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TAKING A LOOK INTO SUPPLY CHAIN'S CRYSTAL BALL

New Technologies That Will Fundamentally Change the Industry

Written and researched by Connor Clarke - 2018

Introduction

Supply chain and logistics are fields that are making rapid advancements. Established companies and startups, alike, must capitalize on the opportunities these new technologies offer. As a result, eft wanted to shed some light on the developments across the different functions of our industry.

This report, divided into three separate sections, features technologies being implemented by early adopters, technology in development, and even technologies that are mostly theoretical. We also highlight specific companies working on the cutting-edge and individual success stories within particular industries. With this knowledge, we hope our readership will not only be prepared to take full advantage of the changes coming but will be those leading the innovative charge.

Section overview

The first section of this series will be focused on technologies that are 'on the cusp'. By this we mean, innovations that are being heavily tested, deployed into actual operations, and are expected to make impacts within the next five years. Though this list is far from comprehensive, the main focus of the "**Technologies on the Cusp**" section will be self-driving vehicles, warehouse innovation, and drones. To provide the full picture, we will describe the basis of the technology, describe the potential benefits arising from it, and highlight companies making the technology a reality.

The second section, "**Emerging Technologies**", will cover innovations that some may have heard of, but whose supply chain application and potential are widely unknown. The two main highlights of this section are Hyperloop and the Internet of Things. The Hyperloop is an ultra-fast, low friction transportation method that is able to transport goods and people at up to 760 mph / 1200 km/h. The Internet of Things we're talking about here isn't your grand dad's RFID inventory method; it is full-scale end-to-end visibility with machine learning and automated problem solving to boot. For Hyperloop, we will explain the basis of the technology as well as the benefits of the technology, especially in how it relates to the supply chain. Meanwhile, for the Internet of Things, we will show where we are today, what steps we have to take to reach its full potential, and what that potential is.

Tangential, to "Emerging Technologies", the "**Supply Chain's Laboratory**" section will briefly highlight different technologies that promise great advancement for the supply chain but are considered long-term plays that have are technologically infeasible currently or have not had that much interest from the supply chain community. In this, we will cover the biggest benefits and barriers to additive manufacturing, droids, and a 'loop' underground network and also a brief analysis on what could be done to make them mainstream.

Contents

Technologies on the Cusp

Self-driving vehicles, warehouse innovation, and drones have created a lot of buzz, quite literally for some – we're talking to you drones. In the quickly evolving world of logistics and supply chain operations, these technologies promise to dramatically change the way businesses operate and interact with customers. Here are a few macro trends to look out for as self-driving vehicles, warehouse innovations, and drones become mainstream.

A general overview of how the industry could change:

Capacity, lack of drivers, and labor shortage problems will be minimized. The problems will fundamentally change.

80% of parcels will be carried by autonomous vehicles
Source: McKinsey 2016

52% of transportation and storage tasks can be automated
Source: PwC 2018

Human involvement will focus on high-skilled tasks.
- Job growth will occur in functions like: forecasting, programming, customer retention, cyber security, and in providing a better customer experience
- New processes and careers will be discovered, further increasing job growth and the efficacy of the supply chain
- In trucking, docking and other complex tasks will still be needed, especially initially as technology and regulation are progressing

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With less human error and better tracking abilities, predictability will increase to the advantage of both shippers and consumers.

Expect larger short-term investment, but higher long-term profits.
- Autonomous vehicles, robotics, etc. will be cheaper to operate – require bigger upfront investment
- Less labor will be required to operate, but the high-skilled workers required to operate new technologies will be more expensive

HR, with comparatively fewer employees and lower overall turnover, can shift from an emphasis on recruitment to a focus on development and retention of key employees.

Unknown challenges will arise, as we have never experienced a supply chain with this level of automation.
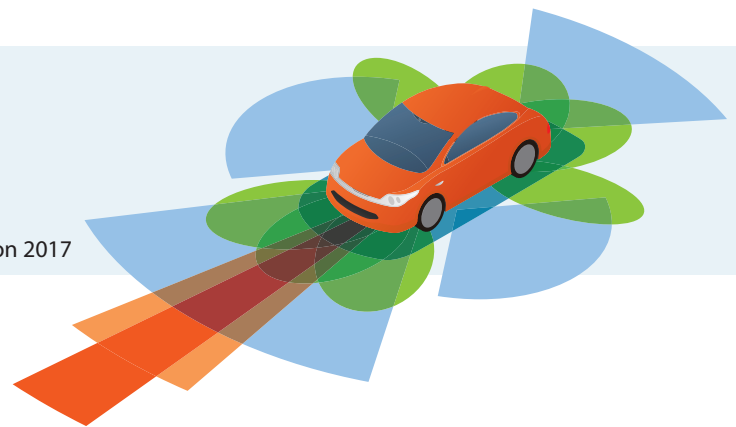
Self-Driving Vehicles

With many industry leaders promising fully autonomous vehicles on the road by 2020 or before, the disruption, or perhaps advancement, of the supply chain is imminent. Beyond the obvious reduction in costs, let's take a look at what autonomous vehicles mean for the industry.

