

# EXPLORING SERVICE SYSTEMS IN THE DIGITAL ERA

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**Project title:** Human-centred service design with big data applications for smart building environment

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# MOTIVATION

Over the next five years, sensors, the cloud, connected smart devices and real-time analytics will combine to deliver a new layer of connected intelligence that will revolutionize the ability of companies and organizations to offer increasingly indispensable digital services to consumers.

The challenge will be that design must become tailored, responsive and able to adapt quickly to changing circumstances. Data-driven Services with a design perspective will be powered by users data, collected from sensor-rich objects and devices we interact with, apps and everyday services, such as banking, as well as historical, behavioral (if we permit this) and third-party contextual data, including weather or traffic information. It will be the responsibility of organizations from business to government to non-governmental organizations (NGOs) to create services that are suitable and helpful to their customers, citizens and users.

## **WHERE WILL WE EXPERIENCE DATA-DRIVEN SERVICES WITH A DESIGN PERSPECTIVE?**

There are several areas where data-driven services could be applied and used, but in this research project, we will be focused on the smart home environment. In the future, we see a potential for the expansion of the other cross-disciplinary research area like smart mobility, workplace and health services.

**HOMES:** Managing energy, security, environment, entertainment, our diaries and budgeting.

**LIFESTYLE:** Everyday schedule management, diary coordination, location and status updates and cultural and social event recommendations.

**TRANSPORT:** Driving management and support, maintenance management, route planning, traffic information, insurance assessments, roadside attractions and services, media and work communications, fuel and energy management, social media and entertainment.

**WORKPLACE:** Coordinating travel arrangements, diary workload management, learning and reading recommendations, resource management and decision-making advice.

**HEALTH:** Fitness and dietary advice, training, illness diagnostics and personal health diary planning.

Data-driven approach to service design is inherently human-centric and flows from the question “how can we improve consumer’s lives?”. The business modelling will be designed and based on identifying a specific consumer need and designing a solution by testing services that consumers appreciate and begin to find indispensable. Such services will require organizations and businesses to transform their ability to tailor service experiences to the expectations and habits of individual users. Data is vital for Data-driven Services. In order to create a dynamic experience that can be continually tuned and tweaked to benefit the consumer, data must be collected, analyzed and acted on from two source points: the customers and the contextual environment. Designs should be immersed in behavioral data from the concept stage.

A challenging but critical aspect of this approach is establishing the capability to capture highly detailed behavioral and customer preference data, which entails the liberation of customer data from individual silos within an organization. In addition to tracked behavioral data based on past interactions with services, designers must consider a framework of external data sources that can create a launchpad for a dynamic service. Awareness and concern about data privacy and specifically the use of personal information by digital service providers and communications channels is becoming one of the most significant issues of our time. Data-driven approach to service design draws on multiple, real-time, personal data feeds—blended with third-party information—inevitably raise questions around privacy and ethics, which is be part of the research.

# BACKGROUND

The smart building concept is constantly evolving. It is dynamical in its nature and various actors are inserting different components, functions and preferred outcomes into the concept to fit with their perception. At the same time, many existing definitions share central ideas of what a smart building is – interconnected, flexible, automated, energy efficient and comfortable for the occupants. The concept has expanded due to technological innovations and external events, such as the growing anxiety over climate change, which has amplified the importance of energy efficiency and the progressing level of building automation and management. As buildings are becoming increasingly complex they are generating vast quantities of data. The dissemination of data provides numerous opportunities for improvement existing services and develop new.

In developing new services, designing service concepts is the first and foremost issue. A service concept is defined as a bridge between the “what” and the “how” of a new service [1], which mediates between customer needs and the strategic intent of a company [2]. The importance of designing new service concepts has gradually increased because of various customer demands, competitive environment, and globalization of services.

Service concepts are commonly designed through intuitive, investigative, and analytic approaches [3]. In the intuitive approach, service concepts are designed on the basis of the intuitions of service designers, which are gleaned from activities such as brainstorming. The investigative approach designs new service concepts by asking for customers’ ideas directly, for example, through customer surveys or interviews. The analytic approach uses engineering methodologies and tools for designing new service concepts.

