SMART SERVICES AS SCENARIOS FOR DIGITAL TRANSFORMATION

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Abstract: *Digital transformation, new business models development and business processes automation ranks among the key business concerns and company priorities. In this context, smart services propose new models for service automation, combining data, analytical components and physical infrastructure in unique customer offerings. The present research aims to present the smart services potential, exploring its characteristics, perspectives and fields of application. First, the paper makes an overview of smart services features and concepts, then, it determines smart services perspectives and last, it presents use cases and industry sectors for smart services implementation.*

Keywords: SMART SERVICES, DIGITAL TRANSFORMATION, INDUSTRY 4.0

1. Introduction

Within the framework of digital transformation and Industry 4.0 wider adoption, the role of companies is continuously changing from manufacturers and traders of mass products to data integrators and providers of complex and customer-oriented services. Many opportunities exists for companies to extend their value-creation offering and business models by developing focused and personalized services, by implementing Industry 4.0 technologies such as big data, cloud computing, Internet of Things, robotics, virtual reality and others. That is the reason smart services and smart service integration to be on the next frontier of Industry 4.0 ecosystem.

However, the development and smart service offerings requires new set of prerequisites such as technological advances: industry standards, cybersecurity, appropriate infrastructure and new business scenarios: organizational practices, new business models and customer-oriented business processes. In this context, the present research aims to identify the main features of smart services and to outline the companies' potential to develop and implement smart service scenarios on practice. The first part of the paper provides a short background overview of smart services, discussing its main concepts and perspectives. The second part defines the main layers and characteristics for smart service offering. Last, there are identified different application models and use cases for smart services implementation in new value-offerings. The present paper is partially supported by INTERREG project DIGITRANS - *Digital transformation in the Danube Region*.

2. Background

The common definition of smart services states that they combine digital services, data analysis and physical infrastructure within complex "smart product-service ecosystem". In this context, smart services are considered as individually configured systems, merging physical layer (infrastructure), digital services (access to computational capacity), and data (integrating contextualized and personalized data) [1]. Other definitions state that smart services are interconnected, data-driven and personalized, and "smart" stands for context-sensitive data and customer orientation. Smart services are digital services, adapted and delivered based on specific user requirements, and stepping on data analytics and contextual data [2]. They are individually configured and often delivered physically, covering digital services and physical products, usually performed on integrated platforms [3]. From data perspective, smart services are data-driven applications (set of traditional and digital services, integrating various data sources on technology platforms) [4]. Smart services come as result of the progress in machine intelligence, global connectivity and big data.

As alternative terms for smart services in literature are used: data-driven services, Internet of Services, Smart Web Services, intelligent or smart products, smart product-service systems, intelligent ecosystems and others.

Smart services advance on the increasingly blurring differentiation and convergence between physical products and services [5, 6], providing personalized customer offerings as "complex service packaging" [7]. Thus, smart services allow companies to use smart digital products as "distribution mechanisms for service provision" [5] extending their opportunities to digitally transform and personalize their customer offerings.

3. Smart services perspectives

The emergence of smart services is largely due to new intelligent or smart products, improved cybersecurity and encrypted data transfer, data analytics models and customer-oriented business models [8]. Smart services can be analyzed from three main perspectives – technology perspective (technology infrastructure), customer perspective (context of service delivery and value co-creation) and business perspective (value offering, based on integration of data and inter-organizational networking capacity).

-***Technology perspective*** covers technological architecture for smart services, including smart products or smart objects, assuring connectivity and infrastructure, such as sensors and actuators (IoT/IIoT), wearables or access to local physical devices. Technology perspective allows company to connect, to analyze and to adapt to specific customer preferences and context. Technology perspective consist of in-place technology infrastructure, determining the elements of the context and delivering physical components of the smart service.

-***Customer perspective*** builds on business scenarios and personalized user profiles. Extending data analytics and context recognition, companies can customize and adapt its smart service offerings to specific users based on preferences, patterns and experiences. Improving access and analysis to personal and general data statistics, models of use customization and recommendation services can further extend opportunities for value co-creation.

