Emerging Risks Webinar

The Smart Factory – Innovative New Technologies Affecting P&C Insurance in Canada

PACICC Risk Officer's Forum

Moderator

Ian Campbell

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The Smart Factory – Innovative New Technologies Affecting P&C Insurance in Canada

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Guest Speaker

Luke Watts

Head, Enterprise Risk Management

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Smart Factory

(and other autonomous machines)

17 May 2017

Luke Watts

Head of Enterprise Risk Management, RSA

Member of the Emerging Risk Initiative, CRO Forum

CRO FORUM

Introduction – CRO Forum

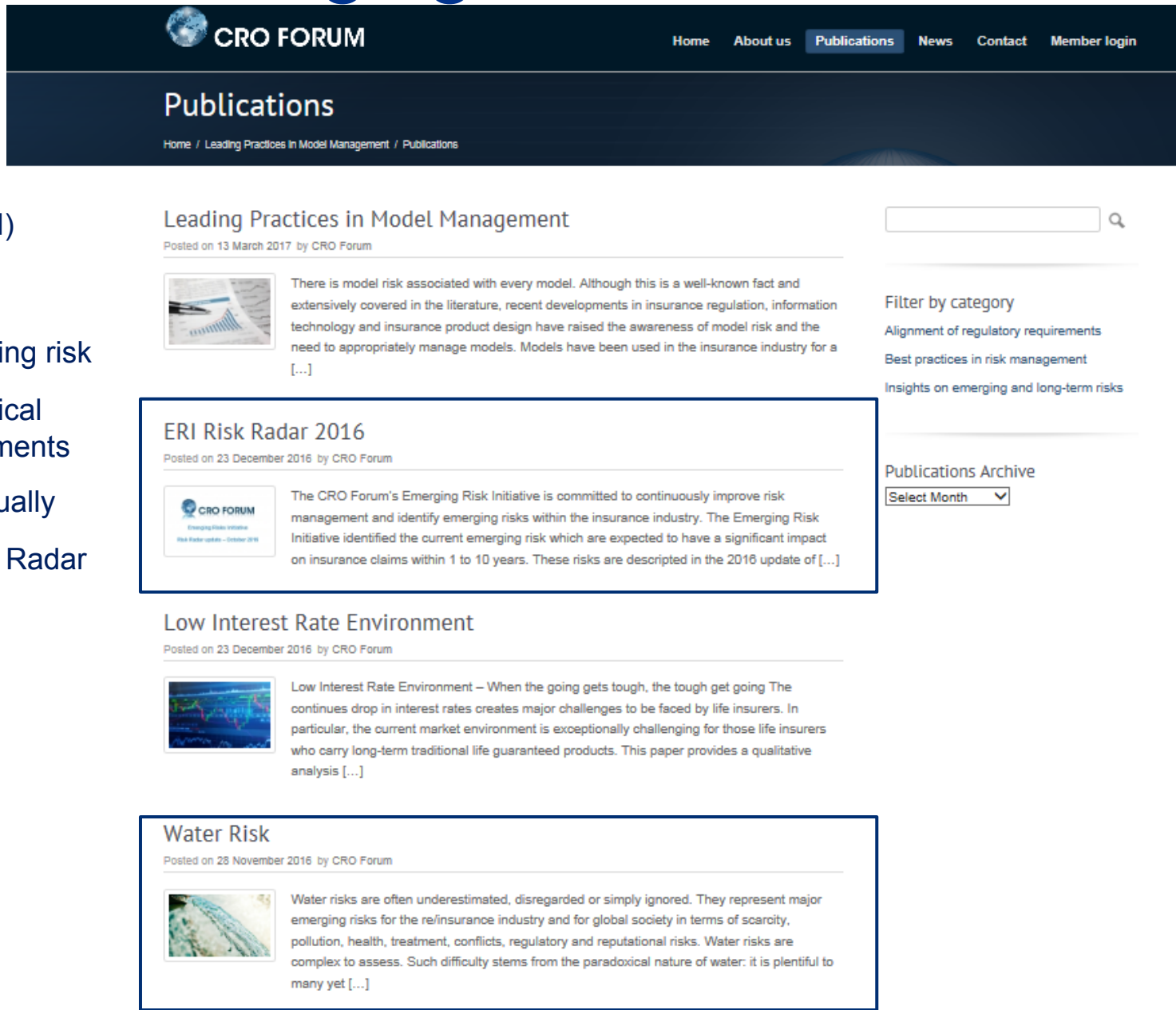
The CRO Forum's Core Aims:

1. Championing best practice in risk management to advance business;
2. Alignment of regulatory requirements with best practice in risk management; and
3. Providing insights on emerging and long-term risks.

Introduction – Emerging Risk Initiative

Emerging Risk Initiative (ERI) deliverables:

1. To raise awareness and understanding of emerging risk
2. Analyze current and topical emerging risks developments
3. Publish topic paper annually
4. Maintain Emerging Risk Radar