TODAY'S PROBLEM

50,000

driver shortage in 2017

Source: American Trucking Association 2017

Potential Improvements:

The People

Nights and holidays will be less of a restriction on supply chains.

Despite recent accidents, self-driving vehicles will increase safety.
- Worldwide, 1.25 million people die per year in road accidents – Only 3 have died in total from self-driving vehicles (with over 1 billion miles driven)
  Source: WHO 2014 and Medium 2018

Drivers' lives could be vastly improved with the creation of "trucker hotspots" where drivers congregate to make last leg of journey and complete difficult tasks such as docking.
- This would result in more time home and better working conditions for drivers

Increased ride sharing, public transportation, and inter-vehicle communication could make congestion even less of an issue when transporting goods.

Convoys

Autonomous semi-trucks will be able to form convoys, increasing efficiency and decreasing the environmental impact of the logistics industry.
- One driver could be responsible for one convoy (3+ vehicles – driver in lead), cutting the amount of labor needed and raising wages for drivers

Tesla Semis, if estimates hold, would be more cost competitive than rail transport at just $0.85 per mile and will pay for themselves in just 1.5 years.
Source: USA Today 2017 and DHL 2018

Overall, convoys, non-commercial platooning, and a reduction in congestion could mean 273% greater capacity on roadways and up to $121 billion recovered in lost fuel and productivity, yearly.
Source: Lécué, et. al. and Tientrakool, et. al. 2016

But there are still questions…

Who is responsible for the, albeit less common, accidents?
- Car company, software company, driver, pedestrian, insurance

Who/what will the software of vehicles prioritize?
- Pedestrians, driver, structures, multiple people

Policy decisions will be made to allow and regulate autonomous vehicles. What will they be and how will they affect the progress of the industry?

How will roadways change?
- Truck-only lanes, autonomous vehicle optimized highways, smaller roads (due to less margin of error/closer proximity vehicles can maintain)

Because of better fuel efficiency, will fuel taxes increase? Will this include electric vehicles?

With fewer drivers needed, how do we avoid widespread unemployment?

And who are the Players?

Warehouse Innovation

For warehouse technologies, the future is already here.
Warehouse technology, unlike many other new developments, is already in use in several locations across the world. Let's take a look at the benefits, challenges, and some of today's success stories.

Think what you can do for your warehouse?
I don't think so, JFK, think what your warehouse can do for you.
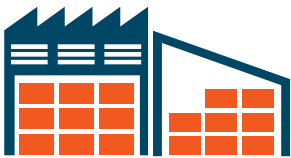
Automated warehouses are able to work around the clock. Very little, if any down time.

Drones and robotic inventory tracking is quicker, reduces error, and is safer for staff.

Robotics can actually decrease overhead costs.
■ Most technologies don't need lights, air conditioning, etc. to function

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Turnover is a non-issue for the technology and will increase standard of work for employees working alongside.

- Employees will have safer and more engaging technology-assisted work

Reaching the Moon wasn't an easy, straight-forward process. Implementing these technologies won't be either.

Finding the right balance of people and automation for different applications will be trial and error. There isn't a one-size-fits-all approach – expect growing pains.

There are many different technologies and approaches to automating a warehouse. Finding the right solution is largely theoretical.

Hiring people with the skills to program, fix, and improve the technology in your warehouse will mean an increase in cost and possibly a shortage of qualified individuals, especially short term.

Again, unemployment. Most people are concerned that warehouse automation will take jobs.