-***Business perspective*** aims to extend the capacity of the company to explore vertical and horizontal industry integration in order to enhance value-creation and value offering for its clients, by combining personalized features and general elements within smart service configurations. The business perspective integrates internal company resources and business processes with extended company ecosystem and network of partners, suppliers and end-customers.

The three general perspectives provide general understanding for the physical, customer and business layers, defining the smart service structure. In order to identify scenarios for smart service development, we will go deeper by examining the smart service platform model of Smart Service Welt [1].

Visually, the smart service system architecture covers five platform layers (fig.1), consisting of: 1) infrastructure and physical components, 2) smart products/smart objects, 3) data analytics, user profiles, 4) smart service platforms and 5) business models configuration. These five layers combine technology infrastructure (layer 1 and 2 – technology infrastructure and physical platform),

customer service infrastructure (layer 3 and 4: software platform – data, computational and analytical layer and service platform - smart service or customer layer) and business infrastructure (smart service integration layer- smart business model ecosystem and smart business processes).

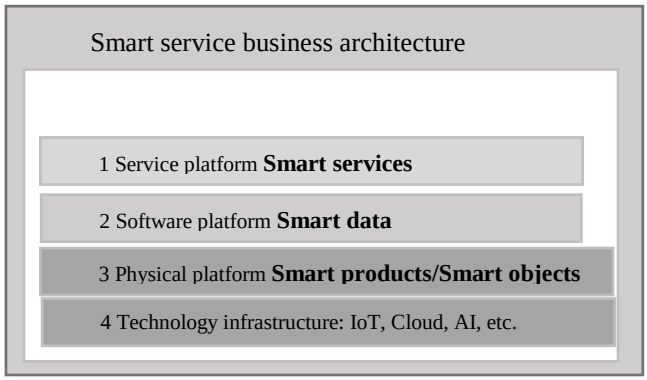

Fig. 1 *Smart service business architecture based on Smart Service Welt [1]*

3.1. Physical infrastructure (smart product)

Smart products or smart objects are the backbone of the physical infrastructure within the "smart service system". Intelligent (smart) objects (products) are able to sense its own condition and its surroundings and thus allows for real-time data collection, continuous communication and interactive feedback [9]. Furthermore "smart products" enable monitoring, optimization, remote control, and autonomous adaptation of products or objects [10]. Smart products use sensors (IoT) to obtain contextual data, exchange data with other actors (cloud technologies), store and process data locally (edge computing), make autonomous decisions, and act physically by means of actuators [1].

Smart products can include smart devices, smart objects, and cyber-physical systems. They embed hardware and software systems into physical goods that can connect digitally to other products and information systems. Smart products obtain contextual data from the field, analyze these data, automatically make decisions and take actions. The smart products (objects) may be associated with an individual customer (e.g., health monitoring), a group of customers (e.g., family home monitoring) or a firm (e.g., monitoring of industrial equipment) [9].

Some of the main features of smart products include [10]: unique identification, localization, connectivity, sensors, data collecting and computation (edge computing), actuators, interfaces, invisible computing. In this perspective, smart products act as service-distribution mechanisms.

It is important to underline that smart products can mediate the interactions between service providers and service consumers in two ways. First, when consumers use the products' embedded functionality as a self-service. This way, the smart products transfer the configuration of customer service. Second, smart products can act as point of interaction or interface between the end-users and the service providers. In this scenario, smart product transmits data on its use, condition, and context back to the service provider, who analyses these data to offer additional value propositions that fit the detailed contextual situation of the customer. The technology infrastructure and physical platforms, based on smart products (objects) (layers 4 and layer 3 from fig.1) can deliver different scenarios for remote and continuious services, routinized and technology-mediated interactions and personalized and contextualized customer services.

