

HOW AI IS SPREADING ACROSS INDUSTRIES



PRESCOUTER

PRESCOUTER

How AI Is Spreading Across Industries

2018

CONTENTS

INTRODUCTION

3

AI & CONSUMER GOODS: ENHANCING THE OVERALL CONSUMER EXPERIENCE

Daniel Morales

5

CONSUMER ELECTRONICS: AI & IOT COMBINE TO DOMINATE

Sofiane Boukhalfa

10

AI & HIGH-TECH: BOTH A CHALLENGE AND OPPORTUNITY FOR HARDWARE MANUFACTURERS

Sofiane Boukhalfa

12

TRANSPORTATION: ENHANCING PRODUCTIVITY & DATA DRIVEN DECISIONS AND PREDICTIONS WITH AI

Anu Antony

14

FOOD & BEVERAGE: AI TO IMPROVE SUPPLY CHAIN MANAGEMENT

Rachel Murkett

18

AI & DRUG DEVELOPMENT: A MAJOR OPPORTUNITY FOR THE PHARMACEUTICAL INDUSTRY

Salma Buddaseth

22

INTRODUCTION

Artificial Intelligence (AI) refers to the ability of computer systems to perform tasks that would normally require human intelligence. AI, and one of its heavily researched subsets, machine learning, are both poised to radically transform a multitude of industries ranging from transportation to pharmaceuticals. According to Accenture, AI will double the annual economic growth rate in 12 developed economies (including the US) and boost labor productivity by up to 40 percent by 2035.

In this white paper, we discuss how AI is redefining various industries. The first industry explored is the **consumer goods industry**. Different aspects, such as overall customer experience, manufacturing, logistics and delivery, household connectivity, and advertising are covered.

Tangential to the consumer goods industry is the **consumer electronics industry**. AI is being paired with the Internet of Things (IoT), and the results, so far, have been pretty exciting. We delve into some of the existing examples and the possibilities to come.

Next, we cover the technologies that will be powering AI. NVIDIA is clearly dominating this aspect of the **high-tech industry**. What other players are entering this space?

The **transportation industry** is also becoming massively influenced by AI, from road safety to autonomous transportation to corporate decision making and more. This white paper covers it all.

Afterwards, we shift our attention to the **food and beverage industry** and how AI will affect food safety and quality as well as how companies can use AI to forecast industry needs and improve transparency in supply chains.

The last industry covered is the **pharmaceutical industry**. How is biopharmaceutical research making use of AI to develop new drugs? We answer this pivotal question while providing examples of companies already making use of AI in their ongoing research.



CONSUMER GOODS INDUSTRY:

- Overall customer experience
- Manufacturing
- Logistics and delivery
- Household connectivity
- Advertising



FOOD AND BEVERAGE INDUSTRY:

- Food safety and quality assurance
- Industry forecasting
- Supply chain transparency



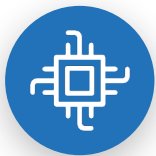
CONSUMER ELECTRONICS INDUSTRY:

- AI / IoT combinations



PHARMACEUTICAL INDUSTRY:

- Drug discovery & development
- Drug target identification & toxicity prediction



HIGH-TECH INDUSTRY:

- Hardware manufacturers - namely video cards (GPUs)



TRANSPORTATION INDUSTRY:

- Autonomous vehicles
- Public safety
- Road safety
- Corporate decision making

AI & CONSUMER GOODS: ENHANCING THE OVERALL CONSUMER EXPERIENCE

Daniel Morales

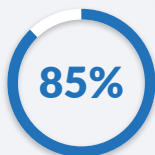
Artificial intelligence (AI) is currently taking the retail world by storm and will increasingly continue to do so. The market size of AI software and systems is expected to reach \$38 million by 2025, and the potential opportunities for interacting with customers in new and increasingly customized ways are causing retailers to invest in such technologies.

Today:



of in-store sales are influenced by digital interaction

By 2020:



of customer interaction in retail will be managed by AI

By 2025:



Market size of AI software to reach \$38 million

AI to Enhance the Overall Customer Experience

According to **Forbes**, AI is in fact an umbrella term for 3 distinct capabilities: machine learning, natural language processing and optimization. These technologies are being applied across the entire product and service cycle – from product assembly to post-sale customer service interactions. The main goal is to develop leaner, more optimized operations and to enhance the overall customer experience. By 2020, 85% of customer interaction in retail will be managed by AI, according to **Gartner**.