Introduction - Smart Factory

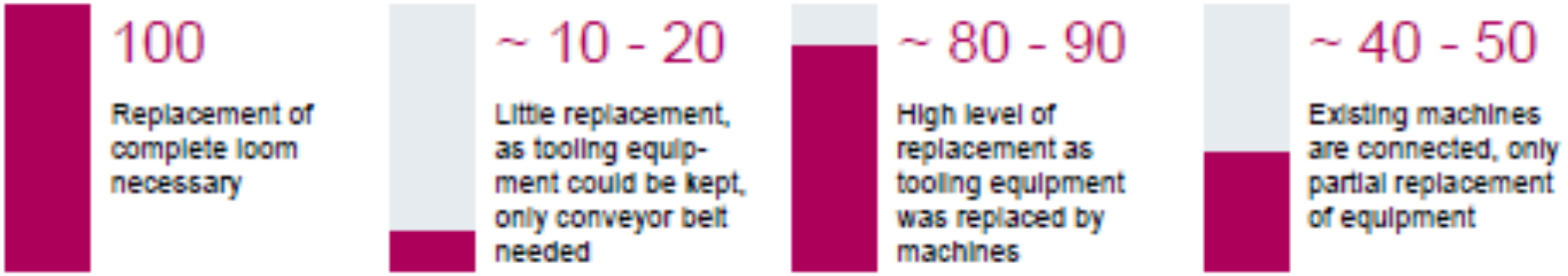
1st revolution
Water/Steam

2nd revolution
Electricity

3rd revolution
Automation

4th revolution
Cyberphysical systems

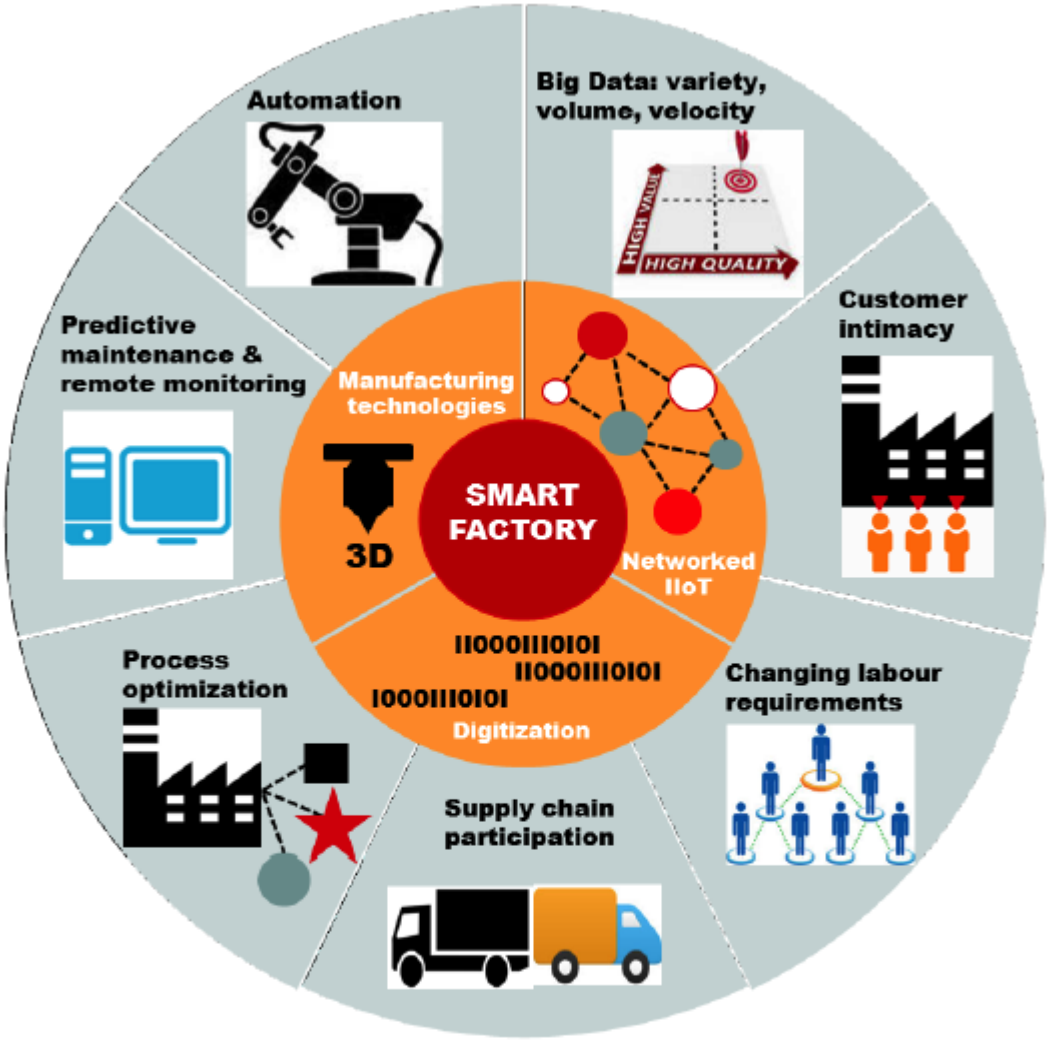
Replacement of equipment
Percent of installed base



SOURCE: Statistisches Bundesamt; Deutsche Bundesbank; Prognos; Thomas Nipperdey; McKinsey

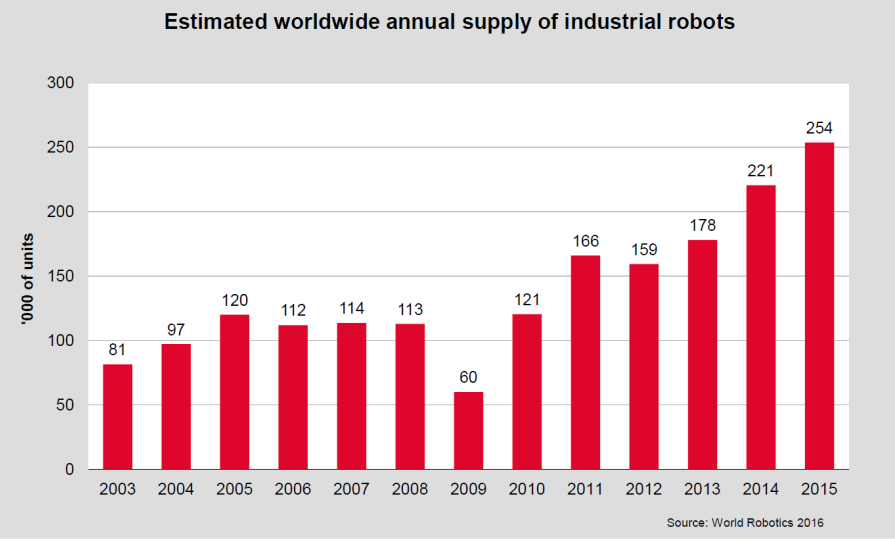
Introduction - Smart Factory

- Industrial Revolution 4.0 – is it really 4.0 or extension of 3.0?
- Imagine
  - A factory reboot without human intervention
  - Creating a personalized car exact to your specification
- Originates from strategy followed by the German government (€40bn every year until 2020)
- Scale and speed difficult to envisage
- Risk challenges could be equally difficult
  - Determining liability of losses
  - Securing data and cyber attacks
  - Business interruption risk and supply chain problems
- Key for re/insurers will be understanding the changing loss patterns



[5] Adapted from: Vizexplorer, *6 Critical Ideas Behind the Smart Factory and the Internet of Things (IOT)*, retrieved from http://www.vizexplorer.com/6-critical-ideas-behind-the-smart-factory-and-internet-of-things-iot/