3.2. Customer orientation (smart service)

On one side, smart services rely on the application of specialized competences, through deeds, processes, and performances that are enabled by smart products. On the other side, smart services require customer orientation and customer focus. Therefore, for the design and development of smart services it is essential to understand the customer and his surroundings, to explore various data sources and to analyze, integrate and process these data into valuable personalized offerings. Within smart data software platform – layer 2 and service platform -layer 1 (fig. 1), smart services build on "smart data" concepts and integrate them in new user-oriented service modules, new diagnostic applications, new control and automation solutions. The customer perspective allows companies to extend the use of the growing volume of contextual data and to combine it in innovative ways creating on-demand, personalized solutions for customers [3].

- *Customer profiles*

Customers and customer experiences are the cornerstone for any smart service scenario. By defining and extending user profiles, smart service technologies can personalize and enrich the user experience by developing individual combination of service elements reflecting individual preferences and expectations. The customer profiling is defined by algorithm or user acquisition model. This model can combine both explicit and implicit user information, including on one side explicitly submitted user information and on the other side, by observing and tracking user preferences, service usage and behavior patterns. In order to rely on appropriate customer profiles, the user acquisition models scenarios should evolve and extend over time, upgrade user preferences, skills and competences, combining various types of data and measuring their relative weights.

- *Context recognition*

Customer orientation or service personalization requires on one side to understand the customer profile (personalization based on personal preferences) and on the other side - to recognize the specific context of service delivery (personalization based on external conditions). The context is determined in plan recognition module that integrates historical data (plan libraries), input observations and potential plans, adapting the service delivery pattern to local conditions.

The smart services main feature is the individual approach to customers based on their context and personal preferences. The service platforms can develop and support individual profiles and context recognition patterns using various artificial intelligence technologies (such as chatbots, image or text recognition), allowing development of scenarios for three types of personalized services:

1. Interactive configurations: customized smart services, adapted both to the customer profile (explicit data and implicit preferences) and to the service delivery context (taking into account the context).

2. Recommendation systems: customized service models, supporting decision-making and choice options, based on personal preferences, past data and environmental/contextual information.

3. Personalized interactive processes: application of different models of service interactions, so that the services are tailored to the individual preferences and context/environment data.

Smart services usually support customers for taking decisions and selecting one or another solution, based on personal preferences, evaluation criteria and decision-making patterns, conformed to the specific context. Smart service platforms have to facilitate the decision-making process, but in the same time, they have to provide relevant explanations of its own logical models. In the same time, the smart service platforms have to allow the end-users to apply and customize other solutions that may differ from the system recommendations.

3.3. Business infrastructure (smart service integration)

Smart services often require individual organizations to extend its capacity by delivering boundary-objects that integrate resources, data and activities provided by different actors from the ecosystem

[10]. As customer-oriented, platform-based and service-oriented business models are expected to replace traditional product-oriented business models, development of new smart services will require new mechanisms for value adding and value integration.

Within business perspective, companies should define new opportunities for re-integration of resources and processes from the ecosystem in order to improve or extend its value offering. For example, it can exploit open data, work in open innovation processes, collaborate in open communities or rely on open source infrastructure.

In the concept of the Smart Service Welt [1], business models stand as the outermost layer of smart-service architecture functionality (fig.1), supporting digital transformation and directly affecting inter-organizational business processes and workflow configuration. In this context, the most important elements of Smart Service business model are [8]:

- Content or the specificity of the smart service, how it is created and used and what is the customer added-value;
- Customer or focus of the smart service, customer preferences and level of satisfaction;
- Platform or the technology infrastructure, supporting the delivery, personalization and access to smart services;

The role of the business ecosystem is crucial for smart service configurators and integrators. As different social and economic actors use different data, resources or services, the possibility for networking, partnerships and exchange of digital assets and physical infrastructure can extend the capacity and value co-creation potential for smart service providers.

3.4. Smart service characteristics

The characteristics and elements of smart services vary, but usually they are considered as: data dependent, agile and customer focused, cross-company and cross-sectoral delivered[12].

The smart services classification in [8] distinguishes the following five characteristics: 1) smart services are the connection between the physical and the digital world, 2) they upgrade the value creation and economic efficiency; 3) they provide extension of products and services with a digital layer; 4) they transform the product into a part of service-offering; 5) they require transformation from product-centred to customer-centred business models.