Something to think about

Rethink how you calculate RoI on an investment like this. Traditionally warehousing and inventory have been looked at as a cost center, and rightfully so, but with that, improvement has typically focused on minimizing costs. Not only do we need to improve the technological advancement of our warehouse, but we need to update our thought process also. When considering RoI on implementing technology, don't only look at the investment as cost and recovery of cost, but think of how this creates value for your customers, how you improve the productivity of your employees, what impact does it have on your culture and public image, will embracing technology give an advantage over competitors, and so on. Explicit costs and benefits are just one part of the equation. Finding a way to quantify the non-obvious factors is perhaps even more important.
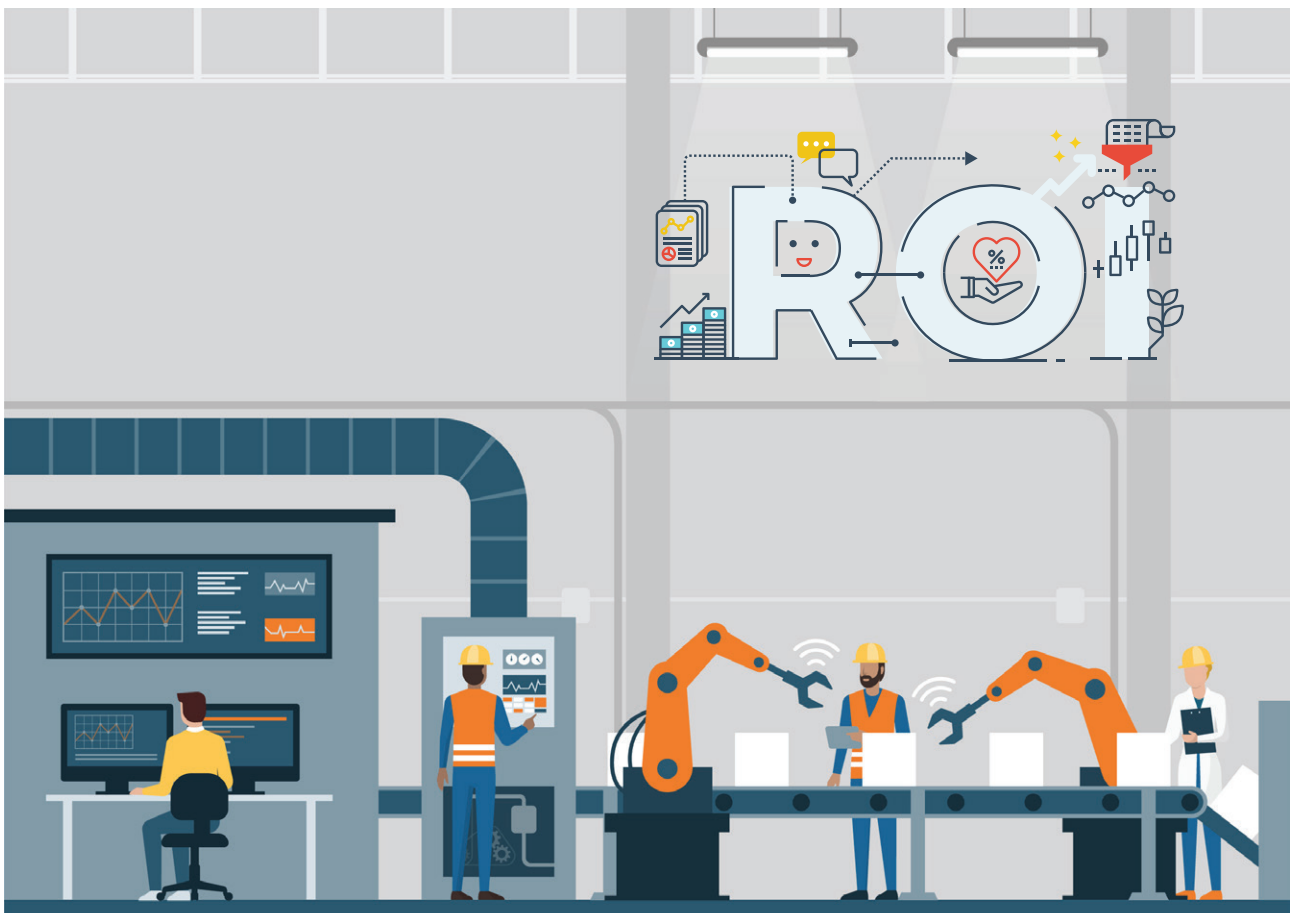
Success Stories

Ocado

Ocado is using an innovative approach to fulfill online orders for groceries. In its new facility, it employs a team of hanging robots and containers within feet of the ceiling. This method allows Ocado to move over 1.7 million items a day across its four fulfillment centers. Because of this, Ocado maintains margins of 12% compared with the industry average of less than 6%.