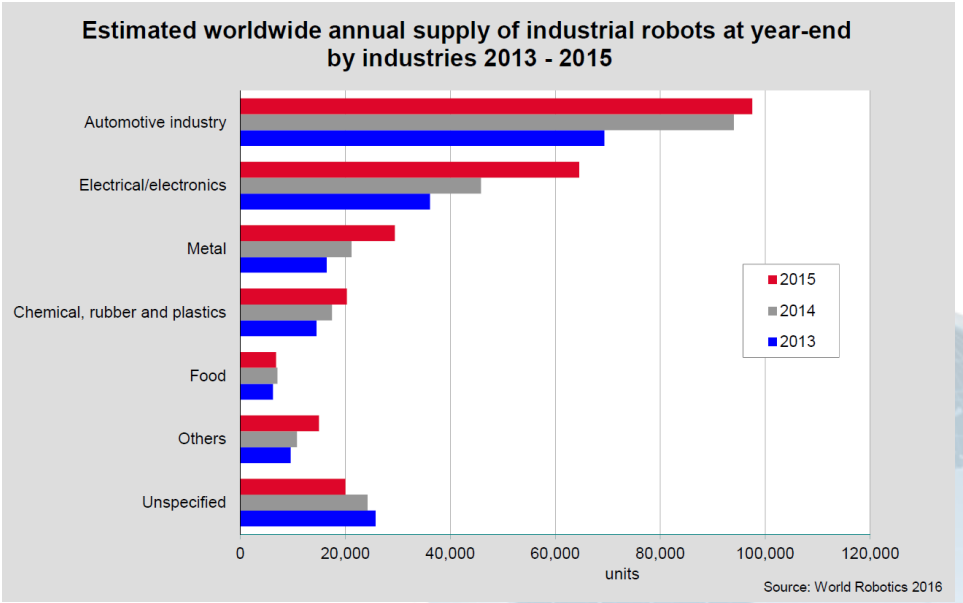
Enablers of the Smart Factory - Robotics



- Not new technology
- Important part of Smart Factory but innovation is lower
- Advances in control, handling and use of AI may move robots from high volume, high value products (TVs and Vehicle) into other less automated areas
- Not convinced humanoid robots have a place

According to World Robotics, 2016

- Globally 69 robots to every 10,000 employees in manufacturing
- Republic of Korea has 521 to every 10,000
- Most automated is Automotive – yet employment figures have risen
- Double digit growth expected in 2016 to 2019
- Human – Robot collaboration to be a breakthrough in this period



Enablers - Autonomous Robots

Many autonomous machines in factories set up for one task and are linked to the next machine

However, use of smart sensors and automated decision-making will link and move everything together more effectively and efficiently

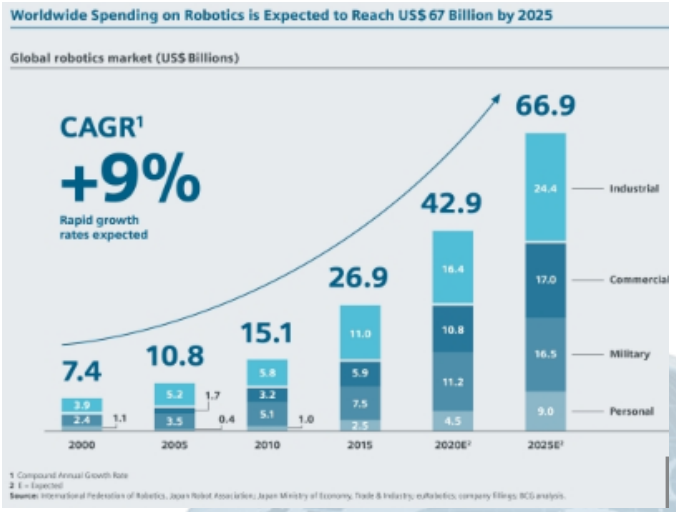
- Autonomous vehicles - logistics
- Autonomous production lines
- Autonomous maintenance
- Beyond ‘Just in Time’

> The unfortunate flipside of the success of robotic automation in the automotive industry is that it has led to a popular belief that robots are only suitable for mass-production processes," says Mike Wilson, general industry sales and marketing manager for ABB Robotics in the UK. "This couldn't be further from the truth. Developments in robotic technology have made robots more flexible than ever, enabling them to be switched quickly between completely different products and processes
>
> Source: ABB robotics and automation survey

Example EPSRC research projects

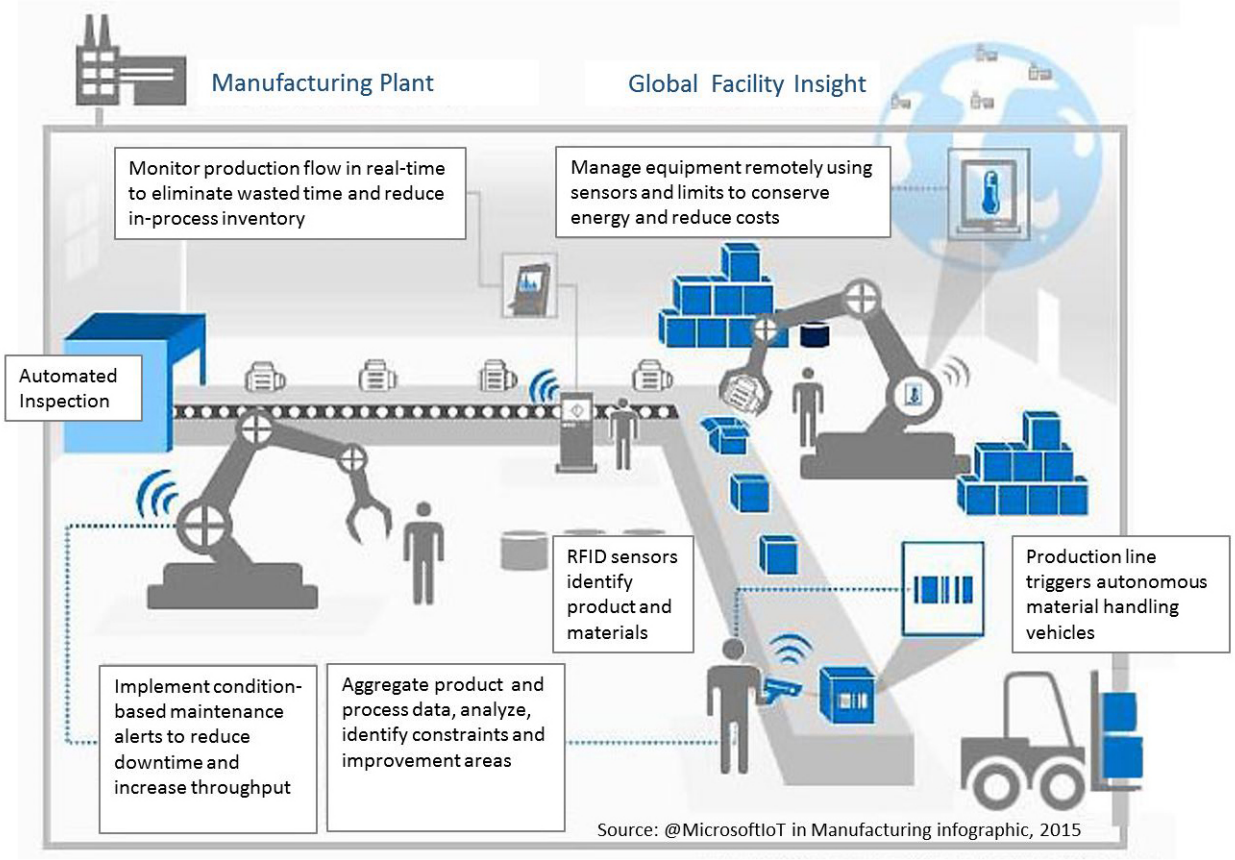
Autonomous Inspection in Manufacturing and Remanufacturing, £1.9M

