Case Study

INTERNET OF THINGS IN INDUSTRY 4.0 – A CASE OF GERMANY

Keywords: *Internet of Things, Shipment of goods, Interconnectivity, Data tracking, Industry 4.0*

Background to Case Study

The Internet of Things (IoT) has become an important part of our daily lives. It surrounds us wherever we go: connected cars, home automation, smart office sensors and fitness trackers. But the world was not always like that. There have been visions of machines communicating with one another since the early 1800s. Machines have been providing direct communications since the telegraph (the first landline) was developed in the 1830s and 1840s. However, until 1999, the term "Internet of Things" did not even exist.

The first connected device was a Coca-Cola vending machine that used an early form of the Internet to see if the cooler kept drinks cool enough and if coke cans were available. This invention was a decisive factor for the development of interconnected machines all over the world. A decade later interconnectivity started to rise tremendously.

In 1990, John Romkey was the first to connect a toaster to the internet using a TCP / IP protocol. In 1991, at the University of Cambridge, scientists came up with the idea of using the first prototype webcam to track the amount of coffee available in their lab's coffee pot. 1999 was easily one of the most important years in the history of the IoT, as Kevin Ashton coined the term "Internet of Things". In 2000, LG Electronics introduced an Internet-connected refrigerator, which allowed its users to shop online and make video calls. All these important developments fostered the evolution of the IoT. (Khvoynitskaya, 2019)

Introduction to the Case Study and it's growth within Industry 4.0

IoT-enabled management systems can be extremely beneficial for small business owners. With many small and medium-sized enterprises (SMEs) struggling to stay afloat, those who have integrated advanced IoT systems into their day-to-day operations have seen great benefits.

The Internet of Things will play a key role in the development of Industry 4.0 with its ability to connect physical devices to digital platforms creating a more conducive environment for manufacturing and management.

IoT systems consist of a set of sensors and "smart" devices that, in a sense, communicate with each other via the cloud. The sensors and devices detect changes in the state of their environment or collect the requested data from their designated target for the software to process and then decide on an automated response, such as issuing a notification to responsible parties.

In short, IoT is about gathering information and using accumulative data to improve existing business practices and promote communication between devices. (Saribardak, 2020).

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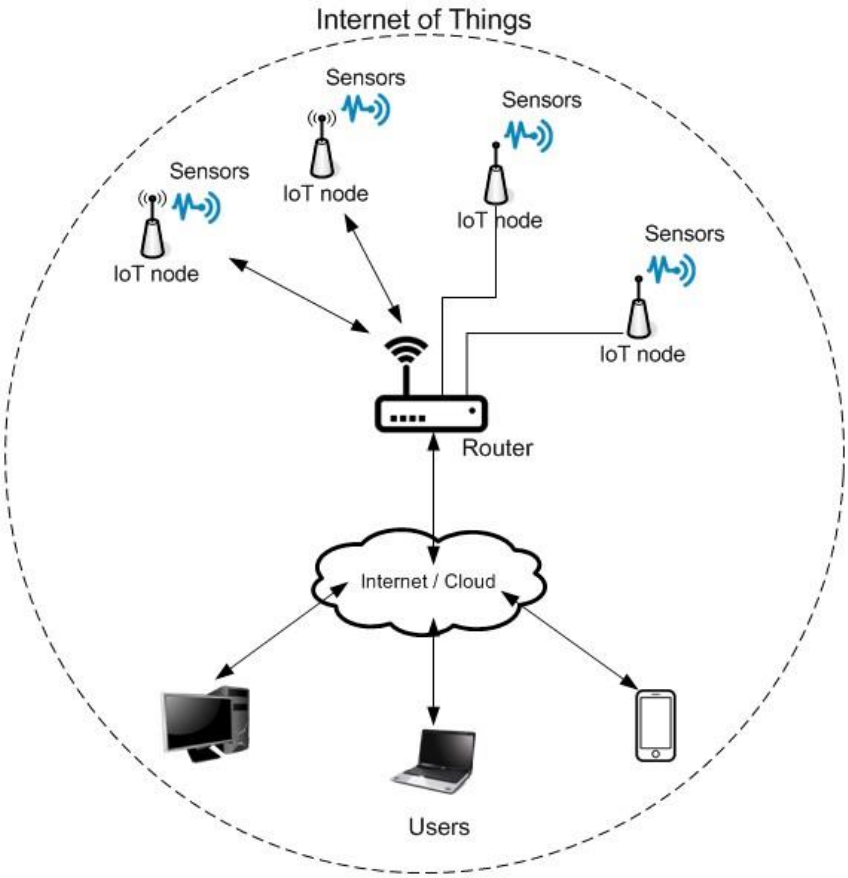
This connectivity of devices (smartphones and automobiles) is crucial for the mobility sector, which is one of the main problems of large cities. The application of Internet of Things and Big Data to the world of carsharing *offers us a way to improve urban traffic. Together with the massive data processing, connectivity allows users to be in contact with companies and calculate the most efficient routes to minimize the travel time.*