Source: Forbes 2017

FLEXE

A U.S. startup labeled the AirBnB of warehousing, FLEXE certainly has earned the title. By facilitating peer-to-peer warehouse sharing, companies operating outside of peak season may rent their excess capacity while giving smaller companies a vast network without the industry standard 5-year contract. This is very much a win-win. Smaller companies are able to fulfill orders in as little as one day and grow their footprint in real-time, while warehouse owners avoid seasonal hiring and cover overhead costs. FLEXE currently has over 900 partner warehouses. To give that context, Amazon has 140 (full size) fulfillment centers in the US.

Source: Business Insider 2017

Exotec Solutions

Another startup in the warehousing business, Exotec Solutions recently released its Skypod shelf-climbing robot. This unique ability allows the technology to work 3-dimensionally and reportedly doubles similar competitors' output. Romain Moulin, CEO, prioritizes deployment speed and flexible capacity rather than heavy, fixed infrastructure. This is certainly the case, as Skypods are charged and capacity can be added all without interrupting existing operations.

Others to Watch

Alibaba.com QuiKTRON ROBOTICS	DHL UBiMAX AUGMENTED REALITY	amazon ROBOTICS	ZEBRA SPEECH PICKING	fetch robotics ROBOTICS
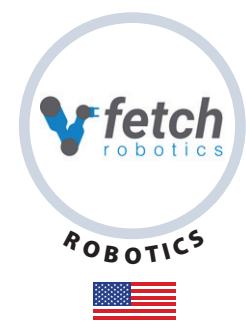
Drones (Unmanned Aerial Vehicles)

No longer a toy or the stuff of science fiction, drones have a chance to revolutionize the most expensive part of the supply chain: last-mile delivery. Drone-makers look to decrease cost, time, and environmental impact, but are being challenged by regulations and oversight adapting to this new branch of aeronautics. The time may have come when the park or Back to the Future won't be the only time we see this budding technology. Next stop: your doorstep.

50% or more of the of the total cost of the logistics journey is from last-mile delivery.
McKinsey & Co.

Best Uses:

Due to their flexibility and lack of required infrastructure, drones are the optimal vehicle to deliver parcels to the end consumer.
86% of Amazon packages weigh <5 lbs
Source: Business Insider 2016

Smaller vehicles mean reduced fuel costs.
Fuel costs could be as low as $0.88 per delivery.
Source: ARK Invest 2016

Drones can, on average, fly about 10-15 miles, well within the distance of most Walmarts.
70% of Americans live within 5 miles of Walmart, 90% within 15 miles
Source: The Motley Fool 2017

The United States being an extreme example of distance needing to be covered, drones could work even better in smaller countries.

According to McKinsey, drones are particularly attractive in rural areas (less wires/obstructions).

■ However, as the case is for all aeronautics, weather is an issue.

Companies today have had success deploying drones in warehouses and performing maintenance work, increasing inventory visibility, safety, and speed in daily operations.

The Playbook:

How drones deliver packages

The Fisherman: Drone releases cord that sets package on ground	**Sticking the Landing:** Drone sets package directly on ground	**The Wingman:** Trucks act as distribution center from which drones take packages
PROJECT WING GOOGLE - FISHERMAN	AMAZON AIR STICKING THE LANDING	MATTERNET-MERCEDEZ THE WINGMAN
FLIRTEY FISHERMAN	DHL STICKING THE LANDING	WORKHORSE THE WINGMAN

Emerging Technologies

"You must always be able to predict what's next and then have the flexibility to evolve."

Marc Benioff, Founder and CEO of Salesforce

The supply chain space is one that is rapidly advancing. We must be able to **predict what's next**. Because of the speed at which technology is progressing in our industry, we must not only look at what is happening now, but what the future holds beyond self-driving vehicles, warehouse innovation, drones, and other recent developments. A thoughtful approach towards future technologies is truly the way we will find the **flexibility to evolve**.

History reminds us that embracing change is not only a matter of success but one of survival. Just ask premier saddle-maker and one of the original 12 members of the Dow Jones Industrial Average, Central Leather Company. They failed to change their business model to incorporate a ridiculous new technology. You might know it, they called it the automobile.

On a much more positive note, new innovations allow companies to differentiate themselves, find new value for customers, and capture market share even in the most competitive industries. FedEx, "a technology company disguised as a transportation company" according to Donald Broughton, is an excellent example of this. By being an innovator, FedEx has become one of the most admired and successful companies in the world. They even got Tom Hanks to star as an employee in Cast Away. Basically, what we're saying is, if you want Tom Hanks to play you in the next big blockbuster, you're going to have to be an innovator also. In all seriousness, these two featured innovations are game-changers. By being involved and prepared for the impact they will make, you and your company can help choose the path these technologies take. Leave your competitors to make their 'premium' leather saddles.

