"The Internet of Things: A New Perspective Beyond Technology"

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The interview is conducted by Prof. Dr. Dennis Herhausen, Associate Professor of Marketing, KEDGE Business School

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**Nowadays, everyone is talking about the Internet of Things (IoT) as one of the most promising technological trends. You have been publishing about IoT for more than 10 years now.
Why does it appear more topical today than ever before?**

I firmly believe that we need to assess the potential of the Internet of Things not just for its technological capabilities but rather for its impact as an enabler of new business models. Thus, the focus should not be on the technology but on the associated business model. In this sense the topic is becoming ever more relevant because the business demand for IoT solutions is growing while the development of key enablers is reducing the barriers to developing viable IoT solutions.

Firstly, a decrease in hardware costs makes the implementation of IoT sensors and technology much more feasible. In addition, the decreasing prices go hand in hand with the miniaturization of smart devices. As they are getting smaller and smaller, it becomes easier to include cheap sensors in many consumer products.

Secondly, IoT depends on the connectivity between the physical world and the digital world. Network connectivity as well as bandwidth and coverage are increasing, which makes it easier to implement IoT solutions as compared to 10 years ago when we had weaker connectivity, lower bandwidth, and less coverage.

A third point is that when talking about connectivity we need standardized software platforms. In the past, companies faced a very fragmented landscape of different IoT solutions. These days, we see more and more standardization and a consolidation of IoT platforms in the market, which simplifies vendor selection and reduces implementation costs.

The fourth and most important point is the maturity of complementary technolo-

gies that drive the value of IoT. Topics like Big Data and Analytics play a pivotal role for the Internet of Things because the more I can learn from the acquired data the more value I can generate. Thus, IoT generates more value when combined with advanced analytics capabilities because the value will increase dramatically if I can analyze, learn, and then act on information instead of only recording it.

Finally, a range of technologies that may be subsumed under the term "digital reality" allow you to visualize what is happening in the physical world around you based on augmented reality, virtual reality and mixed reality. For example, as a maintenance technician you can look at a production line using an augmented reality headset and see quality KPIs as well as maintenance instructions in real time. Digital reality technology visualizes IoT in a way that makes it easier for people to interact with the physical world and the digital data associated with it.

In summary, the complementary technologies outlined above are boosting IoT adoption and driving value beyond an isolated IoT solution.

Where do you see IoT and its technologies creating the most impact?

For me, the impact of IoT is visible across three different dimensions. The first dimension is operational efficiency and the associated cost reduction. Condition monitoring and predictive maintenance are examples of IoT technology driving an increase in the operational efficiency of production lines.

The second dimension is the generation of new revenue streams and new business models. For example, the Internet of Things enables a new line of "connected" products (e.g. cars, industrial machinery, coffee machines, and smart home assistants) that allows companies to generate new revenue streams or sell their products at higher prices.

The third dimension relates to an improved customer experience where an IoT solution augments the experience and leads to higher customer satisfaction.

Can you give us an example of value creation by the Internet of Things?

There are many industries where IoT is already creating value by improving operational efficiency, driving new revenue streams, and improving customer experience. The manufacturing industry has applied IoT solutions for decades to improve operational efficiency of production lines. IoT sensors allow detecting machinery malfunctioning and in

combination with analytics capabilities potential problems can even be identified in advance transforming service tasks from reactive to predictive maintenance. In the consumer industry, we see IoT-empowered products entering the market such as coffee machines with embedded sensors. Here, IoT technology is applied to improve the customer experience by choosing the optimal water temperature for a capsule while revenues for the retailer are increased by automatically reordering capsules whenever the consumer is running out of them.

Although first announced years ago, IoT-empowered smart and connected household appliances have been slow to enter homes. Probably the most well-known example is the "smart" fridge. Why do you think it is taking so much time for this appliance to conquer the market?

Especially for the smart fridge, I see a couple of hindering factors. On the one hand, there is a lack of standardization across all the players involved, and this is a massive challenge. When looking at RFID as a prominent product identification technology, you would need to have all products in your fridge tagged in the same way no matter by which vendor

Fig. 1: Technological Innovation and Decreasing Cost Unlock the Full Potential of IoT

Smart Devices	Mobility	Cloud Computing	Analytics	Data Security
· Devices are becoming miniaturized and more affordable	· Mobile devices are used to control other devices	· Cloud Computing is used to drive business agility and speed-to-market	· Data from smart devices is collected and monetized	· Complexity of requirements is increasing given the number and types of devices
· Away from "all-in-one" devices towards meeting specific needs	· With BYOD the focus moves from device management to app management	· It provides an innovation platform for mobile, social, and big data	· Predictive analytics helps businesses be more proactive in driving decision-making	· Increased regulation and focus on privacy

Source: Deloitte 2019.

