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Anticipating the Entry of Industry 5.0 in Transportation Sector

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Abstract. The paper is organized so that readers can find out how much important for anticipating the entry of fifth industrial era that we provide based on observations from various sources. This paper set up by the compiler with various obstacles. Whether it came from self-constituent or who come out from outside.The research method of this research is using Future Log method and discuss with the experts about upcoming era, this research discuss about future that has not implemented yet. By experimenting and Imaging of any sector, combine by Document analysis, Interviews, and Qualitative research. Industry 5.0 is focused on interaction between humans and machines. While we're already starting to see this as humans work alongside machines and are connected to smart manufacturing plants via devices, the fifth Industrial Revolution is likely to continue the push toward more advanced human-machine interfaces. This will mean improved integration, allowing faster, better automation paired with the power of human brains. The authors draw attention and need support from all parties who prepare about the incoming of fifth industrial era.

Keywords *:* industry 5.0, transportation, technology

1. Introduction

While there is a movement globally to create smart factories and make things communicate digitally, a new trend is appearing on the horizon aiming to bring back the human touch in production. The trend is dubbed "Industry 5.0" or collaborative industries

This redeployment of human creativity is necessary due to market evolvement and customer requirements demanding a high degree of individualization in the products they buy (as seen in the automotive sector, for instance). Furthermore, according to a survey conducted by Accenture Consulting, 85 % of manufacturers see the "connected workforce" being commonplace in their production processes by 2020. So, while robots are excellent at manufacturing standard products in standardized processes in a high production volume, adding this so-called "special something" to each and every product is a challenge where robots require guidance. Thus, we recognize the need to bring back the human touch to production processes.

In production processes, automation can be used to its fullest potential only when there is a spark of human creativity influencing the processes as well. On its own, an automated production with traditional industrial robots will do only what it is being told – often only after long and strenuous programming efforts. Collaborative robots, however, work in sync with human employees. These two forces complement each other and thrive together, as the human can add this so-called "special something", while the robot processes the product further or prepares it for human attention. In this way, the employee is empowered and uses the robot as a multi-functional tool: as a screwdriver, packaging device, palletizer, etc. The robot is not meant to replace human workforce, but to take over strenuous or even dangerous tasks. Thus, human employees can use their creativity to turn to more complex projects. "We have already saved three man-years of monotonous work thanks to our two UR5s", says Sigurdur Runar Fridjonsson, Director at Mjolkursamsalan Akureyri, Icelands biggest dairy producer.

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At Paradigm Electronics in Toronto, Canada, a UR10 robot works side by side with an employee polishing loudspeaker cabinets:

"Collaborative robots is a new technology that allows us to have a human and a robot working in the same workspace. They're now working in a pendulum type of an operation where they can safely interact, allowing the human to check whether the robot has done an adequate amount of work before the final polishing is handed over to the human. It's a very hand-in-hand kind of operation," says Senior Manager of Production Services at Paradigm, John Phillips.

Of course, this means that collaborative robots need to have certain characteristics: They need to be flexible, easily programmable and safe. Only if these preconditions are met, a true collaboration of human and robot can take place and thrive

1.1 Identification Problems (Background)

In connection with the title (Analysis for anticipating the entry of the industrial revolution 5.0), then the problem can be identified as follows:

1. What industrial 5.0 is all about?
2. How is efficiency and productivity of industry 5.0 in transportation and how to manage?

1.2 Limitation Of Problems

To clarify the scope of discussion, the issues discussed is limited to the problem:

1. The role industrial robots will play in industry 5.0
2. The ways industry 5.0 changes affect manufacturing plant

1.3 Problem Formulation

Based on the background and the limitation issue, the problems discussed can be formulated as follows:

1. How does the description of the role of industrial robots on the implementation of industry programs?
2. How the description of the way for industry 5.0 can truly improve the quality of manufacturing plant?.

2. Reserch Methods

The research method of this research is using Future Log method and discuss with the experts about upcoming era, this research discuss about future that has not implemented yet. By experimenting and Imaging of any sector, combine by Document analysis, Interviews, and Qualitative research.