Consumer goods companies have been at the forefront of the current rise in digital innovation in commercial areas such as marketing and sales. The overall goal, according to Bruce Macinnes, chairman of BrandAlley, is to move towards personalizing the entire customer journey from homepage to checkout. AI can be used to provide services such as digital shoppers to simplify the shopping process and provide personalized

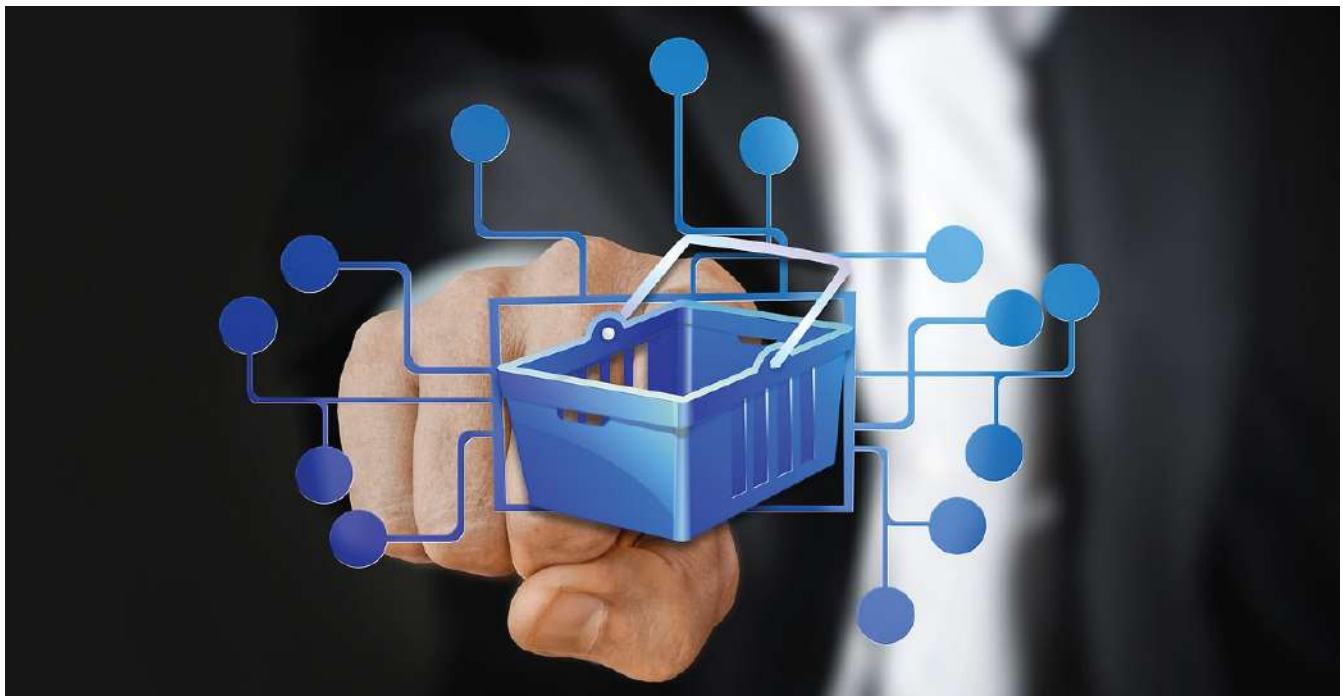
experiences that increase customer loyalty and retention. Companies are benefiting by achieving higher sales, reducing manufacturing costs and improving the retail brand.

Regardless of the hype, AI technologies are still in their infancy. If a retailer does not already value data and analytics for their current operations, investing in an AI solution may not be appropriate. The technology itself is still growing and changing at a rapid rate, and concurrently, understanding how such technologies can be applied to retail is also evolving rapidly. With all this in mind, we highlight various aspects of the consumer goods industry that are currently being affected by AI technology.

AI & Manufacturing

The predictive analytics capabilities enabled by AI can provide manufacturers with plant-floor and plant-wide collaborative visibility of all work occurring during a process and provide insight into possible bottlenecks and pain points. An operational supervisor can identify a floor-based problem that arises in workflow in real-time instead of spending time making time-consuming walk-throughs of entire manufacturing facilities.

Toray Plastics is one example of a company that is using **GE's Plant Applications** product to allow management to collect granular-level data throughout production and reduce defective products and wasted productivity. By taking advantage of predictive analytics, some of the highest-impact developments have been in quality control, predictive maintenance, and supply-chain optimization.