Hyperloop

Hyperloop, once believed to be one of Elon Musk's overstated visions, is quickly gaining ground, with Virgin Hyperloop One recently winning a bid to build a route in India. Let's take a look at the basis of Hyperloop technology, as well as the benefits that attract India, transportation leaders, and the supply chain community to the possibilities it creates.

The Many Benefits of the Hyperloop

Speed and Travel Time

Hyperloop:
760 mph/
1200 kmh

Plane:
560 mph/
900 kmh

High-speed rail:
220 mph/
350 kmh

Automobile:
65 mph/
105 kmh

Travel Times

Mumbai to Pune:
25 minutes vs.
2.5 hour (car)

Los Angeles to San Francisco:
40 min vs.
3 hour
(high-speed rail)

London to Paris:
30 minutes vs.
1 hour 15 min (plane)

Source: Virgin Hyperloop One 2018

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Cheaper Passenger and Freight Costs
- Based on higher passenger rates and similar capacity…

Hyperloop: $390   **Intermodal Container: $1000**

Source: Freightos 2018

Stockholm ▶ **Helsinki**

And More…

Much cheaper to build than other infrastructure
- Hyperloop: $40 million/km
  High-Speed Rail:
  $56 million/km

Source: Hyperloop One 2016 and World Bank 2014

Lower environmental impact
- Emissions practically zero if powered by renewables
- Solar on top of tube easily accounts for all demand, even on busiest routes

Source: GTM 2015

Companies and distribution centers able to locate further away from population centers
- Population able to disperse
- Cheaper real estate

How It Works

The Hyperloop is a high-speed pod propelled by passive magnetic levitation in a low-pressure tube with blistering max speeds anticipated at 760 mph / 1200 km/h. Initially, the Hyperloop uses its linear motors to accelerate to about 20 mph / 32 km/h, at which point magnetic levitation kicks in, propelling the pod to cruising speeds. These fantastic speeds are achieved because of the low-pressure environment which is approximately 1000 times less than the pressure of Earth's atmosphere. Between the low friction, pressure, levitation, and air cushion, the journey is incredibly smooth. To fight against catastrophic damage, the Hyperloop employs flexible, individual tubes and girders that are earthquake and weather-resistant. Furthermore, pods have the ability to break off and take different routes mid-journey, increasing the options for both civilians and cargo.

Source: Hyperloop Transportation Technologies

Potential Routes

Both Hyperloop One and Hyperloop Transportation Technologies have made agreements and conducted research with various governments and organizations. Here are few of the most promising ones.

Indian Hyperloop
- **Status:** Government agreement and second feasibility test underway
- **Notable Connections:** Pune, Mumbai, Mumbai Airport
- **Company:** Virgin Hyperloop One

Korean Hyperloop
- **Status:** Construction to begin as early as 2018
- **Notable Connections:** Seoul, Busan
- **Company:** Hyperloop Transportation Technologies

UAE Hyperloop
- **Status:** Working with government organizations, prototype released
- **Notable Connections:** Abu Dhabi, Dubai, Al Ain
- **Company:** Virgin Hyperloop One, Hyperloop Transportation Technologies

Nordic Hyperloop
- **Status:** Proof of concept underway in Finland
- **Notable Connections:** Helsinki, Stockholm, Tallinn
- **Company:** Virgin Hyperloop One

Note: **Virgin Hyperloop One** and **Hyperloop Transportation Technologies** are completing various feasibility studies in North America, Asia, and Europe. Furthermore, Elon Musk's Boring Company has received approval to dig an underground Washington, D.C. – New York City route.

The companies making Hyperloop a reality

Conclusion:

The Hyperloop isn't exactly a hard sell. There are obviously massive benefits – reducing transport times, shipping cost, environmental impact, and even location-based costs. The technology may be coming sooner than you think, too! Estimates place the first fully operational Hyperloop to make its debut in 2021. Regardless of the optimism of these claims, the Hyperloop will be here soon. While passenger transport gets all the press, logistics stands to benefit significantly, perhaps even more. However, more needs to be done on the freight-side to bring this to fruition. Forward-thinking companies will find a unique means of differentiation and have a hand in shaping the technology to their benefit by embracing the Hyperloop. At the very least, they'll be on Elon Musk's good side – not a bad place to be considering he can mass produce flamethrowers.