Industry 5.0 is focused on interaction between humans and machines. While we're already starting to see this as humans work alongside machines and are connected to smart manufacturing plants via devices, the fifth Industrial Revolution is likely to continue the push toward more advanced human-machine interfaces. This will mean improved integration, allowing faster, better automation paired with the power of human brains.

This also means robots aren't going to be taking over manufacturing plants any time soon. In fact, the shift from Industry 4.0 to 5.0 means more emphasis on human manufacturers. And this shift bringing together the best of both the human and machine worlds will likely also mean improved productivity.

3. Futurolog

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4. History of Industrial Revolution

1.0 : 1780 – Mechanisation

Industrial production based on machines powered by water and steam. Dating back to around 1760, the First Industrial Revolution was the transition to new manufacturing processes using water and steam. It was hugely beneficial in terms of manufacturing a larger number of various goods and creating a better standard of living for some. The textile industry, in particular, was transformed by industrialization, as was transportation.

Fuel sources like steam and coal made machine use more feasible, and the idea of manufacturing with machines quickly spread. Machines allowed faster and easier production, and they made all kinds of new innovations and technologies possible as well.

2.0 : 1870 – Electrification

Mass-production using assembly lines. The first Industrial Revolution represented the period between the 1760s and around 1840. This is where the second industrial revolution picked up. Historians sometimes refer to this as "The Technological Revolution" occurring mainly in Britain, Germany and America.

During this time, new technological systems were introduced, most notably superior electrical technology which allowed for even greater production and more sophisticated machines.

3.0 : 1970 – Automation

Automation using electronics and computers. It began with the first computer era. These early computers were often very simple, unwieldy and incredibly large relative to the computing power they were able to provide, but they laid the groundwork for a world today that one is hard-pressed to imagine without computer technology.

Around 1970 the Third Industrial Revolution involved the use of electronics and IT (Information Technology) to further automation in production. Manufacturing and automation advanced considerably thanks to Internet access, connectivity and renewable energy.

Industry 3.0 introduced more automated systems onto the assembly line to perform human tasks, i.e. using Programmable Logic Controllers (PLC). Although automated systems were in place, they still relied on human input and intervention.

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4.0 : Today – Digitalisation

Introduction of connected devices. The Fourth industrial Revolution is the era of smart machines, storage systems and production facilities that can autonomously exchange information, trigger actions and control each other without human intervention.

This exchange of information is made possible with the Industrial Internet of things (IIoT) as we know it today. Key elements of Industry 4.0 include:

- Cyber-physical system — a mechanical device that is run by computer-based algorithms.
- The Internet of things (IoT) — interconnected networks of machine devices and vehicles embedded with computerized sensing, scanning and monitoring capabilities.
- Cloud computing — offsite network hosting and data backup.
- Cognitive computing — technological platforms that employ artificial intelligence.

5.0 : Future – Personalitation

Less than a decade has passed since talk of Industry 4.0 first surfaced in manufacturing circles, yet visionaries are already forecasting the next revolution — Industry 5.0. If the current revolution emphasizes the transformation of factories into IoT-enabled smart facilities that utilize cognitive computing and interconnect via cloud servers, Industry 5.0 is set to focus on the return of human hands and minds into the industrial framework.

Industry 5.0 is the revolution in which man and machine reconcile and find ways to work together to improve the means and efficiency of production. Funny enough, the fifth revolution could already be underway among the companies that are just now adopting the principles of Industry 4.0. Even when manufacturers start using advanced technologies, they are not instantly firing vast swaths of their workforce and becoming entirely computerized.