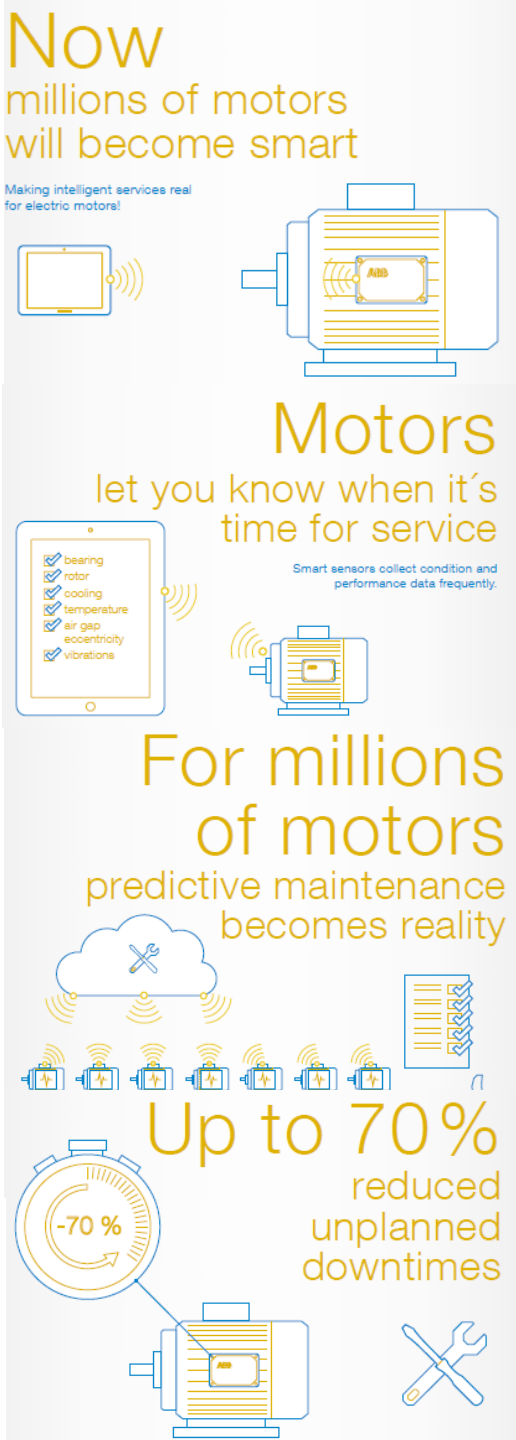
Autonomous tugger train supplying assembly logistics at BMW plant in Dingolfing



Enablers - Smart Sensors

- Essential to Smart Factories
- Sensors detect and alert in real time
- Always on but only communicating when needed
- Can be monitored and adjusted remotely
- Inform intelligent systems



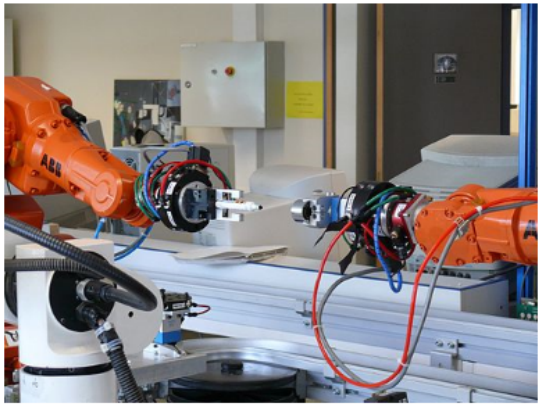


Enablers - Collaborative Machines / IoT

- The primary enabler – Machine-to-Machine communication systems or the commercial side of ‘Internet of Things’
- Communications revolution another aspect of the “Internet of Things “ phenomenon
- Industrial Revolution 3.0 was about computer power and basic programmable functions
- Industrial Revolution 4.0 is about connected devices that make programmable autonomous decisions (true AI is some way off)
- Production and logistics completely linked making production without human intervention possible
- Major cyber threats created, including industrial espionage and hacking
- Augmented reality further adds to this connectivity giving remote operatives direct visualization of factory activities; supporting control, incident response, logistics and maintenance
- Another potential element of this is blockchain with the ability to share transactional data more easily with external parties like suppliers or customers

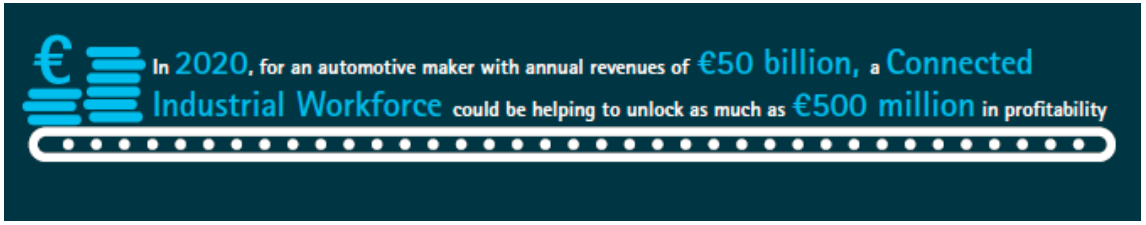
The Holobridge framework offers a holographic view of the inner workings of craft beer brewing through IoT data.