The Internet of Things

The Internet of Things (IoT) is a well-known term in the supply chain industry. Essentially, it connects physical products or assets to the internet, thereby giving us the tools we need to gather information, draw conclusions, and take action all from disparate sources. It promises to simplify the purchasing process for consumers, allow full transparency of operations and machinery in the workplace, and provide end-to-end visibility throughout the supply chain. Despite all these grand aspirations, McKinsey states that the hype may actually understate the full potential.

IoT will have an economic impact between

$4 trillion & $11 trillion by 2025

Source: McKinsey 2015

What is IoT's Full Potential?

IoT offers immense opportunity for businesses looking to learn about their customers. In an age increasingly invested in personalization, IoT could give businesses the data they desire to cater to their customers exact tastes and needs. There are a couple ways this can manifest within a company's IoT strategy. First, based on customer profiles and personas, specific solutions and material may be distributed, thus increasing the efficacy of a company's marketing. Second, data collected from IoT devices is, by nature, impartial. Traditionally focus groups and reviews have been the means of testing and improving products; however, with IoT technology, unbiased data can be readily collected to improve the customer experience in any industry. Finally, based on patterns and trends, proactive approaches may be taken ranging from maintenance on assets before they break down to identifying when a customer will need to retain the services of your company again.

IoT will provide better visibility of inter-company operations, resulting in a higher expectation of quality and accountability from suppliers, shippers, and other key cogs. IoT enables the creation of a seamless, autonomous supply chain. With IoT integration and cooperation, a sale now triggers machines to make the product, a new order for materials placed at the supplier, delivery arrangements made, and information on how to track the asset distributed to the consumer all with one action from a decision maker.

The full potential of the internet of things is almost unfathomable, it could do anything from warn that a tire needs to be replaced on a fleet vehicle to provide macro data on road usage. By providing 'nerve endings' to each asset within a supply chain, the end-to-end visibility conundrum can finally be solved. From an economist's perspective, the thing standing between predictable markets at equilibrium and what we have now is accurate information. By embracing the Internet of Things, we take a giant leap towards becoming better forecasters, optimizing inventory, reducing costs, and serving customers needs how and when they need it.

Examples of the Technology Today

Kwik: **Automatic replenishment of consumer goods i.e. detergent, beverages, etc.** Kwik aims to boost orders, increase customer retention and loyalty, and of course collect real-time data on customer habits and preferences by providing buttons for one-touch purchases to consumers.

Losant: **Enterprise platform that specializes in asset tracking, environmental statistics (temperature, humidity, etc.), and analytics that can be embedded into ordinary objects.** Losant provides a catch-all solution for the supply chain, offering the base for which data can be collected for a variety of applications. Losant is particularly useful in monitoring perishable products.
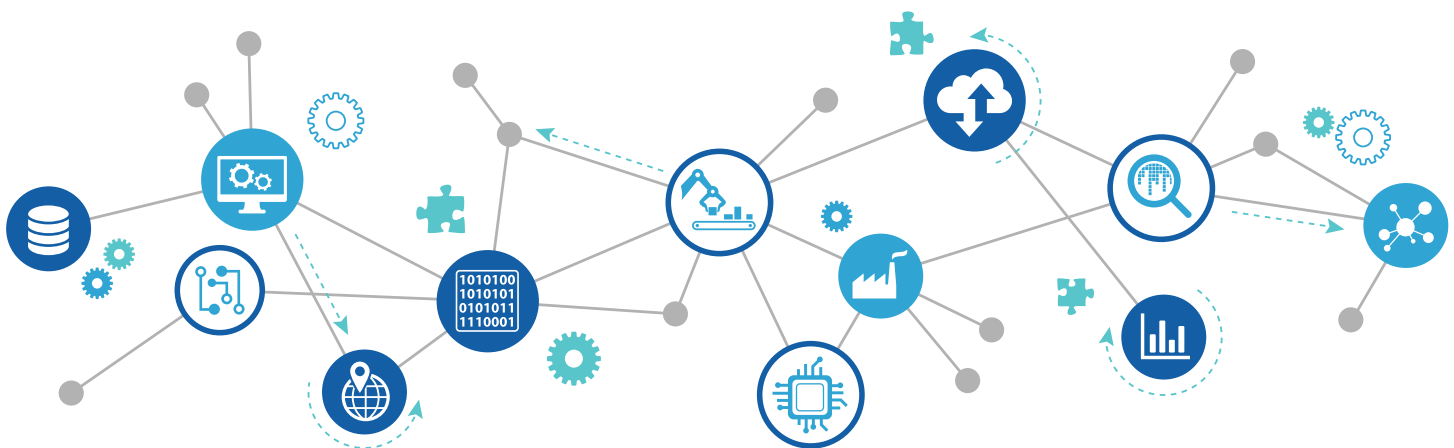
What stands between IoT now and its full potential?