AI & Logistics and Delivery

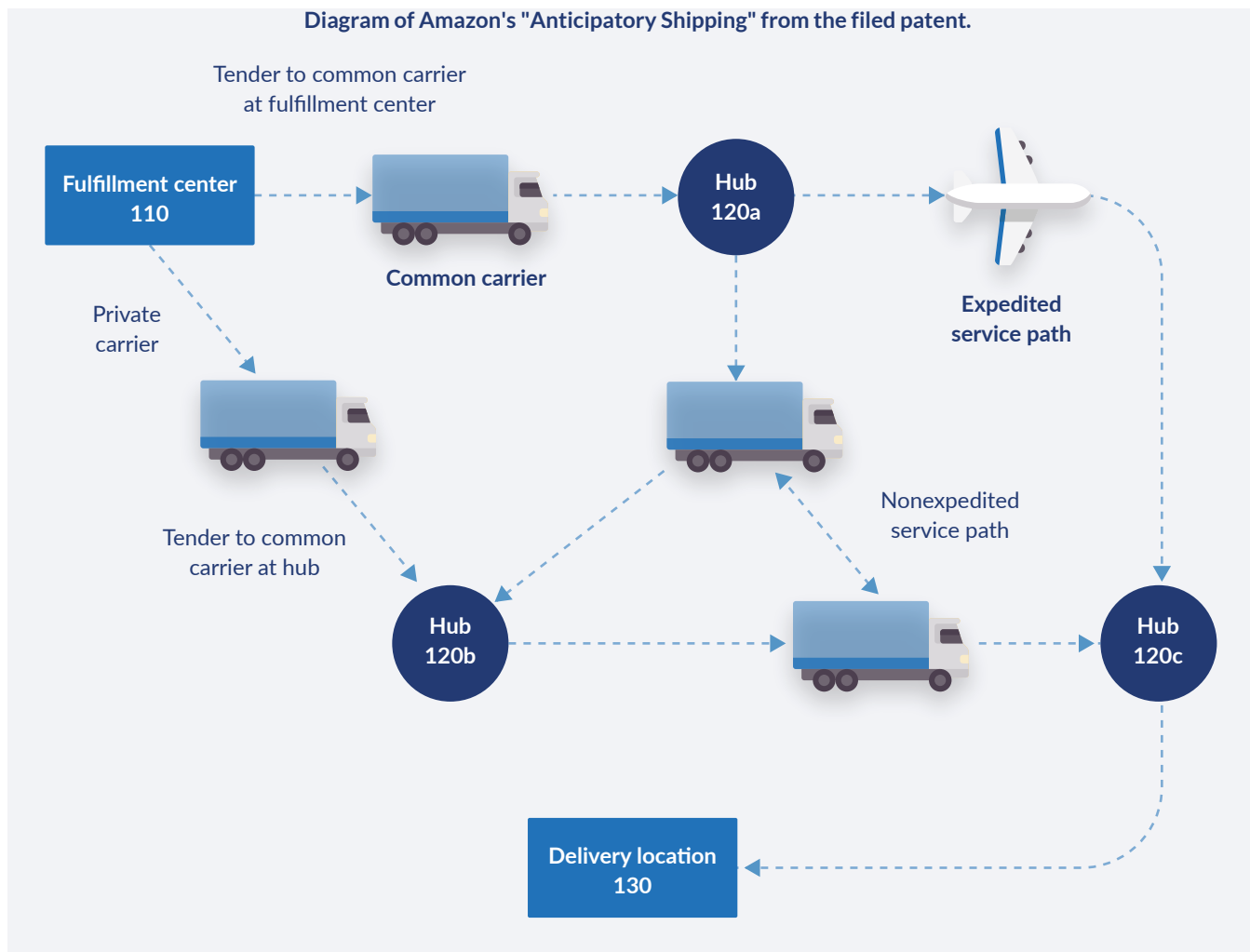
In addition to manufacturing, AI will have a great impact on the logistics and delivery of consumer goods. **Amazon** recently received a patent for “anticipatory shipping,” which is a method to start delivering packages even before a consumer has placed an order. The system first predicts your future purchases based on previous purchases and interests, site searches and online lingering time. It then preemptively will ship items to the warehouse nearest the consumer before they even press the button to complete the purchase.

AI & Household Connectivity

Among the various consumers goods that can be integrated with AI capabilities, household electronics and appliance manufacturers have perhaps been the most active in leveraging such technologies to simplify and enhance consumer interactions with their products.

- ✓ For example, more than 10 years have passed since the **Roomba Vacuum Cleaning Robot** came to market in 2002. Since then, kitchen appliances, such as microwaves, refrigerators and dishwashers, have become increasingly intelligent, interactive, and connected.

Diagram of Amazon's "Anticipatory Shipping" from the filed patent.



Effective robotic applications in household products offer the promise of a connected and intelligent household.

- ✓ In addition, electronic personal assistants such as **Amazon Echo**, **Google Home**, **Microsoft Cortana**, and **Apple Siri** are acting as the central hubs that can connect to various devices throughout one's household and the inhabitants themselves through smartphones and wearable devices.

AI & Online Advertising

Machine learning can provide a more personalized, contextual, and anticipatory experience when making a purchase.

- ✓ Flash sales site **BrandAlley** worked with marketing automation company **Emarsys** for persona-based targeting in its email campaigns. The project led to a 16% conversion increase.
- ✓ AI firm **Sentient Technologies** provided 256 real-time website design variations for consumers for Swedish flower delivery chain **Euroflorist**. This process resulted in a 17% increase in conversions.
- ✓ **Guess** integrated the **True Fit** machine learning software into its web and mobile platforms. The True Fit algorithm matches consumer preferences with clothing or footwear to offer the best fit. It also leverages its machine learning capabilities to track returns and successful purchases, enabling it

to increasingly tailor its recommendations to users.

AI & In-Store Advertising

According to Deloitte, digital interactions currently influence more than one-third of retail in-store sales. **PepsiCo** and **Frito-Lay** are using image recognition to drive in-store promotion and consumer engagement via contests in which customers photograph their products to compete for prizes. As stated in the Deloitte report:

"As an example, one apparel manufacturer is developing a virtual personal shopping assistant that aims to act like an experienced in-store salesperson. The prototype app, Expert Personal Shopper, was developed by Fluid Inc. using IBM's Watson platform. Speech recognition enables customers to interact via voice with the app, which uses NLP [natural language processing] to understand customer questions so that it can make appropriate recommendations based on its analysis of product information. Machine learning is used to improve the quality of the app's recommendations over time."