The fifth industrial or industry 5.0 will be focused on the co-operation between man and machine. As human intelligence works in harmony with cognitive computing. by putting humans back into industrial production with collaborative robots, workers will be upskilled to provide value added tasks in production, leading to mass customisation and personalisation for customers

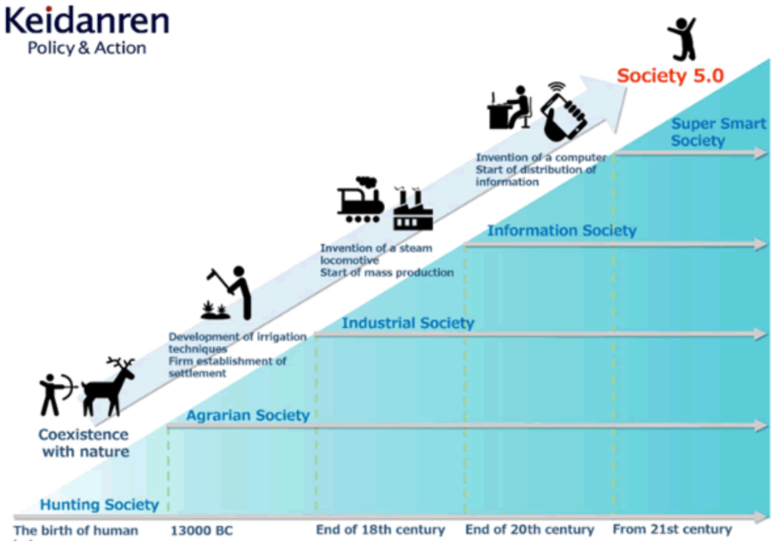

Figure 4.1

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5. What is industry 5.0 focused on

As Industry 4.0 was centered around the Internet of Things connecting devices on the plant floor, Industry 5.0 is focused on interaction between humans and machines. While we're already starting to see this as humans work alongside machines and are connected to smart manufacturing plants via devices, the fifth Industrial Revolution is likely to continue the push toward more advanced human-machine interfaces. This will mean improved integration, allowing faster, better automation paired with the power of human brains.

This also means robots aren't going to be taking over manufacturing plants any time soon. In fact, the shift from Industry 4.0 to 5.0 means *more* emphasis on human manufacturers. And this shift — bringing together the best of both the human and machine worlds — will likely also mean improved productivity.

Production line collaboration will bring about many changes and Industry 5.0 is also likely to affect the economy, ecology, and the social world, according to the LinkedIn article. Both the economy and environment could see major impacts because of reduced wasted material as manufacturers move toward zero-waste production, also reducing material expenses and waste management costs. In terms of the social environment, Industry 5.0 will return focus to the human aspect of manufacturing whereas Industry 4.0 focused solely on the technology.

With this focus returning to humans, the fifth Industrial Revolution may also require a new manufacturing role: Chief Robotics Officer (CRO). This C-suite position will require an expert who specializes in human-machine connectivity and be responsible for all things tech, from making decisions on which machines or devices to add to the plant floor to improving strategies for optimizing the production line.

How will these changes affect your manufacturing plant? It depends on how willing we are to embrace Industry 5.0 as well as how quickly we choose to adopt and implement the technologies necessary to bring the next Industrial Revolution to our plant floor.

5.1 Industry 5.0 is about humans, not robots

Robots are designed to help humans and make our lives better. Universal Robots uses the term "cobots" for collaborative robots to emphasize the importance of people in robotic technology.

"Industry 5.0 will make the factory a place where creative people can come and work, to create a more personalized and human experience for workers and their customers," said Esben Østergaard, Universal Robots chief technology officer and co-founder, in an article published on Enterprise IoT Insights (2).

He thinks consumers will increasingly demand craftsmanship and personalization of products. Through automation and cobots, the manufacturing process can be streamlined to allow humans to create something special and unique. The use of robots will actually bring back the human factor to manufacturing.

5.2 Industry 5.0 meant to optimize human efficiency and productivity.

Industry 4.0 is about the interconnectedness of machines and systems for optimal performance. Industry 5.0 takes such efficiency and productivity further by honing the interaction between humans and machines.

Rogers Corporation touts its ability to integrate robots into the manufacturing process to deliver high quality products, as shown by video clips on its website. The Arizona-based company manufactures specialty materials used in different consumer and electronic products.

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"Industry 5.0 recognizes that man and machine must be interconnected to meet the manufacturing complexity of the future in dealing with increasing customization through an optimized robotized manufacturing process," said Marc Beulque, vice president of global operations at Rogers (3).