Considering recent events like the Cambridge Analytica and Facebook scandal, data collected on customers will certainly be subject to restrictions from regulators and skepticism from the public.

■ Flow of information may be slowed, and data sharing to 3rd parties could be restricted

End-to-end visibility requires cooperation and data sharing from partners, suppliers, consumers, etc.

Devices being able to work together is essential.

■ Keep an eye on the race for the 'Facebook of Things', a platform for IoT devices that standardizes communication across devices

With the various 'nerve endings', cheap computing power is crucial. Furthermore, storage and data infrastructure will have significant demands placed upon them.

Protecting consumer, partner, and internal data is already a problem, and will only grow in scale as we collect more information.

Practical Tips for Implementation:

Start planning now.
- Implementation is different for every business. It will require significant training and tweaks over time.

Focus on giving more tools to employees to work with instead of simply replacing tasks and job functions. Growth outweighs cost-savings significantly for IoT.

Work to integrate systems like ERP, asset tracking, CRM, and connected machines. More comprehensive decisions are able to be made when all the data is present and conclusions are drawn from the whole picture.

Data analysis is even more important than data collection. Focus on drawing meaningful conclusions and hiring top business analytics and information management professionals.

When looking at solutions and companies, focus on flexibility and the ability to upgrade both hardware and software.
- With substantial yearly advances in technology, make sure your system won't be outdated or incompatible with future services

Cisco predicts a shortfall of 300,000 workers with IoT relevant skills in industrial and operational settings. Invest in your people and find that talent within. Ensure that employees are equipped to deal with the change in technology.

Conclusion:
The internet of things is a technology in very limited use today with enormous potential to change how we consume, create, and fulfill orders and commitments. It could be mutually beneficial to users and enterprises by creating a better product and supplying data to improve internal processes and quality – a truly positive, positive-feedback loop.

Supply Chain's Laboratory

We at eft identified a few other technologies that are largely theoretical or limited in use or experimentation that we couldn't bear to leave out. Our reasoning for this is put into words perfectly by Chief Innovation Officer of Aurecon, John McGuire, when he says, "As with most radical innovations today, science fact was once science fiction. If we're going to help design the future of transport, we have to be able to envision it." Who knows, one of these ideas may be as successful as the "insult to common sense" that the London Underground was dubbed by the New York Times.

Additive Manufacturing

Benefits:
- Decentralized production and increased personalization
- Reduced inventory and material costs / Just-in-time capabilities

Hurdles:
- Time-consuming process
- Limited number of current products and materials

Ideas:

Additive manufacturing, or 3D printing, has a wide variety of possibilities and will certainly depend on the industry and demographic for how the technology will be deployed. The most radical possibility would be to completely decentralize manufacturing by transferring blueprints and raw materials directly to a consumer's machine at home or work. More conservatively, this technology could be used to add flexibility and offer smaller, strategically located manufacturing and distribution centers to accommodate the trend of shorter shipment times.
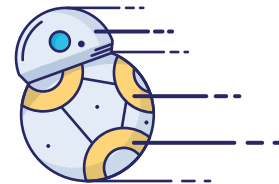
3D PRINTING

Droids

Benefits:
- Cheaper than drones to operate and manufacture and fewer regulatory challenges
- Flexible delivery times

Hurdles:
- Foot traffic or car traffic in dense areas
- Limited capacity and range

Ideas:
Droids, or delivery robots, present a solution to an important niche in logistics – last-mile delivery in cities. While drones are best in rural and suburban areas, droids are able to provide flexible, autonomous instant delivery like their flying counterpart, without as many regulatory challenges. Further, droids could operate within their range without the need for large distribution footprints. If other technologies mentioned here come to fruition, the traffic issue could be solved by extra capacity on existing roadways.

## Loop/Underground Networks

Benefits:
- No over-ground disruption
- Traffic non-existent – stream-lined fulfillment process
- Vast city roadways now able to be replaced. Potentially a way to solve numerous housing crises.

