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Creating New Innovation Services for Underground Labs in the Baltic Sea Region via Service Design: Part 1: Exploration

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The well-known geophysical conditions and easily accessible underground facilities are among the reasons why e.g. geo-measurement companies are interested in conducting their testing in Underground Labs (ULs). Other possible uses for ULs in the Baltic Sea region involve farming special crops in conditions which are thermally stable all year round. The six ULs of the BSUIN project will create a joint innovation platform in order to boost economic development; they will offer underground infrastructure, facilities and related expertise that SMEs can use in their innovation work in Finland, Germany, Poland, Russia and Sweden around the Baltic Sea.

Introduction

Traditional industrial business practices and a linear 'take-make-dispose- approach to production requires modernisation: a transition to circular systems which consider reusing, remanufacturing and recycling [1]. The Baltic Sea region is an area with a long history in mining, which has brought about several abandoned mines with world-class underground infrastructures (deep mines and specially constructed tunnels) in the region, as it has become unprofitable to dig and sell the ores they contain, due to diminishing quantity and/or market prices. The Baltic Sea Innovation Network is responding to circular economy related opportunities by exploring potential new uses for abandoned mines and related underground spaces and laboratories. There is, consequently, potential for transnational growth: the aim of the Baltic Sea Innovation network project (BSUIN) is to make underground laboratories in the Baltic Sea region more accessible for innovation, business development and science by improving the availability of the information about the underground laboratories, their operation, user experiences and safety. In addition, the final objective is to create a joint service offering for the Baltic Sea Region's (BSR) underground laboratories (ULs) and thus develop their capability for technology transfer by effectively utilizing the facilities and research infrastructures of the ULs for business development.

The Baltic Sea Region Innovation Network of underground laboratories consists of the following ULs (figure 1):

1. Callio Lab, Pyhäsalmi Mine, Finland
2. Ruskeala Undergroud Lab, Russia
3. Khlopin Radium Institute: Underground Low Background Laboratory, St. Petersburg, Russia
4. Conceptual Lab: development by KGHM Cuprum R&D Centre, Wroclaw, Poland
5. Reiche Zeche, TU Freiberg Research and Education Mine, Germany
6. Äspö Hard Rock Laboratory, Oskarshamn, Sweden

FIGURE 1. The location of the Baltic Sea Innovation Network Unground Labs around the Baltic Sea [1]

The objective of the present paper is to describe the opportunities, challenges as well as the process of developing new services for underground spaces and their labs (ULs). In order to acquire more understanding of the current service design process, a qualitative approach is adopted. The relevant research questions are the following:

1. What kind of business models the six underground spaces and labs (ULs) currently have?
2. What are the opportunities and challenges in developing new innovation services and related business models for a network of diverse ULs in the Baltic Sea Region?

Service design was chosen as an approach for developing services for the ULs, as the BSUIN Steering Group is convinced that its visual tools and customer orientation will benefit industrial B2B (business to business) service development, although service design has traditionally been used mainly in B2C business development (business to customer).

Service Development: Definitions

Services in general and industrial services in particular are processes or journeys that are experienced differently by different people [2]. The term service concept was originally used by to describe bundles of services and related goods that are provided to customers [3]. The term service package has also been used [4]. Currently, service concept is defined as a shared understanding of the nature of the service, including its delivery and consumption [5]. It includes a detailed description of the customer needs to be satisfied: what is to be done for the customer, how this is to be achieved and how the needs are to be satisfied:

1. Service operation: the way in which the service is delivered.
2. Service experience: the customer's direct experience of the service.
3. Service outcome: the benefits and results of the service for the customer.
4. Value of the service: the benefits the customer perceives as inherent in the service weighed against the cost of the service. [5]

Knowledge-intensive services are services that involve a high degree of contact intensity and complexity [6]. Such services include, for example, business consulting and legal services, design services and medical services: they are professional in nature, relating to the accumulation, creation or dissemination of knowledge that satisfies clients' needs [7]. In the context of new service development, knowledge codification is particularly important as it helps organizational learning [8]. In developing knowledge-intensive services, it is thus important to use formal processes to coordinate development activities, including a wide range of formal methods such as business model canvas, service blueprinting, and customer focus groups.