Several studies have explored the approaches to designing new service concepts, including a computer-based tool to design the functions of a service concept [4], a morphological approach to designing new smart service concepts [5], and a knowledge-based method for designing product service system concepts [6]. Opresnik and Taisch [7] similarly noted that the utilization of data from customers can facilitate the development of services in manufacturing industries. Huang and Rust [8] indicated that service companies can leverage and transform customer data into useful information about customers for strategic marketing planning. For example, Sakao and Shimomura [9] proposed a computer-based tool to design the functions of a service concept for satisfying customer needs.

The mentioned studies can support the design of new services using data. However, the applicability of the results is limited because these studies do not focus on the use of data to service design. In addition, human-centered services that can be deployed at scale requires adequate experimentation environments and real end-user involvement in which these services can be matured and their effectiveness understood before commercial roll-out.

The present study focuses on service design starting from the users’ needs and experience and associated data, which will be interconnected with BMS data and external data. The approach suggested in this work is aimed at providing a systematic procedure that links data analysis to human-centered service design.

# PROBLEM

This study proposes a data-driven approach to service design integrates insights from the data science, service design and behavioral science. The proposed approach aims to enhance the effectiveness and efficiency of new service design starting from the users' data. The proposed approach contributes to the continuous design of new services for smart buildings by enabling efficient data analysis and further creating a synergetic effect when incorporated into existing approaches to service design.

In order to create a dynamic experience that can be continually tuned and tweaked to benefit the consumer, data must be collected, analyzed and acted on from two source points: the customers and the contextual environment. Designs should be immersed in behavioral data from the concept stage. A challenging but critical aspect of this approach is establishing the capability to capture highly detailed behavioral and customer preference data, which entails the liberation of customer data from individual silos within an organization. Awareness and concern about data privacy and specifically the use of personal information by digital service providers and communications channels will be one of the most significant issues of the study.

The main question we plan to answer during this research:

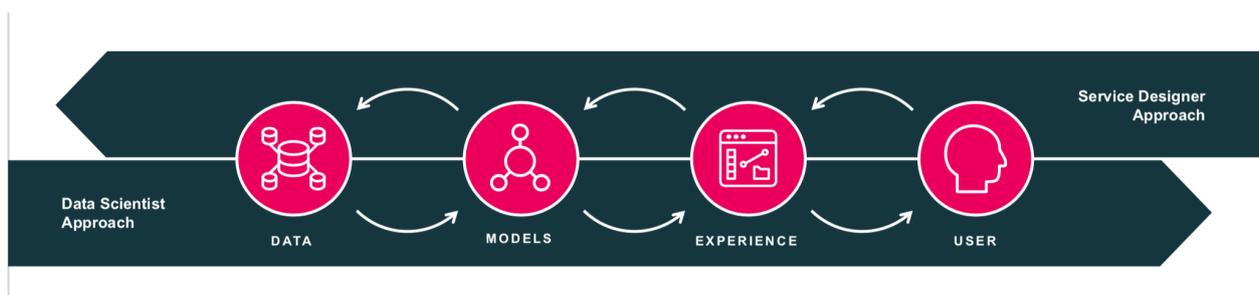
**RQ: How to implement a human-centric data-driven approach to the service design process?**

# METHODOLOGY

This study proposes a data-driven approach to service design integrates insights from the data science and service concept design. The proposed approach aims to enhance the effectiveness and efficiency of new service design starting from the data. The proposed approach contributes to the continuous design of new services for smart buildings by enabling efficient data analysis and further creating a synergetic effect when incorporated into existing approaches to service concept design.

# EXPERIENCE

'Data-driven approach to new service design for smart buildings' project is a continuation of the already begun research project called 'Big data for smart buildings', which explore the role of Data Science in improving existent BMS (building management system) utilizing different types of data. The proposed big data architecture is currently implementing at KTH Live-in-Lab and offers to assist building owners, facility managers, operators, and tenants. In addition, there are an ongoing research project conducting in the area of GDPR influence on the user's data in the building environment.