Conclusions

The ultimate goal of incorporating AI with consumer goods is to enable simpler and more direct shopping for both the producer and consumer. This will enable consumers to spend more time doing (and finding) what they really want. Companies can leverage these innovations to contending with increasingly value-conscious and tech-savvy consumers. As increasing numbers of consumers depend on using digital and mobile devices to shop, many consumer goods companies are investing in existing and emerging technologies to better understand, connect with, and engage with consumers.

It is important for manufacturers to understand how technologies such as voice recognition, natural language processing, and computer vision will enable leaner operations and more direct interfacing with their consumers.



DANIEL MORALES

Daniel is one of PreScouter's Project Architects. He specializes in the consumer goods sector. Daniel received his PhD in Chemical Engineering from North Carolina State University in Raleigh. His dissertation research focused developing stimuli-responsive polymer networks for micro-robotics applications. After his graduate studies, he completed post-doctoral work at the LPCNO Lab in INSA Toulouse, France where he focused on incorporating microfluidics with nanoparticle assembly techniques to develop multi-parametric sensors. In addition, Daniel has industrial experience in pharma manufacturing and polymer processing. Daniel joined PreScouter as a Project Architect after two years as a Global Scholar.

AI & CONSUMER GOODS: ENHANCING THE OVERALL CONSUMER EXPERIENCE

Sofiane Boukhalfa

The technological revolutions in IoT and AI are accelerating at breakthrough speeds. These technologies are integrating with multiple e-products and services that power and add comfort to our lives. By combining such technologies, one can create new products with even higher value to consumers everywhere.

AI-Powered Consumer Electronics

Many organizations have already picked up on this. The CES 2017 Show was evident of this trend. The big trend this year was definitely AI powering numerous consumer products, or augmenting the capabilities of connected products and smart appliances. **Amazon** led the fray, announcing several partnerships with manufacturers to connect Alexa with a wide array of consumer products ranging from smart

EXAMPLES OF SOME ALEXA-POWERED DEVICES:



- Lenovo's Smart Assistant
- Ubtech Robotics Lynx
- Mattel's Aristotle
- Ford
- Volkswagen
- GE LED Ring Lamp
- LG SmartThinQ Appliances

EXAMPLES OF SOME GOOGLE ASSISTANT-POWERED DEVICES:



- LG SmartThinQ Appliances
- Smart Speakers
- Smart Displays
- Android TVs
- Android Auto

light bulbs to loudspeakers, and even sprinklers. **Google** has made several moves with its Google Home and Google Assistant competing directly with Amazon in this space. Other players are far behind.

With more industry leaders incorporating AI and IoT, it is interesting to imagine what other consumer electronics devices might benefit from combining the virtues of IoT and AI that have not been touched yet. Of course, most electronic devices have already gone through this evolution; from smartphones and computers, to alarm clocks and toys, the evidence associating AI to IoT in consumer electronics everywhere is overwhelming.

The Era of Machine Learning and Electronics

So, what is next? Will it be digital cameras that use machine learning to input settings and wait for the right time to always take the perfect picture and upload the results directly to

Instagram and Twitter? Or will it be a sound speaker that always projects songs with the preferred personal settings, and adjusted based on the genre of song through deep learning?

The possibilities are endless. In order to be able to continuously develop new products that appeal to an ever-evolving consumer, organizations need to develop core competencies within both of these fields. Relying on just one of these competencies (AI or IoT) may help in the short to midterm, but the value that can be created by combining both is exponentially higher and will soon be a necessity for most products in the long term.



SOFIANE BOUKHALFA

Sofiane is one of PreScouter's Project Architects. He specializes in the financial industry. His responsibilities include managing the overall project and scholar team to ensure successful project outcomes for our clients. Sofiane earned his B.S. in Materials Science and Engineering from The University of Illinois at Urbana-Champaign, and his Ph.D. in Materials Science and Engineering from the Georgia Institute of Technology. His research focus was in nanotechnology and energy storage. Since graduating from Georgia Tech, he has worked as an emerging technology and business strategy consultant at several firms and for his own clients.

AI & HIGH-TECH: BOTH A CHALLENGE AND OPPORTUNITY FOR HARDWARE MANUFACTURERS

Sofiane Boukhalfa

Along with the players that will be able to successfully integrate and offer AI capabilities to their customers, the key benefactors of this growth will be the organizations offering the hardware that makes AI possible. At the moment, the key players in this sector are video card manufacturers because the ability to process videos and render lifelike images that simulate explosions requires the same type of processing that AI requires.

NVIDIA Takes the Lead

NVIDIA identified this fact early and facilitated graphics processing unit (GPU) programming by offering a programming toolkit called CUDA in 2006, which deep learning and machine learning researchers used to great effect in testing and developing more deep learning models.



Has **>70% share** in the graphics processing unit (GPU) sector as of 2016



Made key partnerships with **Tesla, Facebook and Baidu**



Stock grew **224%** in 2016



Offers GPUs to **>3000 AI startups**

NVIDIA (which has >70% share in GPU sector as of 2016) has benefited immensely from this serendipitous coincidence, and Wall Street has approved of the new direction the organization is taking (NVIDIA stock grew 224% in 2016). The organization's alignment with key players in high impact industries will help it keep the lead it already possesses.