A combined human and robot workforce will call for a new executive role, the chief robotics officer (CRO), who will be responsible for planning and managing all activities related to robotics and intelligent operational systems. A report by Myria Research forecasted that by 2025, more than 60 percent of manufacturing, logistics and supply chain, agri-farming, and the oil, gas and mining sectors will have CROs (4).

5.3 What are the benefits

Industrial robots provide a variety of benefits:

- Accuracy : Robotic palletizers are software directed for proper load placement
- Flexibility: Robotic systems can be re-purposed for other uses; end effectors can be switched out to handle different load types
- Lower labor costs : Automated pallet building reduces worker strain and frees operators for other tasks
- Quiet operation: Servo based, robotic palletizers generate low noise levels
- Reduced product damage: Gentle handling prevents package and product damage
- Speed: The systems increase rate productivity up to 50%

When it comes to technology, there's no turning back. The European Economic Social Committee (EESC) said it best: "The proliferation of robotic automation is inevitable."

The committee, a European Union (EU) consultative body, acknowledged that Europe lagged behind the United States and China in artificial intelligence, and called for acceleration of artificial intelligence (AI) and robotics development in the region. "The EU should embrace digitalization wholeheartedly for the sake of consumers, manufacturers, and employees alike," it said.

While it's impossible to ignore the existence of Industry 5.0, there are fundamental questions that manufacturers and policymakers need to address in the near future. In a research paper, academics questioned the impact of "extreme automation."

"Highly integrated systems are vulnerable to systemic risks such as total network collapse," according to the paper. "Extreme connectivity creates new social and political structures. If left unchecked, they might lead to authoritarian governance."

While there are real-world artificial intelligence (AI) applications for enterprises today, there is still much more potential and development for AI, which holds promising benefits for companies in every industry. Still, while there are plenty of compelling arguments for the promise of AI adoption, there are also pitfalls, as well as societal and ethical implications to consider. These technologies blur the traditional boundaries between human and machine while constantly creating new, dynamic business models.

Now that we are in the midst of the Fourth Industrial Revolution, companies are defining and implementing the digitalization of industrial processes. New business models are emerging – driven by AI and intelligent machine learning – and collaboration between not just disparate business functions, but also different companies, is becoming increasingly important. The next wave of the industrial revolution needs to define how society as a whole wants to work together with technology and how the rules of human-robot or human-machine collaboration can be shaped when decisions are made based on artificial intelligence.

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6. Industry 5.0 and Society 5.0 for Indonesia

Industry 4.0 has become a major revolution in the development of human life. Digital technology has influenced humans in various ways from economic, social, political and even in the life of the human person itself. Industry 4.0 does not develop by itself but with the existence of a society that continues to learn and develop, because the relationship between industry 4.0 and society is a reciprocal relationship that must be maintained and developed. Japan as a developed country known for discovering a variety of advanced technologies has introduced the concept of Society 5.0 where people have developed to the point of being able to use information to improve their welfare.

In his presentation, Prof. Jay conveyed how the development of technology and Japanese society to date has been able to utilize big data for the welfare of its people. "Japan is able to produce important components that are used by large companies throughout the world that cannot be produced by other countries, this is the fruit of the concept of Society 5.0 that is able to provide excellence for a country" he said.

Prof. Jay also tells of the history of Japan which experienced a lot of developments from Society 1.0 to Society 5.0, as well as differences in Society 4.0 and Society 5.0. "The Society 4.0 relies on automation, robots, the internet, global supply chains, and also big data formed from internet information, but in Society 5.0, big data developed significantly, big data was formed from sensors, connected through the internet of things, analyzed using artificial intelligence and is used for the welfare of society, "he added.

7. How are Robots used

Robots are used in a variety of ways throughout manufacturing and distribution.

- Load building: Assembling a pallet load of products at the end of a production line
- Manufacturing: Performing processing and assembly functions to work in process
- Quality control: Testing and inspection procedures deploy robots for repetitive or dangerous work
- Transportation: Loading pallets prior to shipping
- Warehousing: Removing received products form pallets and routing them to storage locations within a facility.