Hurdles:
- Large cost of materials, tunnel boring, and labor
- Acquiring permits and land rights
- Time required to build infrastructure

Ideas:
Underground networks most likely will work best in cities because of cost, land rights, and population. There are several ways to look at implementing this in a city. One solution could be, incorporating and expanding dedicated logistics lines into existing infrastructure systems (low disruption/reduced cost). On the opposite end, small tunnels, used to transport the significantly more common smaller package, could be built with small pick-up points located across the city (vast network/low cost).
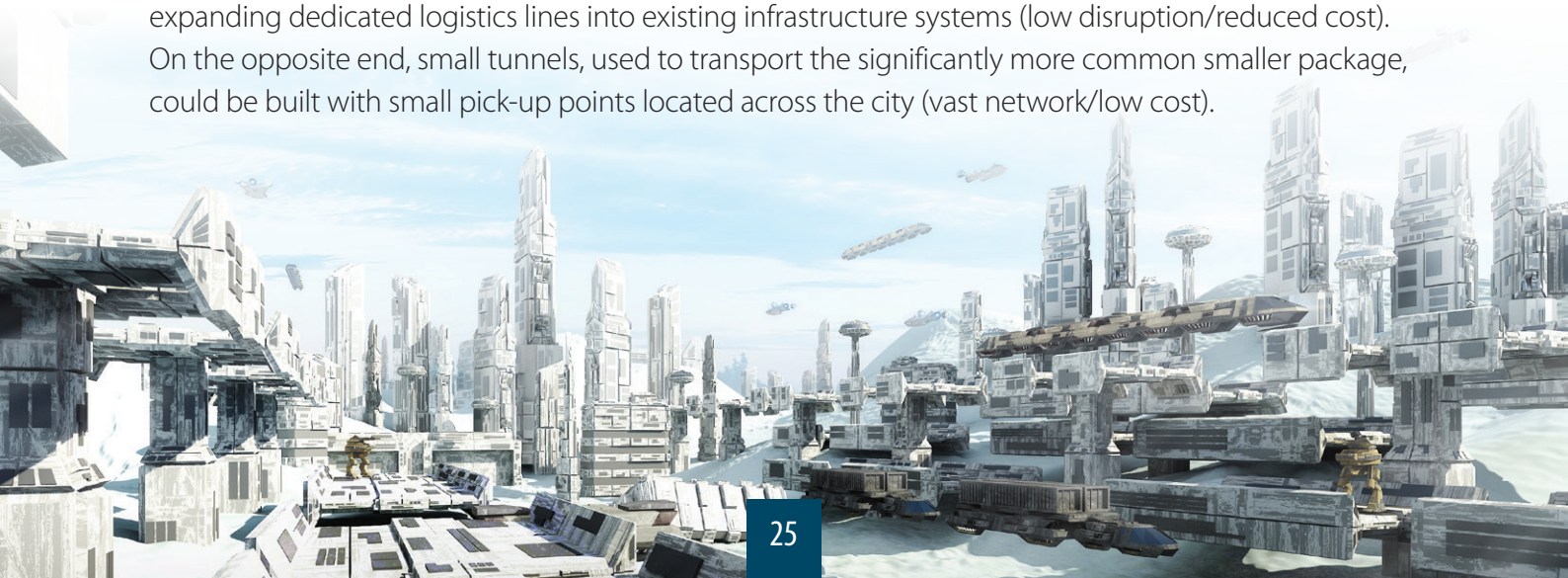
Author's Vision

With all the information and new technology discussed in this report, you may be wondering what the future will actually look like. To illustrate this, we've come up with a story of the vision we have for the future of transportation.

Story:

Stephen, a software engineer working at a London additive manufacturing facility, finishes up for the day. As he's leaving the office, his fridge at home warns him he's dangerously low on mozzarella cheese, and so, he quickly taps the notification and orders a new packet from an eGrocer. Stephen has plenty of options to get home like the new underground loop system or calling an autonomous car; however, he decides with the newly converted roads, he'll take a bike home instead.

As Stephen enjoys his ride back from work, the supply chain is hard at work making sure he has his mozzarella cheese by the time he gets back. A hyperloop containing just that, arrives at the large distribution center right outside of London. The container is unloaded by automated warehouse robots, separated, and loaded into a container. From here, it is put on a track and quickly transported via underground tunnels to the repurposed red phone booth a block from Stephen's flat. A droid picks up this package and several others and delivers them start to finish by the time Stephen is back from his office. Furthermore, the droid picks up Stephen's box of recycled materials and his flatmate's returned package, credits their respective accounts, and sends them back through the underground tunnels.

When Stephen arrives home, his mozzarella cheese is waiting for him, the oven has started its preheat, and all he has to do is make his famous home-made lasagna and entertain his sister, fresh off the Hyperloop from Edinburgh that left the same time Stephen did so from work.

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