Canadian tech developer Finger Food has created a holographic application for a brewery that enables users to see how beer is brewing using IoT sensors within equipment.



83,000 industrial robots are ‘exposed’ to public-facing internet, according to Trend Micro

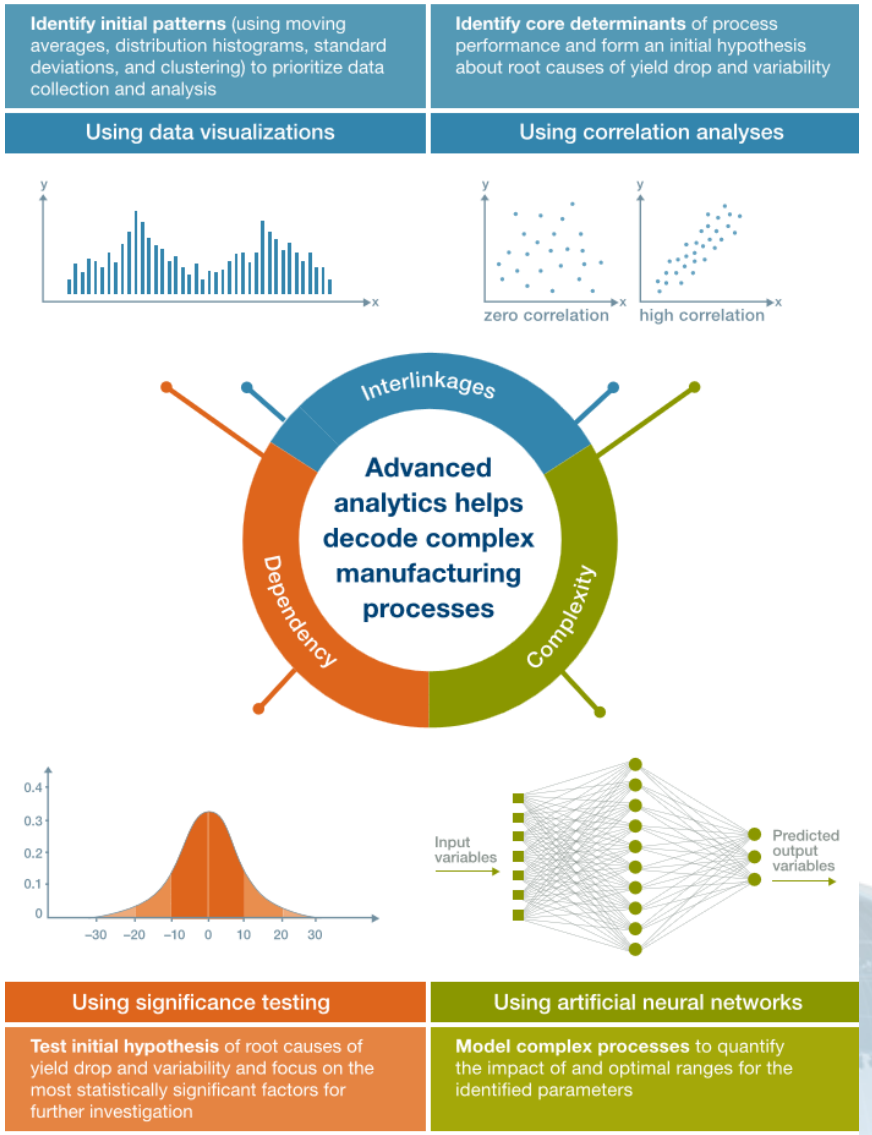
Industrial robotic systems are vulnerable to cyber-attacks, with 83,000 units exposed to the public-facing internet, of which thousands are not protected with authentication, according to research from IT security company Trend Micro.



Enablers - Big Data

- The capture and storage of vast volumes of data across a wide range of sources and formats to enable smart machines to make decisions and to 'learn'
- IoT makes data gathering possible. Data Analytics provide the competitive advantage
- All the data captured by sensors can help optimize production
- Data feeds coming back from the 'product' when in use could be used to enhance production in real-time
- Challenge will be to extract the value from the data,
  - gaining real-time actionable intelligence to increase productivity;
  - undertake pre-emptive maintenance and generate cost savings; and
  - enabling greater customer service through product enhancements and individualization
- The Rolls Royce quote below helps brings this to life

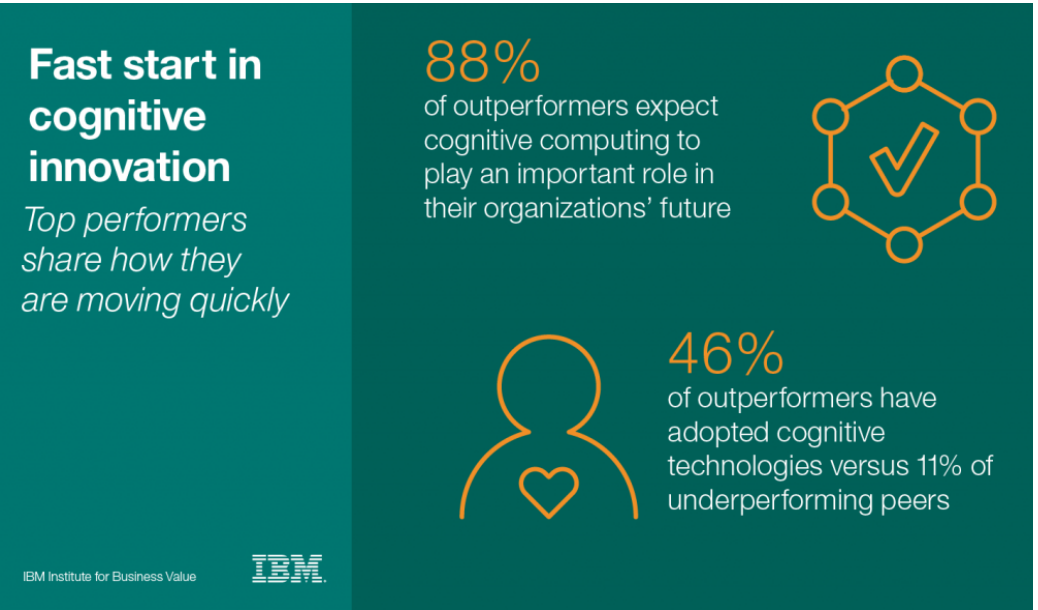
We are moving very rapidly towards an Internet of Things based solution. At our new factory in Singapore we are generating half a terabyte of manufacturing data on each individual fan blade. We produce 6,000 fan blades a year there, so that's ***three petabytes of data on manufacturing just one component****. It's a lot of data."*