- ✓ NVIDIA has made key partnerships with leading automobile manufacturers in response to the demand for self-driving cars. For example, it recently announced a partnership with **Tesla Motors Inc.'s Autopilot system**.
- ✓ It has partnered with Internet giants **Facebook** and **Baidu**.
- ✓ It also offers GPUs to many of the more than 3000 AI startups that have sprung up worldwide, as well as to key researchers at leading institutions around the globe.

Prospects for Other Industry Players

NVIDIA has benefited immensely from the explosive growth in AI affecting most industries, and it will be interesting to see if the other GPU manufacturers follow suit. Currently, **IBM** and **Intel** are making some headway in the area but still lag far behind NVIDIA. The other manufacturers need to start developing their offerings for AI applications now, and designing an innovation and ideation strategy that focuses in this area will be essential to ensure they also benefit from this growth.



SOFIANE BOUKHALFA

Sofiane is one of PreScouter's Project Architects. He specializes in the financial industry. His responsibilities include managing the overall project and scholar team to ensure successful project outcomes for our clients. Sofiane earned his B.S. in Materials Science and Engineering from The University of Illinois at Urbana-Champaign, and his Ph.D. in Materials Science and Engineering from the Georgia Institute of Technology. His research focus was in nanotechnology and energy storage. Since graduating from Georgia Tech, he has worked as an emerging technology and business strategy consultant at several firms and for his own clients.

TRANSPORTATION: ENHANCING PRODUCTIVITY & DATA DRIVEN DECISIONS AND PREDICTIONS WITH AI

Anu Antony

Research into AI has experienced a surge in the last few decades. This was built largely on pioneering results from the 60's and 70's, including the utilization of advanced neural networks (NNs). It has even taken inspiration from biological behavior for methods like fuzzy logic or genetic algorithms (GAs).

A major area where AI has taken off is in transportation. Media hype has covered quite a bit of recent advances, like **self-driving Ubers** or **Tesla's new semi-autonomous trucks**, but what else lies ahead? How will AI impact this industry?

How AI Can Help Transportation

Transportation problems arise when system behavior is too difficult to model according to a predictable pattern, affected by things like traffic, human errors, or accidents. In such cases, the unpredictability can be aided by AI.

AI uses observed data to make or even predict decisions appropriately. NNs and GAs are perfect AI methods to deal with these types of unpredictability. AI has been in development and implemented in a variety of ways. Some examples are given below:

- ✓ **Improvement of Public Safety:** Safety of citizens when traveling by public transport in urban areas is improved by tracking crime data in real time. This will also enable the police to increase their efficiency by patrolling and keeping their citizens safe.
- ✓ **Corporate Decision Making:** The road freight transport system can utilize accurate prediction method to forecast their volume using AI methods, which simplifies transportation company planning. Additionally, several decision making tools for transport can be designed and run by AI. This will affect investments made by companies in the future in a productive way.
- ✓ **Autonomous Vehicles:** Self-driven cars and trucks have been of high interest in the last

several years. In the commercial sector, Uber and Elon Musk have produced self-driving trucks to reduce the number of accidents on highways and increase productivity.

- ✓ **Traffic Patterns:** Transport is greatly affected by traffic flow. Traffic congestion in the US costs around \$50 billion per year. If this data is adapted for traffic management via AI, it will allow streamlined traffic patterns and a significant reduction in congestion. Several similar systems are already in place. For example, smarter traffic light algorithms and real time tracking can control higher and lower traffic patterns effectively. This can also be applied to public transport for optimal scheduling and routing.
- ✓ **Pedestrian Safety:** The use of AI to predict the paths of pedestrians and cyclists will decrease traffic accidents and injuries allowing for more diverse transportation usage and an overall reduction in emissions.

The Impact of AI on Transportation

Benefits:

In October 2016, **Uber** announced a driverless truck made by **Otto** that successfully drove 120 miles at 55 mph without any issues. Additionally, **Daimler Trucks** has produced an 18-wheeler semi-autonomous truck with an auto-pilot system.

Costs of labor in this sector will continually decrease with increased use of AI, providing higher profits for industry players. The issue of long driving hours and stopping for a break will no longer be a concern with fully automated fleets.

Beyond straightforward labor costs, safety and traffic accidents will be majorly affected by AI. The number of accidents involving truck drivers at night is a large issue and can be significantly



improved with the use of smart unmanned vehicles. The personnel and financial costs of these accidents are quite substantial. Auto-pilot or complete unmanned vehicles can allow the driver to have a snooze without causing severe accidents. Some AI trucks even have a special feature of predicting accidents as well as health issues of people around the truck like detecting a heart attack and alerting the emergency services automatically with the location and details of diagnosis.

Drawbacks:

Automated trucking has sparked a hot debate among 3.5 million truck drivers in the US alone. Developments would mean autonomous trucks, ships, aircraft or trains slated for the future, along with any future vehicles becoming completely unmanned. Job flow is thus a major concern for truck drivers, taxi drivers, and other members of the industry. Social experts have argued that job skills can be shifted or evolved to other sectors, but tensions remain high.

Implementation around the world presents another major issue. Undeveloped and third world countries face enormous challenges in utilizing these solutions, as their infrastructure is not as stable or capable of providing maintenance and repairs. It will be a long time before AI can become a reality there.