The Case Study and Industry 4.0 Elements: A Pictorial Overview

In the following graph we can see the monitoring and control system model of IoT. IoT devices are pieces of hardware, such as actuators, gadgets, appliances, sensors, or machines, that are programmed for certain applications and can transmit data over the internet or other networks. IoT devices connect to the network through the router and have the ability to send data to the remote server over the Internet or to the Cloud services. Sensor data collected by IoT devices is stored in the Cloud database in order to be available to users. This information is accessed by users from any location using desktops, tablets, or smartphones.



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IoT Technology has led to a disruptive evolution of the rent a car model towards carsharing. The concept refers to the loan or temporary use of vehicles made available to users in exchange for a specific tariff, generally for short periods of time and in limited geographical areas.

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The Element Explored within Industry 4.0 Application. 	*Bosch is a multinational engineering and technology company based in Germany. Its diverse business portfolio consists of hardware and software, consumer goods, industrial, energy, and building technologies (Wikimedia Foundation, 2021).* *Bosch desires high level of transparency along its complex supply chain through a continuous digitized material flow in its IT systems. In order to cope with this aim, Bosch implements Track and Trace, a holistic logistics solution. In practice, using Track and Trace means that any freight could be accompanied by its own digital logbook, where every location and station during a freight's transmit is regularly recorded and sent to the Cloud. Thus, it facilitates logistics staff with the depiction of the transport process of the goods for better planning and monitoring the conditions of the transport and for intervening, if needed.* *The tracking process of packages is conducted by sensors on them that transmit data, regarding temperature, humidity, vibration etc., to the gateways, where the links to the shipping information occur. Real-time tracking is also applied with sensors to containers or load carriers, following the same process. Thus, Track and Trace provides optimized transparency, high-level utilization of the containers, and new billing forms in cases of rentals.*

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	Moreover, it helps with the avoidance of bottlenecks and the analysis of losses. *Two notable examples verify the usefulness of Track and Trace system. An automotive industry customer that applies this system to its long supply chains for gathering reliable and almost real-time data about its shipments the location of individual packages and their shipping status and forwarding the information directly to the stakeholders. A machinery and plant manufacturer monitors its containers using Track and Trace for easier tracking and high-level utilization of the load carriers and for precision in the analysis of its supply chain losses (Bosch Global, 2021).*
Application Target Audience	*The results of the case-study are intended for use by SMEs, Enterprises and Entrepreneurs.*
Resources Used:	*- "The history and future of the internet of things", by S. Khvoynitskaya. (2019) Available here.* *- "How IoT Reshapes Industry 4.0 and the Effects of IoT on SMEs", by E. Saribardak. (2020) Available here.* *-"Application of IoT in monitoring and controlling agricultural production." By Markovic, D., Koprivica, R., Pesovic, U., & Randic, S (2015). Available here.* *-"A Brief History Of the Internet of Things". By Keith D.Foote. (2016) Available here.* *-"Robert Bosch GmbH. Wikipedia". By Wikimedia Foundation. (2021). Available here.* *-"When Freight Writes Its Own Log". By Bosch Global (2021). Available here.*
Further Reading:	*- "Guide to IoT Innovation (SME focus)", by IoT Analytics Available here.*

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