While there are shortcomings to AI technology in its current state, for example in the detection of image objects or in describing visual scenes, machine learning is already being used effectively in several industries. Cybersecurity, warehouse automation and agriculture are all examples of huge industries where machine learning is being used effectively. In cybersecurity, for example, machine learning is being used to learn what is “normal activity” for today’s enterprises and to alert businesses automatically when anomalies or suspicious threats occur.

Not only can machine learning be used to protect companies from security threats, but it can also be used to detect and mitigate human rights violations. For example, businesses can use machine learning in the supply chain to identify sustainability or modern slavery hot spots in high-risk communities, and work to create solutions. And, where there aren’t solutions, they can rely on sophisticated business networks to identify new suppliers that can meet their sourcing needs, without the ethical setbacks. In healthcare, AI algorithms in medicine can allow doctors to better understand and analyze data, as well as create individualized treatments tailored to a patient’s unique genetic structure.

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Figure 6.1

Figure 6.2

8. Robots in Logistics and Transportation

The robotics market serving logistics and transportation companies is primed for rapid growth over the next five years. Currently, around 80% of warehouses are manually operated, meaning they have no automation support.

That's about to change in a big way. In 2016, the logistics robotic market had a global market revenue of $1.9 billion. In 2021, a recent study predicts market revenue for the global sector to reach $22.4 billion. In the same amount of time, robot unit shipments will grow from 40,000 to 620,000 annually.

Amazon is well-known for their automated distribution centers, but other logistics companies are turning to robotics for the safety, efficiency and accuracy they provide.

8.1 Robots in Logistics

8.1.1 Container Loading and Unloading

Much of the goods consumed in America were at some point shipped in a standard container from overseas. Typically, these products aren't palletized, meaning they're stacked from floor to ceiling. The variation in products sizes and shapes has made automation of loading and unloading difficult until recently.

3D laser vision, coupled with new robotic software, can view different products in a container, determine the optimal loading or unloading sequence, and carry out this function with a high level of accuracy.

8.1.2 Stationary Piece Picking

In the warehouse, items are constantly being sorted. Often, it's simply a matter of moving a product from one box to another. Historically, piece picking has been difficult because robots weren't sure which items they were picking. Industrial robot arms, enabled by vision systems that can recognize which product is which, are able to handle this process in a stationary workcell. These robots boost efficiency and accuracy in the warehouse.

8.1.3 Custom Packaging

Whether it's a big sale or a bulk discount, many items need custom packaging before they hit retailers' shelves. This is very difficult for a robot since it means working with different sizes and shapes of products, but also because it requires work to be completed around humans as opposed to inside of a workcell. This is where collaborative robots, designed to work safely around humans, have played a role in logistics.

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Collaborative robots (cobots) have no sharp edges and shut down when they bump into something. In logistics applications, some collaborative robots can even be trained to do tasks by letting a human guide their arms once to learn the motion. This decreases inefficient programming time and speeds of the custom packaging process.

Robots are quickly making their way into the logistics and transportation sector. They're providing safety, efficiency and accuracy in a wide variety of applications, mostly involving work in the distribution center.

There are many exciting robotic technologies in logistics, but collaborative robots have been particularly effective. To learn more about collaborative robots, watch our archived webinar on the state of collaborative robots.

Figure 7.1

8.2 Robots in Transportation

8.2.1 Elements of automated vehicles

The optimism is justified, since modern cars often include drivers' assistants, such as global positioning system (GPS) navigators, cruise controls, anti-lock braking systems (ABS), and rear parking systems.

Autonomous self-driving cars are poised to become the first widespread, high-visibility use of mobile robots. The progress of automated self-driving vehicle development in the last 10 years is astonishing. Even new automobiles without robotic capabilities look more like computers with wheels. More articles on autonomous vehicles are published daily.

The number of participants in this race clearly shows that robotic vehicle technologies are rapidly developing. These include "traditional" car manufacturers (German Volkswagen, Mercedes, and BMW, Japanese Nissan, Toyota, and Subaru, and Swedish Volvo), American electric car manufacturer Tesla Motors, Google, and others, as well as start-ups. Several Russian companies are in adjacent markets. VIST Mining Technology LLC automates mine dump trucks, and RoboCV automates warehousing machinery.