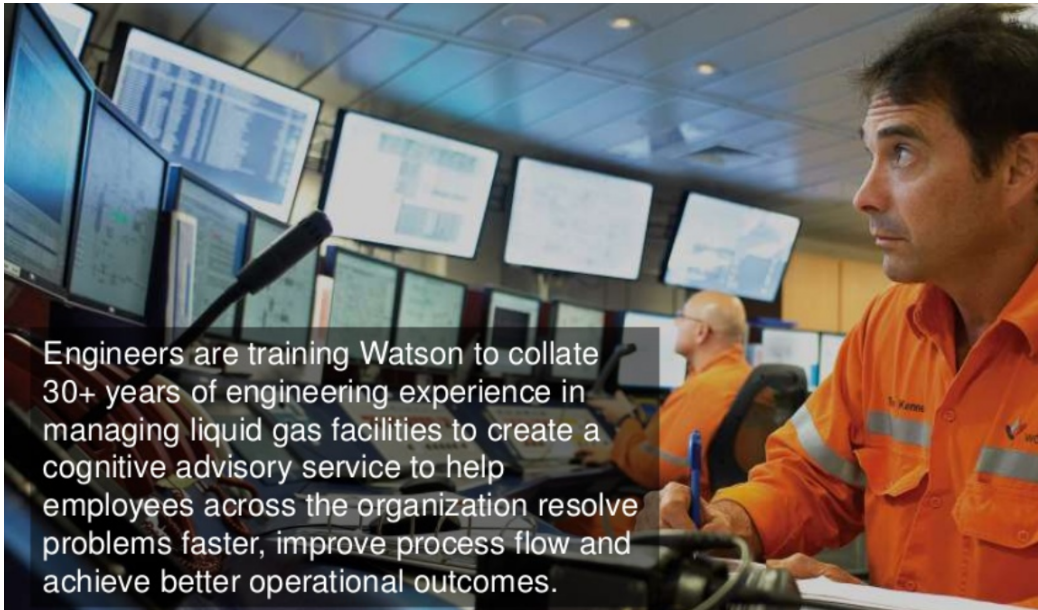


McKinsey

Enablers - Artificial Intelligence

- Really talking about programmable decision making or cognitive computing - True AI is still some way off
- Learning is achieved through use of big data and IoT data feeds which may change how decisions are made but within programmable rules (well that is my simplistic view)
- Enables machines to adapt to
  - Raw material properties (extrusion speeds, flour gluten levels)
  - Supply chain (effectiveness / incidents / issues)
  - Demand
  - Environmental factors (including the people nearby)
- This could have big implications for maintenance, production runs, product design, health and safety





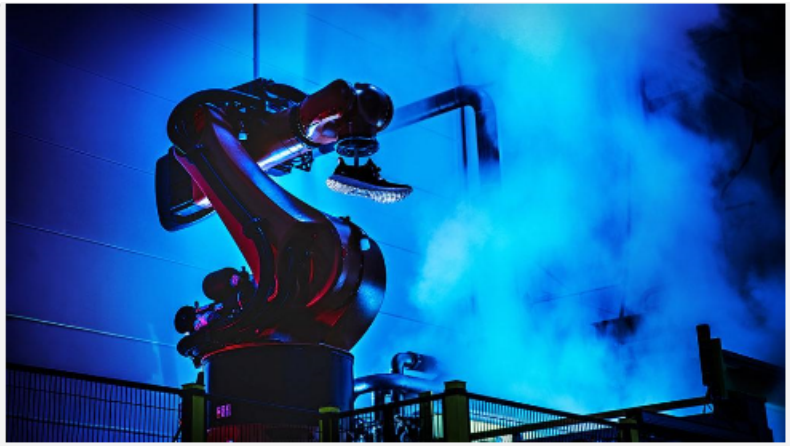
Enablers - 3D Printing

- Not really a part of the ‘Smart factory’ as just another production technique
- However, 3D printing will enable lots of innovation that more traditional manufacturing may not
- Lower waste keeps manufacturing space cleaner and removes a logistical challenge
- Less tooling reduces costs and increases flexibility and product variation
- Producing ‘whole sections’ reduces assembly time and movement of products
- Enables small production runs (with no increase in unit cost) allowing the production of bespoke and personalized products.

World’s First 3D Printed Car Took Years to Design, But Only 44 Hours to Print

IMAGE: LOCAL MOTORS

Adidas sneakers 3D printed using ocean plastic



Adidas robots used in the Speedfactory

Potential Implications

- Fewer and more skilled workers. May lead to high levels of unemployment and further exacerbate inequalities of income
- There could be no or limited human interaction in production and logistics
- Predictive and intelligent maintenance should cut down on frequency of incidents, time of outages and associated costs
  - Human employed to optimize, upgrade and monitor the maintenance of a site
  - Basic maintenance could be performed by robots – this is where humanoid robots may appear
  - 3D printing means that some parts could be produced in little more than a room for local maintenance teams to fit (or change the business model if templates are distributed to customers to use in their own 3D printers)
- Location footprints could change as access to skilled workers becomes less of a constraint
  - Access to raw materials, power sources or customer becomes more important
  - Factories could be located anyway and controlled from a central location anywhere
  - Could encourage widespread reshaping of manufacturing with potential knock-on effects for emerging market economies
- Scale of operations could also change
  - for some this is likely to mean ever increasing size, especially if automated logistics bring the costs right down
  - for others this could mean smaller more flexible factories set up to meet local customer needs doing single short run flexible production.
- Energy optimization technologies will be employed with positive outcomes
  - Power needs will change and investment into energy optimizing technologies will be a natural consequence
  - If energy usage drops this will have interesting implications for the environment and the energy sector
- Design and Go – monitoring operation in live and using data to redesign autonomously

Todays ‘Smart-ish’ Factories

Eliminating inefficiencies and product defects

At **Siemens'** Amberg Electronics Plant, where IT systems control and optimize processes, production quality is 15 defects per million, which are detected, enjoys a 99.99885 % reliability rate and 100% traceability.