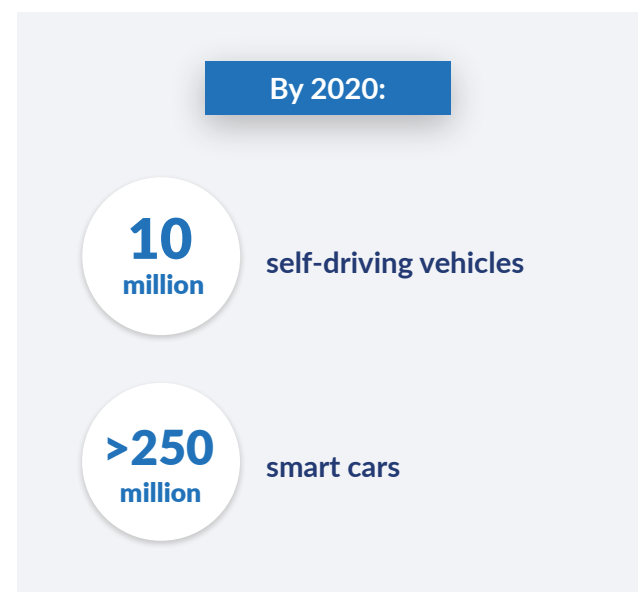
Increasing focus on AI also presents a dilemma for transport companies: transport costs contribute to the company turnover by 3-10%.

This makes it a very important factor in corporate economies as a whole. All existing businesses will need to engage in, develop, and implement AI technologies to remain a competitor in the transportation industry. This affects transportation logistics as well, as it is used in the supply chain of operations and manufacturing and even predicting the time and total cost of the entire process.

The Future

By 2020, it is estimated that there will be 10 million self-driving vehicles and more than 250 million smart cars on the road. **Tesla**, **BMW**, and **Mercedes** have already launched their autonomous cars, and they have proven to be very successful.

Experts like *Elon Musk* and *Stephen Hawking* predict that AI can be a grey area when the root



of AI decisions cannot be comprehended by humans. Stephen Hawking warned at the Web Summit tech conference in Lisbon that:

“Unless we learn how to prepare for, and avoid, the potential risks, AI could be the worst event in the history of our civilization. It brings dangers, like powerful autonomous weapons, or new ways for the few to oppress the many.”

Despite this, we can gain tremendous productivity improvements in several industrial areas. Interstate driving in the US and delivering products to customers will become an easy task

for companies, thereby increasing their profits.

As the transport industry becomes more data driven, the talent profile will also shift as new skills will be needed in the workforce to keep up with ongoing changes. Companies will need new strategies to navigate this dynamic environment.



ANU ANTONY

Anu is currently pursuing her PhD research in renewable energy at Newcastle University. She has also completed her Masters in Renewable Energy. Anu is extremely passionate about sustainable energy. She has worked as an Intern/project coordinator at Pollinate Energy (Hyderabad) a social business in India (sponsored by UNSW,UTS insearch, AECOM, Australia) which provides easier renewable energy accessibility for the urban poor in India as well as being involved in Product Development, Business processes, Recruitment, Training and Market Research while successfully completing related projects. She has also volunteered as an auditor for the Green Impact program at Newcastle University.

FOOD AND BEVERAGE: AI TO IMPROVE SUPPLY CHAIN MANAGEMENT

Rachel Murkett

Supply Chain Management is a constant struggle for food and beverage (F&B) companies. Consumers want more insights about where their food is coming from, and on top of meeting consumer demands, manufacturers have two additional concerns: first, turning around inventory quickly at competitive prices while maintaining stock and supplier relations. Then, manufacturers must keep a close eye on quality, ensuring all products in the supply chain meet industry and consumer specifications. Obviously, there's a lot to track in the data-driven supply chain. That's where AI can provide F&B companies with new supply chain insights to stay ahead of the curve.

AI is essentially programming computers so they can receive data, evaluate it, make a decision based on the evaluation, and then perform a given task based on the decision. This emerging technology helps F&B companies with Supply Chain Management through logistics, predictive analytics, and transparency. Companies from every sector of the food industry — such as perishable foods, like dairy products, and dry

food products, like grains — are using AI to improve quality assurance, provide better forecasting models, and keep up with consumer trends.

AI, Food Safety, and Quality Assurance

Having robots milk cows isn't new, but testing milk for quality and safety using AI is. Preventing foodborne illnesses is top of mind for all food companies and having perishable foods in transit at the right temperature, preventing contamination, is a major part of the food industry's supply chain process.

Cornell University and **IBM** recently announced a partnership to use AI to identify food hazards in milk that will protect global milk supply. By looking at genetic sequencing and bioinformatics analytics, IBM and Cornell hope to identify traits and determine what should be normal and what is abnormal. IBM chose Cornell, in part, because of the university's dairy processing plant. The Ithaca-based plant will help monitor and test

throughout the entire dairy supply chain — from farm to processor to consumer.

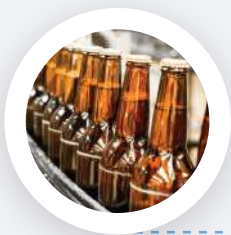
AI and Industry Forecasting

“Through this partnership, we are extending the consortium work to a broader range of ingredients, leveraging AI, and machine learning, to gain new insights into how microorganisms interact within a particular environment.”