8.2.2 Robotic retrofits

While large automobile manufacturers are developing unmanned vehicle brands, other participants are "retrofitting," with a focus on developing navigation technologies and other technologies that turn regular cars into autonomous cars. Stakes are high, as no one wants to yield robotic vehicle supremacy to competitors. Google presented its "raw" prototype this spring, perhaps in an effort to attract cooperation with auto giants.

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8.2.3 Robotic car

Why would anyone need a vehicle that travels without human guidance? Mainly, to 1) get rid of routine activities, 2) increase safety, and 3) optimize traffic flow. We still need to physically translocate ourselves and cargo over land, so we continue to spend substantial time and energy in transport. Who wouldn't want to be productive in the car, instead of spending time behind the wheel, especially as the pace of life accelerates? Options during safe robotic door-to-door transport include reading a newspaper [or Control Engineering online or in print], finishing a presentation, safely making a business call while referencing a laptop, or napping. For now, these luxuries are for those who can afford personal drivers.

Taxi drivers, bus drivers, and truck drivers are worth mentioning. It is possible that robot vehicles may try to replace these professionals. I think a human will remain available to drive a bus or truck, to retake control or interfere in dangerous situations, as do pilots of commercial aircraft and railroad engineers [and some plant operators for some highly controlled processes]. Meanwhile, automobiles equipped with reliable autopilots will begin taking routine, perhaps more rural, routes.

On the other hand, not everyone is a good driver. The statistics of people who have been killed or injured in car crashes looks more terrifying than status reports from battlefields. When technology reaches the level needed, robotic automobiles will be much safer than inexperienced, aggressive, or drunk drivers, though some experts disagree.

A disciplined autobot as a self-driving car never goes above speed limits, keeps the correct distance, and is careful around pedestrian crossings. Some illegal parking enthusiasts or "no entry" sign violators might consider robotic drivers tedious, but autobots are already intelligent enough to break laws in ways that may reduce risk.

8.2.4 Robotic communications

Self-driving vehicles will pre-calculate routes around traffic jams and road work, as well as communicate with nearby cars and traffic lights to optimize throughput and increase safety. Robotic cars will use a feedback approach, using elements of distributed and centralized control.

Priorities can be granted during rush hours or to certain vehicles (like an ambulance or fire crews). These concepts already are familiar in GPS navigation software that helps shorten current roadway transportation.

Figure 7.2

Figure 7.3

9. Implementation

9.1 The Role Of Industrial Robots In Industry 5.0

Industrial robots will be a critical component of the fifth industrial revolution. While much of what defines Industry 5.0 involves a human's ability to customize and personalize a product at a mass scale, this is only possible with advanced robotic capabilities.

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Industrial robots will help close the design loop. By fully and efficiently automating the entire production process, humans are left free to create and innovate without having to worry about production constraints.

Unlike in Industry 4.0 where robotic capabilities take center stage, industrial robots will take a back seat to human intelligence in Industry 5.0. They will remain a critical component, however, enabling entirely new production methods.

While we're still in the process of realizing the true vision of Industry 4.0, it's become clear what's on the horizon. Industry 5.0, while still out of reach for now, will bring major changes for manufacturing.

9.2 The role of industrial robots on the implementation of industry programs

Because they can be programmed to perform dangerous, dirty and/or repetitive tasks with consistent precision and accuracy, industrial robots are increasingly used in a variety of industries and applications. They come in a wide range of models with the reach distance, payload capacity and the number of axes of travel (up to six) of their jointed arm being the most common distinguishing characteristics.

In both production and handling applications, a robot utilizes an end effector or end of arm tooling (EOAT) attachment to hold and manipulate either the tool performing the process, or the piece upon which a process is being performed.

The robot's actions are directed by a combination of programming software and controls. Their automated functionality allows them to operate around the clock and on weekends as well as with hazardous materials and in challenging environments freeing personnel to perform other tasks. Robotic technology also increases productivity and profitability while eliminating labor-intensive activities that might cause physical strain or potential injury to workers.