Fig. 2: IoT Use Cases in Sales, Customer Service and Marketing

Retail / Consumer Products 🛒	Supply Chain 🖧	Marketing & Adoption 📢	Service →
· Connected stores (digital reality, online-offline experience) · IoT consumer devices (e.g. PMI iQOS, Nespresso Prodigio) · Smart shelves (e.g. Coca-Cola) · Store checkout optimization (e.g. Amazon Go) · Quick feedback through smart packaging / in-app surveys	· Product provenance / supply chain visibility · Reverse supply chain / customer service · IoT for waste management & tracking	· Proximity-based marketing · Digital reality commercials · Augmented reality marketing brochures	· Remote condition monitoring · Augmented reality for service technicians · Remote service using mixed reality

Insurance 🐖	Smart Home 🏠	Crowd Management & Space Utilization 📍	Smart City 🏢
· Connected cars · Wearables in sports · Wearables in healthcare and homes / institutions (e.g. medication reminder)	· Smart fridge · Connected entertainment systems · Smart home safety appliances (e.g. remote door lock for home delivery)	· Event management · Retail banking experience · Smart shop floor · Warehouse management	· Smart mobility concepts · Smart parking · Smart lighting

Source: Deloitte 2019.

they are provided. Ultimately, if you cannot cover 100 percent of the products with a single solution, the customer experience is completely blown. If I have to separate the fridge contents into products that have an RFID tag and can be identified by the fridge and other products that cannot be identified, the added value diminishes. Ultimately, you will need to align all players involved, from the food producer to the fridge producer to the infrastructure provider, and this is a very challenging endeavor. On the other hand, there is the issue of tagging products because food retail faces very low margins. The cost of putting an RFID tag on the products might eat up all the margin, e.g. in the case of a yogurt. These are just two of the challenges that currently hinder the adoption of smart fridges.

Given these challenges, what can companies do to increase the acceptance of smart and connected devices like the fridge?

The first point to address is to ensure standardization and connectivity with open ecosystems so additional companies can actually be connected to the solution and contribute to value creation. If you consider the broader smart home environment there are also increasing privacy concerns that need to be addressed. Recently there was a lot of bad press regarding smart speakers like Amazon Echo listening in on consumers, who are getting more and more concerned about this issue. In addition, both companies and consumers have to be convinced that the investment will pay off in the future. These days, smaller producers of smart home appliances have to bet on one of the big players to set the standard for the smart home infrastructure so they can align their own products

to it. Whether it will be Google, Amazon or any other player – at some point one of the big players will "own" the infrastructure and lock consumers into their ecosystem. Many people are scanning the smart home market but not making investment decisions yet because they are not quite sure which player is going to provide the leading platform for the smart home. So if you want to win the smart home market and establish a leading platform it might be a promising strategy to open up your ecosystem for more partnerships and ensure your platform has the largest reach – and finally indecisive buyers will follow the trend.

Speaking about Amazon, I have read that they removed their "dash button" which was a typical IoT example. Why do you think they no longer promote this solution?

That is a very interesting point and actually a very recent discussion because they officially stopped it in September 2019. One of the reasons was significant pressure on Amazon because the dash button did not give the customers buying options and did not allow them to compare prices. After all, it was pre-configured and provided limited transparency regarding price fluctuations on the market. There was even a court decision indicating that the device might violate German consumer protection laws, which added to the pressure on Amazon.

Besides its impact on products, do you also see an impact of IoT on services?

Yes, definitely. Customer service is already undergoing a significant change due to IoT solutions. As outlined above, you can use sensors to monitor the performance of your production line. This also changes the way of providing customer service on production lines because you are moving from scheduled maintenance to on-demand service. But it is not just about the sensors, it is also about the way a service technician interacts with the physical environment. This is linked to the combination of digital reality and IoT technology mentioned earlier. We already see service technicians using augmented reality headsets to receive additional information about the machine they are servicing. As an example, at Thyssenkrupp technicians use a headset during elevator maintenance procedures, which gives them additional information on the specific work task, displays product information and allows them to connect to a remote colleague for further assistance.

Related to these examples, how do you see the impact of IoT on the future of the

workforce and future job profiles?

The example of the service technician relates to a future job profile in a company that provides services on a global level. In the past, the company had to send a highly skilled service technician to every global site to perform maintenance work. For example, if you had a machine breakdown in rural Siberia you had to send someone out to fix that because you were unlikely to have a skilled person on the ground. Now, if you think about technologies like augmented reality you can have unskilled workers on the ground executing the tasks while skilled workers connect from a central control center to steer and