The elements of the services consist of the following dimensions [13]: service structure, service delivery process, service outcome and service business model. In this context, the components of smart services are physical delivery, digital services, technology-based services and data-driven services.

The characteristics of smart services, defined by [11] are:

(1) Smart services rely on embedded information and communications technology that allows data transmission and information generation.

(2) Smart services integrate and are enabled by big data analytics.

(3) Smart services are automated (at least partly) and they are perfectly aligned with human interaction. Such automated service actions are only possible by the integration of smart components like cognitive systems.

(4) From a customer perspective, smart services allow for greater customization of services by reacting on environmental-conditions or customer requests (smart services adapt based on users data).

Finally, smart services elements include physical infrastructure or smart and connected products, they rely on encrypted and secured data transfer, they are developed based on data analytics and data-based intelligence, they are developed on new business models and new mindsets and customer-driven business scenarios.

4. Discussion and conclusions

The successful generation and development of smart service scenarios within companies rely on different factors such as analysis and optimization of organizational processes (communication and coordination processes), good governance and management structure (sufficient resources, access to capacity, competent decisions), appropriate culture (rewarding creativity and trust). Development of smart services start with focus on customers and trigger additional digital transformation processes. The expected benefits from smart service implementation come in two main directions: source of new revenues and cost optimization:

- Smart services can provide additional revenues, improved efficiency, increased visibility & cost reduction, enhance customer base, relationship and satisfaction, larger mobility and independence, stronger interconnectedness, faster decision making. Delivering intelligent customer service can improve customer interaction, customer data collection and analysis, customization and customer value improvement. All these characteristics can lead to: increased innovation, turnover and profit, increasing customer loyalty, creating competitive market advantages, higher employee productivity, satisfaction and qualification.

- Implementing smart services in organization can lead to savings, process optimization, dependency, virtualization and process automation, flexible combining, and enhanced functionality. This would increase the efficiency of processes, reduce resources and waste, solve problems at an early stage.

High complexity for the development of smart services requires systematic approach for defining complex "product-service systems". Smart service ecosystems aims to link data and information connecting different sources, smart objects and products, contextual information, user profile and additional data. Therefore, customers can have different concerns, related to smart services wider adoption.

It is important to state that customers perceive smart services as highly risky if they are invisible, feature a high level of automated decision-making or enable the service provider to access sensitive information [9]. The increased risk perception is mainly driven by the fear of privacy violations and concerns about data security [14]. Different levels of perceived embeddedness might trigger different emotional responses in consumers. The customer concerns about smart services dramatically increase with the increasing of the embeddedness of the technology in their lives and bodies. Research has identified that technology characteristics, customer characteristics and context specific perceptions such as privacy concerns are the main factors affecting the perception and adoption of smart services [9].

Some of the other smart service challenges include [8]:

- Technology (lack of smart service standards and interoperability issues),
- Data (data management, data protection, cybersecurity, data ownership and security),
- Business (high initial investment and uncertain return on investment models, need for new business models and new business logic, differing from traditional markets),
- Competences (lack of practical experience, skilled workforce and management experience);

Smart services have the potential to digitally transform many industries and companies' business models. Combining data, customer focus and data analytics with new hardware applications such as autonomous cars, robots, drones, wearables, IoT/IIoT, smart city infrastructure and others, smart services can provide many value offerings. Examples of smart industry services, smart urban services, and smart senior care services are already provided in the research of [9]. Other smart services use cases are explored as well in education, in health care, utilities, retail, manufacturing and

transport [8]. ICT companies and leading service providers already promote successful use cases for smart services and customization opportunities within smart factory, smart mobility, smart city, smart farming and smart agriculture, smart energy (FIWARE platform), smart trade, logistics, smart predictive asset management and maintenance, smart industry (SAP Leonardo system). Therefore, smart services have the potential to enable next scenarios for customer-oriented digital transformations.

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