9.3 Example: The big societal transformation plan of Japan

Japan has its particular challenges and just as Industry 4.0 is the digital transformation of manufacturing, Society 5.0 aims to tackle several challenges by going far beyond just the digitalization of the economy towards the digitalization across all levels of the Japanese society and the (digital) transformation of society itself. And that has some pretty far-reaching consequences as you'll read.

One of the particular challenges for Japan is the ageing population. While ageing doesn't mean becoming a problem it does come with some challenges on various levels, although some of those can (and will) become less of a challenge as a result of smart approaches, enabled by technology but shaped by smart people.

While an ageing population is a challenge for most countries it particularly is so for Japan. As we mentioned in our article on the digital transformation of healthcare, Japan by far has the 'oldest' population with 26.3 percent being over 65 years young.

To put this number in perspective: it is expected that across the globe over 20 percent of the population will be over 60 years young by….2050. Essentially this means, apart from the amazing numbers in Japan today, that all countries should watch at what Japan is doing and how this Society 5.0 works out in reality as we'll have a lot of lessons to learn from that ageing population perspective – and the many others you'll discover below.

In healthcare, not just the health aspect of dealing with more chronic diseases, which come with older age, but mainly the ways healthcare is reorganized in function of this ageing population reality, digital transformation efforts and the rethinking of care, including technologies, are partially driven by the fact that people on average simply get older.

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Among the other challenges Japan, more than many other countries, has to deal with are natural disasters and pollution. To deal with these and other challenges, the super-smart society has to offer the way.

In order to achieve this, Keidanren (Japan Business Federation) published a vision paper (an 'outline') in which it describes that tackling the challenges which we described – and others – will require the breaking down of five walls. Indeed, five as in Society 5.0.

However, just as in Industry 4.0 as the fourth industrial revolution, Society 5.0 is also depicted as an evolution in five societal stages in the position paper of Keidanren: 1) the hunting society, 2) the agrarian society, 3) the industrial society, 4) the information society, and, 5) the super-smart society a.k.a. Society 5.0.

10. The 4 walls to 'break through' in moving to Society 5.0

- The wall of the Ministries and Agencies. With the need of, quoting from the Keidanren position paper, a "formulation of national strategies and integration of government promotion system". This includes the architecting of a 'handy IoT system' and a think-tank function.
- The wall of the legal system**.** Whereby laws need to be developed to implement advanced techniques. In practice this would also mean regulatory reforms and a push of administrative digitization (good news for all the document capture and information management people out there).
- The wall of technologies**.** The quest for the formation of the 'knowledge foundation'. It's clear that actionable data plays a foundational role here as do all technologies/areas to protect and leverage it, from cybersecurity to robotics, nano, bio and systems technology. The paper also mentions a serious R&D commitment on various levels.
- The wall of human resources**.** Educational reform, IT literacy, broadening the available human resources with specializations in advanced digital skills are just a few of them. Interesting: if the paper becomes reality, Japan will open its doors for highly skilled professionals in areas such as security and data science. At least as interesting: "the promotion of women's participation to discover potential talents".

11. Risk in this industry and what to concern

Finally, some may avoid robotic cars out of fear, although some negative reactions toward self-driving cars may be expected. Fears may include the "rise of the machines," loss of privacy as people may feel watched by Big Brother, or feel that they'll become a hostage of things [locked into an automated vehicle]. While that may seem like paranoia, technology is becoming a bigger part of our daily lives, especially, perhaps, as manipulation goes beyond information to material objects.

It's not hard to imagine that it would be easier to track and systemize movements of a self-driving car. How collected information will be used depends on who obtains the information, related laws [and cybersecurity of connected systems].

What if riders set a "shopping mall" or "restaurant" as a destination point instead of regular coordinates, and the car decides where to go? This could be convenient for riders and a sweet spot for advertisers. Maybe this is why Google is pioneering autonomous cars development.

With sinister motives, successful hackers could make a robotic car a weapon.

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