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Press Release

## Study: Smart Household Appliances From Coffee Pods to Toothbrush Heads: Smart Appliances Replenish Themselves

Let's take a trip into the future. Imagine you're sitting down for breakfast in the year 2030. Almost out of butter? Running low on coffee? No problem. The fridge and the coffee maker have already reordered both. Besides already being equipped to control lighting, heating, and window shades, a new trend is now emerging within private *smart homes*: smart appliances. Smart household appliances are capable of automatically replenishing consumables. Based on "smart home", the phrase "smart replenishment" may well soon establish its place as a fixed term. Where are the opportunities and risks for companies? Kühne Logistics University (KLU) provides answers to this question in a recent study.

*A short description of smart replenishment can be found at the end of this article.*

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### Opportunities: Improved Supply Chains and New Business Models

"There is still uncertainty among companies about whether offering a smart ordering option to private households is worthwhile and how they need to set themselves up for this," says KLU doctoral student Sandria Weißhuhn. Her current study with Dr. Kai Hoberg, Professor of Supply Chain and Operations Strategy, uses a mathematical model and simulation to examine decision-making processes among manufacturers in an automatically controlled refill system. According to the study, smart refill systems that continuously keep track of inventory of consumer goods such as coffee beans, dishwasher tabs or electric toothbrush heads in private households can significantly improve supply chains and generate new business models. Above all, this is made possible by a more even utilization of capacity in production and logistics and better service. The result is increased profits and more satisfied customers.

### Challenge: Mix Between Traditional and Smart Shopping

In the future, there will probably only be networked household appliances, and manufacturers will be able to gear their sales and supply chains entirely to this. At the moment, however, more innovative companies are in a difficult transition phase. Traditionally, most customers continue to buy everyday products in brick-and-mortar retail stores or actively order them themselves online, whereas the early adopters are already leaving this to their smart household appliances, some of which are still in pilot studies, and are

supplied automatically. "At the moment, manufacturers therefore have to serve several sales channels in parallel," explains Weißhuhn. "Figuratively speaking, they are juggling several balls at the same time, trying to make the most out of all possibilities." This is a tricky task, because the manufacturer's production and shipping capacity is limited, and consumer demand is distinct and fluctuates in general. At the same time, expectations regarding product availability and service are high today.

### **Smart Ordering Systems Allow for Flexible Deliveries**

"Our model is the first in our research field to map the complex reality in this context. This in turn enables us to offer manufacturers approaches to finding efficient solutions for this transition phase," says Weißhuhn. To deal with the current situation in the best possible way, Weißhuhn recommends a concept which combines an order corridor with customer prioritization. The following illustration of a coffee machine demonstrates how this would work: an upper and a lower limit are set in the coffee bean container. If the coffee is within the limits of this order corridor, the machine alerts the customer. The manufacturer can then make additional deliveries at a flexible time. However, at the latest when the stock of coffee beans in the tank reaches the lower limit, the machine triggers an order to prevent a coffee shortage in the private household. However, smart orders can always be brought forward if gaps in demand arise due to other distribution channels. In the end, this leads to an optimized utilization of supply potential.

### **Skepticism Among Manufacturers and Consumers**

In practice, there are still further hurdles to overcome before *smart replenishment* can reach its full potential. For example, so far there are only a few devices with interfaces to manufacturers of replenishment products. Where interfaces already exist, there have been challenges in implementation and there are often still problems with data accuracy. Otherwise, there is a lot of skepticism with regard to the huge amount of data that is collected by smart devices and then wants to be stored, analyzed and utilized. In some cases, skills and experience have yet to be acquired. Consumers are concerned about the privacy of their data and are reluctant to hand over their purchasing decisions to companies.

### **A Trend with a Future**

Nevertheless, Sandria Weißhuhn sees a future for this budding trend. "Once the initial hurdles have been overcome, *smart replenishment* promises exciting new business models for manufacturers and suppliers. Not only can manufacturers establish direct connections with their customers, they can also gain deeper insights into usage and consumer patterns and develop a better understanding of their customers' needs overall. Local retailers who get on board may find that their delivery options to be more resilient against growing competition from online retail. And from a customer's perspective, life could get easier, too."

**Publication:**

*Designing Smart Replenishment Systems: Internet-of-Things Technology for Vendor-Managed Inventory at End Consumers, European Journal of Operational Research (in press), <https://doi.org/10.1016/j.ejor.2021.03.042>*

**Video:**

- Sandria Weißhuhn: [Findings and Mode of Operations in Smart Replenishment](#)

**Photo Material:**

- [Sandria Weißhuhn](#) (Copyright: KLU/Christin Schwarzer)
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**Explained: The Concept of *Smart Replenishment***

Household appliances such as coffee machines, washing machines, dishwashers, printers, electric toothbrushes, and even refrigerators are already equipped in part with sensors that monitor functionality and usage. These devices are becoming increasingly more connected to the internet. As part of the Internet of Things (IoT), they enable data exchange between consumers and manufacturers and suppliers. This is the basis for the concept of *smart replenishment*, i.e. the automatic refilling of consumer goods such as coffee beans.

**About KLU**

*Kühne Logistics University – Wissenschaftliche Hochschule für Logistik und Unternehmensführung (KLU) – is a private university located in Hamburg’s HafenCity. The independent, state-certified university’s major research areas are Sustainability, Digital Transformation and Value Creation in the fields of Transport, Global Logistics, and Supply Chain Management.*

*KLU is one of very few private universities in Germany entitled to confer their own PhDs. The 2021 ranking of the Wirtschaftswoche identifies KLU as one of the strongest research universities in the field of Business Administration in Germany, Austria and Switzerland. Comparing the research output per professor among all participating universities, KLU ranked 4th in Germany and 8th in the DACH region. In the latest CHE university ranking, KLU obtained the highest marks for all major criteria.*

*With one BSc and three MSc degree programs, a structured doctoral program, and a part-time Executive MBA, KLU offers its 400 full-time students a high level of specialization and excellent learning conditions. KLU has an international team of 23 professors who teach in English. In open, tailor-made management seminar series, industry specialists and managers alike benefit from the application of academic findings to practical issues.*

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