Service Design as a Reseach Approach

Service design can be considered as a mindset, a process, a toolset, a cross-disciplinary language and a management approach [9]. It has also been defined as the activity of planning and organizing people, infrastructure, communication and material components of a service in order to improve its quality and the interaction between service provider and customers [10]. Service design has established itself as a practice that enables industries to design and deliver their services with a human-centered approach. Through its tools, service designers obtain contextual and cultural understanding which creates a backdrop for new service solutions, with improved user experience and customer satisfaction.

The main principles of service design include the following:

- **Human-centred**: the experience of all the people affected by the service is considered.
- **Collaborative**: all relevant stakeholders should be included in the service design process.
- **Iterative** means that service design is an exploratory, adaptive and experimental approach, iterating toward implementation.
- **Sequencing**: the service should be visualised and orchestrated as a sequence of interrelated actions.
- **Real**: needs should be researched in reality, ideas prototyped in realilty and intangible values should be evidenced in terms of physical artefacts or digital reality.
- **Holistic** in nature: the entire environment of a service should be considered. [10]

These main principles need to be considered throughout the service design process: exploration, creation, reflection and implementation stages. According to surveys with customers, many customers consider that the majority of the services available on the market do not match customer needs. [11] The methods and tools used in service design enable acquiring in-depth customer understanding, which will help overcome this dilemma. Service developers are hence able to grasp with improved insight what services customers need, how they can get access to them and what their experience is of these services, and even what that experience would be like in future. Customer interviews in the exploration stage serve as a basis for ideating. Also, end user perspective is integrated into the design throughout the process. Customer data, information about who the customers are, is obtained from records of who has or is currently using a service, or by using the knowledge of staff or partners who are dealing with customers in delivering the service. Scholars emphasize the importance of embedding the service design process into existing industrial structures and processes: service designers will need to find spaces where design thinking can be used. [12]

Co-creation in Practice

Co-creation is an umbrella term that covers value co-creation, co-production, co-design, and co-innovation [13]. In the service business, this value creation can be seen through three 'different lenses' (see figure 2):

1. A value co-creation view is embedded in strategic thinking and business models.
2. A co-production view is embedded in customer relationships and interactions.
3. A co-design view is embedded in service design. [13]