# IMPLEMENTATION

## Stage 1: Data-driven approach to design new service concept

Explore a data-driven approach to design new service concepts that integrates insights from the literature related to big data and service concept design.

RESEARCH METHOD: LITERATURE REVIEW  
6 MONTHS

## Stage 2: Theoretical framework

Create theoretical framework for data-driven service development with design perspective aimed at helping service designers to understand customer behaviors and contexts through data analysis and then generate new service concepts efficiently on the basis of such understanding. Research method: survey, modelling.

RESEARCH METHOD: SURVEY, MODELLING  
6 MONTHS

## Stage 3: Industry Workshops

Conducting five workshops with stakeholders and reference groups. RESEARCH METHOD: PARTICIPATORY WORKSHOP

6 MONTHS

## Stage 4: Services taxonomy

Classify services for smart buildings and create an interactive map of data driven services.

RESEARCH METHOD: CLUSTERING ANALYSIS, NETWORK ANALYSIS

6 MONTHS

## Stage 5: Cases study

Select 3-5 services to test at KTH Live-in-Lab. Connect selected services with the building data architecture and user experience data.

RESEARCH METHOD: DATA ANALYSIS, MULTIVARIATE STATISTICS

6 MONTHS

## Stage 6: Researche synthesis

Synthesis of the results of use cases and workshop, as well as the dissemination of results.

RESEARCH METHOD: RESEARCH SYNTHESIS

6 MONTHS

## Stage 5': Potential collaboration

There are several areas where data-driven services could be applied and used, but in this research project, we will be focused on the smart home environment.

On this stage we can map potential cross-disciplinary research areas like smart mobility, workplace and health services.

# THEORETICAL AND MANAGERIAL CONTRIBUTIONS

Human-centred service design with big data applications for smart building environment brings together Service Design, Data Science and Behavioral Science to tailor service experiences to the expectations and habits of individuals by using big data. This research project contributes with increased knowledge on how an integrated approach that iteratively delivers the right data insights will not only improve the quality of life and convenience of citizens in indoor spaces, but also contribute towards more sustainable cities through more efficient utilization of scarce resources such as energy and water. A challenging but critical aspect of this approach is establishing the capability to capture highly detailed behavioral and users preference data and consider a framework of external data that can create a launchpad for the new human-centered services in the context of smart building environment. The project will be implemented and tested at KTH Live-in-Lab - fully equipped testbed for smart building environment R&D, which will allow the subsequent possibility of scaling the tested services.

## **Short-term targets:**

Target 1: Design, develop and test 5 different types of the human-centered services at KTH Live-in-Lab.

## **Middle-term targets:**

Target 1: Increase the share of human-centered services by 25% at KTH Live-in-Lab.

Target 2: Increase users satisfaction factor by 25% living at KTH Live-in-Lab.

Target 3: Increase the share of energy-related human-centered services by 15% at KTH Live-in-Lab.

Target 4: Decrease households' energy consumption by 20% with the use of human-centred services.

## **Long-term targets:**

Target 1: Increase the share of human-centered services by 15-20% for smart buildings.

Target 2: Increase users satisfaction factor by 15-20% living at the smart buildings.

Target 3: Increase the share of energy-related human-centered services by 10% for smart buildings.

Target 4: Decrease households' energy consumption by 15-20% with the use of human-centred services.

# OPEN QUESTIONS

Sub-questions:

SQ1: Which data is available for the collection and which should be generated additionally?

SQ2: What is the most efficient way to integrate the data analysis to service design process?

SQ3: Which data analyzing model can be applied to understand users behaviors and its contexts without compromising with the privacy issue?

SQ4: How to apply AI and cloud technologies to advance human-centric services?

SQ5: How new data-driven services could be connected with the service-oriented business models?

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