guide the unskilled workers. This approach will significantly cut costs and reduce response times because instead of going somewhere on a 20-hour trip to fix a machine the technician can log in within minutes and prevent a production breakdown. That means companies need to organize their workforce differently because they no longer need to deploy skilled technicians all over the world. They can build a central center of excellence that provides services on a global scale while deploying less skilled workers out in the field.
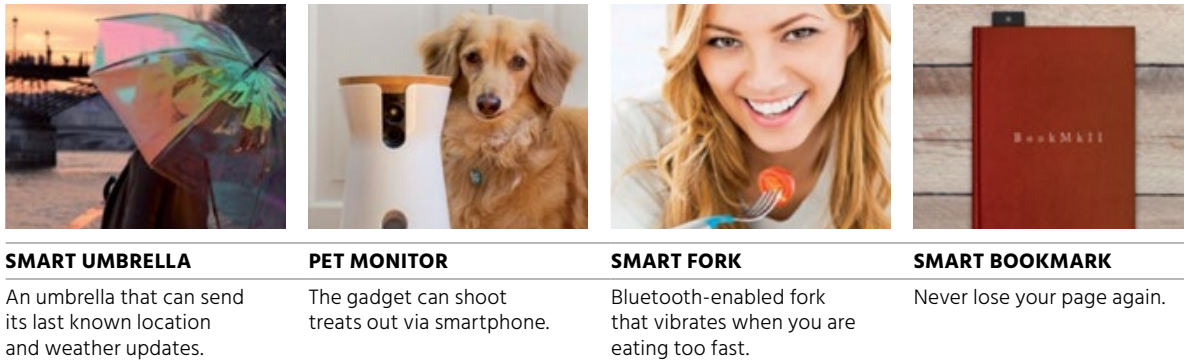
Many people expect an extraordinary impact of the combination of IoT and AI. Can you give an example of this?

There is a range of applications where IoT and AI converge. One of them is what we call "machine vision". In machine vision, you basically have cameras that observe a space and then use machine learning to train the system and get better and better at recognizing objects. This can be used for facial recognition or to generate heat maps of how a space is used. For example, as a retailer you can use the information from machine vision to understand the demographics of your customers and how the customers move across the shop floor. If you then correlate that information with your sales data you can understand how different marketing messages impact buying behavior.

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Image recognition is also important in the field of public safety where we see an increasing amount of safety cameras in public spaces like airports and train stations. These technologies allow you to run very specific queries on video feeds such as: "I am searching for a man that is 40 years old and wearing a brown coat". This obviously requires a sophisticated image recognition technology in combination with AI to process the data.

Smart homes are another field of AI applications, e.g. with regard to virtual assistants that interact with us and the surrounding smart home environment. As an example, I can instruct my virtual assistant to close the window or to turn up the heating. In this example, we talk

Fig. 3: The "Internet of Useless Things"

SMART UMBRELLA

An umbrella that can send its last known location and weather updates.

PET MONITOR

The gadget can shoot treats out via smartphone.

SMART FORK

Bluetooth-enabled fork that vibrates when you are eating too fast.

SMART BOOKMARK

Never lose your page again.

Source: Deloitte 2019.

about the actuator side of IoT because the scenario is not just about sensing (in our example weather conditions) but about actually triggering something in the real world. That is what we call the digital-to-physical loop of IoT.

Does this mean that robots will take over all our jobs?

As in previous industrial revolutions, there is a new technology wave coming in and it is not taking away but transforming jobs. Actually, if you look into the third industrial revolution, you can see that it generated more jobs than it killed and massively changed the kind of work we are doing. You already see robots being heavily used in a production and manufacturing context and in many cases they are not simply used as a replacement for manual work but in collaboration with human workers. You can see collaborative robots (so-called "cobots") working with humans on the same production line. For example, the robot does the heavy lifting that humans cannot easily handle while humans carry out the very sensitive tasks. Therefore, when we see humans and robots collaborating on a task there is a change in the kind of work the human carries out but not a replacement.

Where do you see the main challenges of implementing IoT solutions?

I would like to separate the main challenges into three different categories. The first common misconception we see in many organizations is that they perceive IoT as a technology solution instead of focusing on the business problem. Throwing technology at a problem for the sake of implementing technology generates what I call the "internet of useless things". One recent example is a smart umbrella that has a sensor that will tell you whether it is raining. The second challenge is to fit the new IoT solution into the existing IT landscape. This is linked to selecting the most suitable IoT platform for the problem at hand. Actually, a lot of work is required to benchmark different IoT platforms and pick the right platform based on a client's individual needs. The third common challenge relates to challenge one and the underlying business case. The challenge lies in the uncertainty about the actual benefits of implementing an IoT solution. If you are too technology-focused, you are at risk of losing sight of what is the problem you are trying to solve. You need to know what is going to be the

business value before engaging in the actual implementation.

Based on your experience, where do you see the future of IoT?

At the beginning of our conversation, we talked about the decrease in costs and the increase in standardization, and both will boost IoT in the future. Even today, we can see an exponential growth in IoT solutions. But the true value will be realized when IoT is combined with other emerging technologies like big data, digital reality, and cloud computing. Companies need to integrate these technologies to achieve new solutions that create more value than the sum of their parts. And last but not least, the companies that will be most successful in implementing IoT are the ones that take the risk of moving beyond merely improving efficiency by a few percentage points and start exploring disruptive IoT-enabled business models. IoT is still a new technology for many companies and it takes a lot of guts to disrupt existing business models with IoT. The reward will be huge, though, as it will generate entirely new revenue streams.

Thank you very much for this insightful discussion.