Reduction of machine downtime – Predictive Maintenance

Volkswagen realized an improvement of 15% in machine downtime in factories. Predictive analytics foresaw the failure of certain components that caused outages.

Automation of work

The **BMW** i3 plant in Leipzig can be considered an early example of the smart automated plant archetype, as it is an integrated and highly automated plant. Robots are used at each stage of production, including the body shop.

Forecasting accuracy

Big Data analytics involves vast data volumes from new data sources for more precise outcome. For example, **Hadoop Platform** provides a way to start using the vast amount of unstructured and semi-structured data that organizations have.

Lower emissions and waste and more sustainable use of resources

Parker Water & Sanitation, Colorado, has optimized a much more sustainable use of water by monitoring water flows, water pressure and leaks in the system. The customers can allow their irrigation activities to be automatically managed by sensors, which also record the amount of rainfall.

Reduced inventories and improved just-in-time manufacturing

The Tarkreer oil refinery in Abu Dhabi was able to improve its preventative maintenance. With predictive asset management, inventory could be reduced by 10–20%.

Fewer workers to be injured

Every year more than three million workers are the victims of serious accidents while on the job and **4,000 die in workplace** accidents (EU Commission). Sensors can monitor, assess and alert dangerous environmental conditions.

Potential Limiting Factors

What are the potential factors that may inhibit the move to smart factories?

- Availability of competent / capable resources
- Funding needed to support innovation
- Competitive tendencies restricting innovation and integration
- Failure to address some of the big questions
- Processing power
- Communication speeds
- Public perception
- Enabling legislation
- Cyber Incidents

People unlock the value of transformation

Humans lie at the heart of Industry 4.0 transformation. Most companies are mainly concerned about the people dimension of Industry 4.0, rather than the technological dimension. With regards hurdles identified in our survey, the top two concern people, followed by business dimension, and only then technological constraints.

Every survey respondent expects there to be a huge impact on human capital. Both blue and white collar jobs will be affected, mainly due to a shift in required skills and competences. The biggest challenge companies currently face is a lack of digital talent.

They all have talented people, but as new technologies and applications flourish and at speed, they need more digital expertise to be able to transform existing capabilities into new ones. And it's not a one-off exercise, life-long learning will be crucial.

People | Business | Technology

Where are the biggest challenges or inhibitors for building operations capabilities in your company?

https://www.pwc.be/en/news-publications/publications/2017/industry-hype-or-reality.html

Risk Management Implications

- **Difficulties in determining liability of losses**
  As the complexity of the environment increases so does the complexity of the liability. Especially in products like business interruption where the loss could be caused by telecoms outage, GPS system issues, or decision made by cognitive machines.

- **Using and securing data flows**
  As well as having robust physical systems the electronic systems will be essential ensuring integrity of Big Data systems will be essential to support cognitive machines. This means maintaining the data and ensuring adequate communications links will be essential.

- **Increased vulnerability to cyber attack**
  Great connectivity increases the cyber threats. Someone taking control of a factory could have massive effects. However, relatively small and unforeseen cyber attacks could impact on the product with knock on effects for product liability.

- **Disruption and business interruption**
  Although maintenance downtime should significantly reduce any loss of a major service could cause interruptions that could affect a greater proportion of production and/or last longer. The expectation is such events will be fewer in frequency but greater in impact. When it goes wrong it really will go wrong.

- **Changing labour requirements**
  This has numerous implications such as employee liability.

- **Keeping current and up-to-date**
  A major threat is obsolescence. As with other technologies pace of change will be rapid especially as technologies converge and connect. This changing base and the likely increasing cost of equipment this risk could become more substantial. Products that support investment, akin to car finance may become more attractive.

- **Increased product liability issues**
  Customers may hold greater expectations of manufacturers and become less forgiving of product failures increasing litigation.

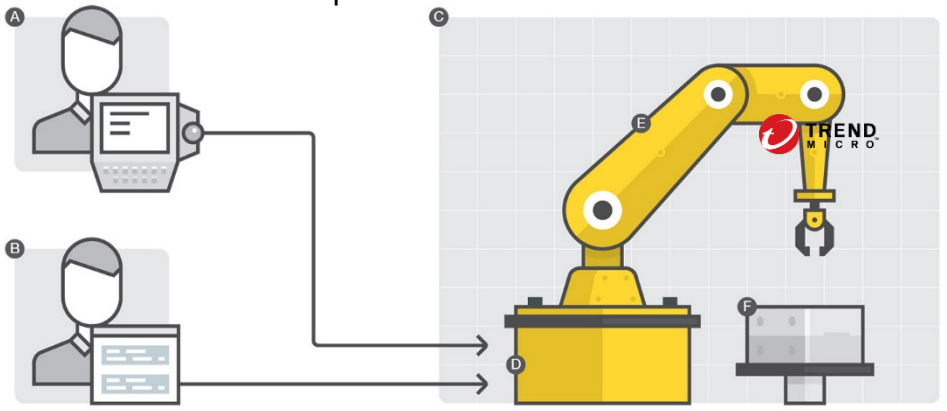
- **Political conflicts**
  Possibly more dispersion of performance between manufacturers and economies, with the emergence of a “winner takes all” phenomenon in which countries (e.g. Germany) and/or companies that are able to fully exploit the technology reap a disproportionate share of the returns. Such disparities could lead to conflicts.

- **Social tensions**
  There are a number of citizens that might get feel ‘left behind’ resulting in a modern luddite movement. Leading to range of negative outcomes, including increased support for populist parties, protectionism and unrest.