- Jeff Welser, VP and director of **IBM Research**, Almaden.

The partnership aims to help prevent foodborne illness and food fraud in the more than 600 pounds of milk and milk-based products the USDA estimates are consumed each year.

One of the main benefits of using AI is having increased data and analytics. This can help manufacturers understand issues with inventory, at the same time through machine learning, data can be used to make predictions on pricing and inventory for more accurate forecasting and better supply chain management. In 2014, only 11 percent of companies had the information to evaluate a “what-if analysis” and only 24 percent of companies were able to model profitability impacts of changing conditions in their complex systems according to Data Informed.



Constellation Brands beer factory is partially robot operated:
6 people watch 70 laser-guided vehicles.

Cornell University and IBM partnered to use AI in identifying food hazards in milk.



Siemens is using AI to run a "lights-out" manufacturing operation.
Their warehouse can be run for weeks without human supervision.

Some agribusiness companies are using Descartes Labs' datasets from satellite imagery to analyze and predict crop yields in real time.



Companies in agribusiness are using **Descartes Labs'** datasets from satellite imagery to predict crop yields and generate the data equivalent to 10,240 yards of books on a shelf updating the system. This data can be used to analyze and predict crop yields in real-time, allowing companies and governments to prepare for crop shortages and forecast pricing. The founder, *Mark Johnson*, said that their model has provided 2.5 percent average margin of error when run through past analysis. This is more accurate than the USDA's estimates and provides a county-level reading rather than USDA's country and state level estimates.

AI and Supply Chain Transparency

One of the emerging trends in the food industry and a big challenge for F&B companies is supply chain transparency: letting consumers know where food products come from and how they're produced. Consumers seek better supply chain transparency so they can make ethical or environmentally-conscious decisions.

In a recent AgFunderNews podcast, Beth Robertson-Martin, sourcing lead for organic, natural, and non-GMO ingredients at General Mills said,

"There's no shortage of demand for transparency through the supply chain and it's not always easy to trace every ingredient to the specific field that it was grown on so I think there's definitely a need for technology to make it easier for us to do that and as quickly as possible."

Beyond just tracking the movement of food and beverages, AI can also be used to make decisions on the operation of the supply chain. Previously, human input would have been required to make decisions based on the data collected. By contrast, with AI, a computer can be programmed to make these decisions automatically and with higher accuracy. One company capitalizing on AI is the German manufacturing company **Siemens**. The company is able to run a "lights out" manufacturing operation, which allows the company to run a warehouse for weeks without human supervision. F&B and other CPG companies are also benefiting from AI compared to other inventory management systems. **Constellation Beer** factory in Mexico, for instance, is partially robot operated with only six people watching 70 laser-guided vehicles.

AI can help track food and beverages throughout the entire supply chain from the farm to the manufacturer to the distributor and store. This helps food and beverage distributors be more transparent to consumers.

I've seen how new technologies, such as AI, are being used to make businesses not only function better, but also more safely. There's a lot on the horizon for AI to help the F&B supply chain. AI not only allows products to become more traceable, and have more analytics to determine supply and demand, but also, on a global scale, it can make food consumption safer by identifying abnormalities.



RACHEL MURKETT

Rachel is one of PreScouter's Project Architects. She specializes in the food & beverage industry. She completed her PhD in Chemistry at the University of Cambridge. Her research was focused around Photobiology, with research themes including the development of fluorescent proteins for biomedical imaging applications and the formulation of lutein as a nutritional supplement. Prior to her PhD, Rachel completed a Bachelor (Honours) Degree in Biochemistry at the University of East Anglia.

AI & DRUG DEVELOPMENT: A MAJOR OPPORTUNITY FOR THE PHARMACEUTICAL INDUSTRY

Salma Buddaseth

Pharmaceutical companies have the opportunity to capitalize on AI. Drug companies continuously analyze thousands of compounds, seeking candidates of therapeutic value. The process can be time-consuming and costly:

- ✓ 1-6 years for preclinical development, costing about \$1 billion.
- ✓ 6-12 years for clinical development before FDA approval, costing about \$1.4 billion, with a cumulative probability of roughly 8 percent of getting a development candidate to approval.

In an effort to speed up the process, improve efficiency, and reduce healthcare costs, several pharmaceutical companies have implemented systems biology, computational modelling, and AI, albeit with mixed success.

AI Saves Half the Time and Money for Drug Discovery

In February 2017, **BERG Health**, a 6-year-old startup backed by Silicon Valley billionaire Carl Berg, made headlines when they announced that their AI platform had selected a drug candidate for rare brain cancers that has now entered

TRADITIONAL DRUG DISCOVERY METHODS CAN BE:

time consuming

costly

7-18 years

~ \$2.4B

For preclinical development:

1-6 years

~\$1B

For clinical development:

6-12 years

~ \$1.4B

AI SAVES ½ THE MONEY AND TIME

clinical trials as monotherapy (i.e., stand-alone treatment). The drug candidate, BPM 31510-IV, was guided through early development by the AI-based BERG Interrogative Biology Platform. The platform analyzed patient data from thousands of cancer patients to build an *in silico* disease model and suggest possible drug treatments.

