traxretail.com/about/>, accessed April 2019.
- ³⁹ "Computer Vision and Retail Intelligence Company Trax Closes US\$64 Million Investment led by Warburg Pincus," press release, July 2017, on Trax Retail website, <https://traxretail.com/news/computer-vision-retail-intelligence-company-trax-closes-us64-million-investment-led-warburg-pincus-2/>, accessed April 2019.
- ⁴⁰ "Investec Bank leads a \$19.5 million investment in Trax Image Recognition," press release, February 2017, on Trax Retail website, <https://traxretail.com/news/investec-bank-leads-19-5-million-investment-trax-image-recognition/>, accessed April 2019.
- ⁴¹ "Trax Enters China's Retail Market with Breakthrough Computer Vision & Analytics Platform," press release, February 2018, on Trax Retail website, <https://traxretail.com/news/trax-enters-chinas-retail-market-breakthrough-computer-vision-analytics-platform/>, accessed April 2019.

- ⁴²Sergey Nikolenko, "Why Retail Business Needs Image Recognition Technology Today ?" *Medium* (Blog), April 16, 2018, <https://medium.com/osadc/why-retail-business-needs-image-recognition-technology-today-2515ab54e828>, accessed April 2019.
- ⁴³Vispera, "Products," <https://vispera.co/products>, accessed April 2019.
- ⁴⁴"Trax Closes US\$125 Million Investment Round Led by Boyu Capital " press release, July 2018, on Trax Retail website, <https://traxretail.com/news/trax-closes-us125-million-investment-round-led-boyu-capital/>, accessed April 2019.
- ⁴⁵<https://www.amazon.com/b?ie=UTF8&node=16008589011>
- ⁴⁶TechVision Group of Frost & Sullivan, "Harnessing Emerging Business Opportunities Through Visual Intelligence", December 2017, Frost & Sullivan, accessed March 2019.
- ⁴⁷TechVision Group of Frost & Sullivan, "Harnessing Emerging Business Opportunities Through Visual Intelligence", December 2017, Frost & Sullivan, accessed March 2019.
- ⁴⁸TechVision Group of Frost & Sullivan, "Harnessing Emerging Business Opportunities Through Visual Intelligence", December 2017, Frost & Sullivan, accessed March 2019.
- ⁴⁹"Introduction to Computer Vision," *Algorithmia* (blog), April 2018, <https://blog.algorithmia.com/introduction-to-computer-vision/>, accessed April 2019.
- ⁵⁰"Introduction to Computer Vision," *Algorithmia* (blog), April 2018, <https://blog.algorithmia.com/introduction-to-computer-vision/>, accessed April 2019.
- ⁵¹"Introduction to Computer Vision," *Algorithmia* (blog), April 2018, <https://blog.algorithmia.com/introduction-to-computer-vision/>, accessed April 2019.
- ⁵²"Introduction to Computer Vision," *Algorithmia* (blog), April 2018, <https://blog.algorithmia.com/introduction-to-computer-vision/>, accessed April 2019.
- ⁵³"Introduction to Computer Vision," *Algorithmia* (blog), April 2018, <https://blog.algorithmia.com/introduction-to-computer-vision/>, accessed April 2019.
- ⁵⁴Jacques Bughin et al., "Artificial Intelligence: The Next Frontier?", Discussion Paper (June 2017), McKinsey&Company, accessed April 2019.
- ⁵⁵Adrien Book, "A Beginner's Guide to Computer Vision in Retail," Hackernoon (blog), December 10, 2018, <https://hackernoon.com/a-beginners-guide-to-computer-vision-in-retail-b5a31cfd5283>, accessed April 2019.
- ⁵⁶Ceygun Akgul, Erdem Yoruk, Farhaan Mohideen, "Intel and Vispera Shelvesight : Effective On-Shelf Inventory Management for Grocers," https://vispera.co/uploads/ckeditor/attachments/5/intel_and_vispera_shelvesight_effective_on_shelf_inventory_management_for_grocers.pdf, accessed April 2019.