Cyber Risk

- Cyber attack on Smart Factories could take many forms:
  - Traditional hacking for disruption
  - Ransomware
  - Data theft or data gathering
  - Industrial espionage
  - Taking over a production line without remote workers' knowledge
  - Insert small programme changes affecting product quality/integrity

What Robot-Specific Attacks Are Possible?



https://www.trendmicro.com/vinfo/us/security/news/internet-of-things/rogue-robots-testing-industrial-robot-security

- The number of vulnerabilities opened up by creating Smart Factories is significant and care is required to ensure that security systems keep pace with the changes and the cyber criminals' capabilities.
- Not only is there the potential to hack the controllers and the databases but also the numerous sensors, especially useful where these are camera-based sensors.
- For insurers this creates opportunities and threats. The opportunity is to design products that support the full range of potential threats. Although the lack of claims history, the rapidly changing nature of the risks and the potential for major systemic issues make reserving and control claims costs more difficult.

"There are only two types of companies: Those that have been hacked, and those that will be. Even that is merging into one category: those that have been hacked and will be again."

Robert Mueller, FBI Director

Cases of digital attacks causing physical damage of equipment

In 2014 a German steel producing company was hacked, which has caused physical destruction of equipment.

http://money.cnn.com/2012/03/02/technology/fbi_cybersecurity/index.htm?iid=EL

Changing pattern of insured risks

- The changing risks associated with changing technology and the socio-political implications of such radical shifts have implications for the insurance market:
- Potential for less injury and H&S claims
  - Recognizing that serious incidents do still happen and deaths have occurred around robots. These tend to arise in areas where humans are working with robots, however safety systems are likely to develop.
- Less public liability claims
  - As with health and safety there is an expectation that safety of others outside the factory could also be improved, especially through automated logistics.
- Downtime maybe less but losses greater
  - Business interruption through factory downtime is likely to reduce, although there is a view that when an event occurred it could have much bigger financial implications. With more connected, more tighter tolerance on 'just-in-time' production and more reliance on technical infrastructure when things go wrong they could go wrong in a bigger way.
  - Also systemic risks may start to appear that have not been present previously. So if a particular technology fails there could be a number of interruption events arising in numerous locations across the globe that would currently be unconnected.
- Major physical losses when something does go wrong
  - Again you would expect physical losses such as fire, flood, theft to reduce substantially given the reliance that can be placed on machines and the number of sensors employed. However, if a major fire was to arise the rebuild/replacement costs will be greater given the complexity of technology.
- Accidental damage, especially in logistics
  - Autonomous vehicles and autonomous robots are less likely to cause physical damage due to the safety features built in. New Cyber arising on autonomous vehicles.

Product Implications

- Product liability and recall
  - Product liability and recall could potentially be reduced as autonomous machines increase quality and reduce accidental damage
  - With autonomous designing and QA activities it is possible product issues could arise. These could be more prevalent. Certainly as we transition through to Smart Factories the potential for new and unforeseen scenarios to arise is great.
  - Cyber threats could also introduce product defects.
- Workers compensation
  - Workers compensation could well reduce as the factory based workforce reduces. Emotional and stress related issues may become more common place with 'lone workers' expected to keep large manufacturing facilities running with little human support.
- General Liability
  - Implications are likely to be relatively neutral although claims may become less common.
- Professional Liability
  - This is one cover where you would expect significant increases given the dependency on professional expert computing/electronic organisations.
- Contingent Business Interruption and standard Business Interruption
  - As covered in previous pages the frequency of losses may drop but the need for this cover may become greater due to increased magnitude of events when they do arise.
- Accidental Losses
  - Accidental losses are likely to reduce with increased automation.
- High Value Concentration Losses
  - New specialist forms of concentration risk are almost certainly going to be needed to reflect the growing number of systemic risks.
- Cyber Coverage
  - Covered in previous slide, demonstrating this is going to become an every increasingly important form of cover.
- Traditional Property Fire, Flood and Theft
  - You would expect the frequency of such events to reduce as autonomous machines reduce incidents, increase monitoring and add additional security monitoring capabilities.

Implications for insurers

- Claims Experience and Reserving
  - As mentioned above the rapidly changing nature of the risk and the potential for new systemic / concentration of risks mean less reliance can be placed on historical experience and reserving could become more challenging.
  - The role of experienced underwriters will become greater to ensure the risks are properly understood at inception. If insurers also look to utilize autonomous machines for site inspections and for automated underwriting this could further add to the 'variability' associated with such risks.
- Connected Insurance
  - By connecting into the insured's systems it may be possible to utilize their information to support underwriting.
  - By utilizing the onsite sensors it is possible to monitor the threats and respond more rapidly to situations as they arise.
- Solving the Liability Conundrum
  - As with autonomous vehicles the questions over liability and who is at fault becomes more challenging.
- Pricing
  - Use of big data and the ability to link directly with customers could have interesting implications for pricing, in terms of identifying new rating factors and providing more dynamic pricing. Could pricing change as equipment changes, as maintenance stats change or even depending on the production runs?
- Responding to claims
  - Autonomous machines could be utilized by insurers to reduce costs whilst increasing speed of response and accuracy, especially if insurers can connect directly to the customer. This could be used to reduce claims costs.
- As indicated in the previous slide the risks may change - the more traditional risks may become less important.
- Automated payment systems and automated logistics could make claims fulfillment quicker and cheaper.
- Are there opportunities for insurers to provide broader services? For example, could autonomous machines be used to support claims be used to provide maintenance support?

Insurance as an enabler

- Finally, insurance should see itself as an enabler of the Smart Factory supporting developments through the cover provided and the use of capital for investments

- Insurance has been at the forefront of human endeavor, from the initial insurance products providing financial stability for early explorers right through to the support provided to space exploration today

- With technological developments and the creation of new perils insurers have rapidly used their financial strength to provide financial stability

- Developments in fire safety and security systems have often been given impetus by the insurance industry through risk inspections / contractual clauses

- Careful and targeted use of investment capital can also be used to provide targeted support as is happening in relation to renewable energy today

Questions?

Guest Speaker

Luke Watts
Head of Enterprise Risk Management

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PACICC

Risk Officer's Forum Meeting

Wednesday, September 27, 2017

12:00 noon-4:00 p.m. EST

Lunch (Noon-1:00 p.m., complimentary) / **Meeting** (1:00-4:00 p.m.)

Goodmans LLP, 333 Bay Street, Suite 3400, Toronto

Guest speaker:

Lapo Calamai

Director, Catastrophe Risk & Economic Analysis

Insurance Bureau of Canada

Topic: *Earthquake Risk*