BERG's President and Co-Founder, Niven Narain stated:

"We've essentially reversed the scientific method. Instead of a preconceived hypothesis that leads us to do experiments and generate a particular type of data, we allowed the biological data from the patients to lead us to the hypotheses."

Legally required regulatory testing necessitates that all drug candidates pass through animal tests; this requirement is unlikely to change in the near future. However, the potential to select a drug candidate entirely from human data may not only expedite the drug development process but also reduce the attrition rate of drug candidates, thus decreasing overall cost. Narain claims that his AI platform took half the time and half the money of traditional methods.

Drug Target Identification and Toxicity Prediction

Despite the daunting drug development process, FDA approved drugs are frequently withdrawn from markets. This is primarily due to their side effects or toxicities, which is a fallout of polypharmacology of drugs. Polypharmacology is the interaction of drug molecules with multiple targets that, besides the intended therapeutic effect, can result in side effects. Two companies already leveraging AI and Big Data for the purpose of drug target identification and side effect prediction are: **Cyclica Inc.**, a Canadian startup and **One Three Biotech**, a spin-off of Weill Cornell Medical College in New York.

Cyclica Inc.

Cyclica Inc., founded in 2010, employs a suite of computational algorithms. Their predictive analytics platform, **Ligand Express™**, combines proteome-docking, ligand effect prediction, and systems biology and drug-protein interactome analysis, to evaluate and compare small molecules, and predict how each drug will interact with the human body (i.e., human proteome). Cyclica's Ligand Express platform is



used and validated through third-party organizations, allowing clients to anticipate a drug candidate's side effects prior to clinical trials, thereby enabling more informed R&D investment decisions.

One Three Biotech

Working in the same space as Cyclica is One Three Biotech, founded by Neel Madhukar. The company's AI-based platform was developed by Madhukar as part of his graduate work with computational biologist Olivier Elemento. When speaking to PreScouter, Elemento and Madhukar explained that their AI platform, **BANDIT**, helped Oncoceutics Inc. predict the target for ONC201, a first-in-class small molecule that is being evaluated in 5 clinical trials. Their results were later confirmed through *in vitro* assays, and the physiological relevance of the predicted interaction was established by analyzing clinical samples.

"The predictions are based on patient data. We are teaching AI to connect small molecules with their targets using curated data from public databases and hope to gain access to databases from Big Pharma to improve connection and correlation predictions," Elemento said.

Referring to their closest competitor, Madhukar claims that,

"While Cyclica may have higher computational capabilities, One Three Biotech's AI platform has greater accuracy (~90%) than Cyclica's platform (~70%)."

Cheaper Drug Development, Cheaper Healthcare

Over the last five years, AI has made headway in various aspects of drug development and is being used by biotech startups and mid-size drug discovery companies. However, AI is yet to be embraced by big pharma corporations. As the adage goes, "the proof of the pudding is in the eating", similarly, the long-term drug safety and clinical efficacy of AI-selected and developed drug candidates remain to be assessed.

AI has already revolutionized other sectors and has the potential to do so in the pharmaceutical industry by increasing drug development efficiency and reducing drug attrition, thereby reducing drug development cost and offering the promise of cheaper healthcare.



SALMA BUDDASETH

Salma Buddaseth is a biomedical research scientist involved in pre-clinical drug development of small molecules and immunotherapeutics at Memorial Sloan Kettering Cancer Center, New York. She obtained her PhD. in Biochemistry from Hannover Medical School, Germany, where she worked on cancer therapeutics and genetic mutations that influence susceptibility to drugs. Besides science and technology, she is passionate about entrepreneurship and business development.

"I don't know enough about X, and I don't have the time to research and learn it. Quickly get me up-to-speed on what I (specifically for my role and context) need to know, so I can understand my options."

**Spend less time on
tedious, tactical activities**

**Spend more time on
high-impact, strategic activities**

Calling external
innovators for information



Collaborating with
external innovators

Searching
databases



Analyzing landscapes that are
state of the art

Studying research
journals



Road-Mapping
internal programs

Mining large
amounts of data



Making decisions

Have top tier advanced researchers work on your project

Our clients value the unbiased insights and innovative thinking that our network of over 2,000 researchers provides.

We take care of everything

Our proven system removes the stress of interviewing, selecting and managing talent to produce high quality results.

"PreScouter made us aware of 23 emerging technologies that we probably would not have become aware of (otherwise)"

Dr Richard Demke

SUNSTAR

PreScouter is trusted by over 400 clients - and counting



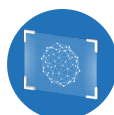
EXPERIENCE IN MULTIPLE INDUSTRIES



Materials



Packaging



High Tech



Financial



Consumer
Goods



Natural
Resources



Medical



Food and
Beverage



Transportation

PreScouter quickly gets Corporate Innovators up-to-speed on what they need to know to make informed decisions.

PreScouter, Inc. 1 N. Franklin St, Suite 1850, Chicago, IL 60606 • info@prescouter.com • (872) 222-9225

PreScouter, Inc. 1 N. Franklin St, Suite 1850, Chicago, IL 60606

info@prescouter.com

(872) 222-9225

www.prescouter.com