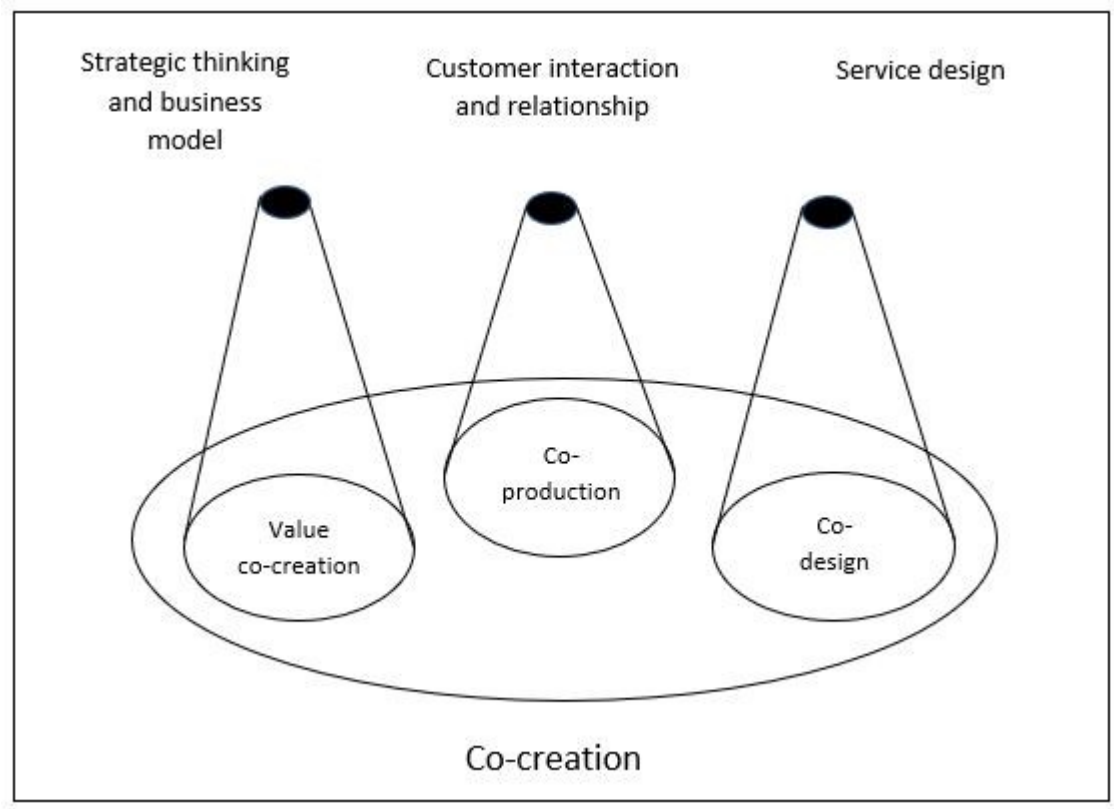

FIGURE 2. The framework for co-creation used in the CoCo Design Game [2]

Firstly, a service company needs to understand its value creation processes, as well as that of its customers and even customers' customers. This involves considering value co-creation in strategic thinking and business models. [13] Secondly, customers must be seen as active players in service provision. Acting in roles such as as resource and as co-producer through different channels and platforms characterized by physical elements, processes and people. This means co-producing the service via customer relationships and interactions. [13]

Customers are, additionally, involved as informants and as co-designers. By spending time with customers and integrating them into the company's processes, profound customer insights may emerge. This inolves co-designing and co-innovating in service design processes. [13] Furthermore, service design emphasises the importance of the lucrativeness of the services being developed for the service provider. According to BSUIN project experts of mining and underground spaces, service design as a practical ‘doing’ approach [14] and its tools [15] [16] have not been applied previously in a similar industrial contexts.

Methodology

The research and development work of the study involves applying case study as a qualitative research approach. Case studies typically combine data collection methods from a variety of sources: archives, interviews, desk research, documents, observation, workshops and their results. [17] A case study is an empirical study which is always a story, although a factual one with a beginning, a middle and an end [18]. The six UL cases start with desk research, observation and interviews; leading to exploration workshops in order to gain understanding of customers' needs in relation to service providers' activities and resources. Data from the workshops and the whole service design process has also been analysed qualitatively for research purposes.

The task of the Oulu University of Applied Sciences (Oamk) team in the BSUIN project is to coordinate the service development and to facilitate the service development workshops. In the exploration phase workshops, the current business models of the six participating ULs were created and analysed, resulting in in-depth understanding of different industrial contexts of the ULs in the network. Additionally, a shared understanding of the existing business models was reached in all project partner organisations. In this process, it was the ULs' responsibility to invite representatives of each UL and relevant other stakeholders (e.g. customers) to take part in workshops, and also to provide relevant information for context mapping (via observation and interviews) prior to the workshops.

Data was gathered in exploration workshops according to the timeline indicated in table 1.

TABLE 1. Data collection process during the exploration stage of the service design process

ULs	Context, available services [19]	Timing, tools, no of participants
Callio Lab Pyhäsalmi Mine Finland	Deep laboratory facility at depth of 1.44 km. Especially suited for particle physics experiments. E.g. micro-seismic monitoring network installed in the mine.	21.2.2018: 6 participants CoCo toolkit, interviews, discussions, and Strategizer platform was used for co-creation.
Ruskeala Mining Park Russia	Tunnels located in an old marble quarry at max 36 m depth. Knowledge in geology, geophysics, rock engineering. E.g. photogrammetry available.	7.3.2018: 2 participants CoCo toolkit, interviews, discussions, and Strategizer platform was used for co-creation.
Khlopin Radium Institute Underground Low Background Laboratory St. Petersburg Russia	Located in St. Petersburg Metro Gamma-spectrometer complexes with protection against external background.	17.5.2018: 7 participants CoCo toolkit, interviews, discussions, and Strategizer platform was used for co-creation.
Conceptual Lab development by KGHM Cuprum R&D Centre Wroclaw Poland	Excavations of 650–1300 m depth accessible for trial panels. Knowledge e.g. in swelling clays, ground water chemistry, geochemistry.	2.5.2018: 1 participant CoCo toolkit, interviews, discussions and Strategizer platform was used for co-creation.
Reiche Zeche TU Freiberg Research and Education Mine Germany	Part of Erzgebirge mountain range: 19 km accessible to a level of 230 m. Knowledge in mining and raw materials. Underground lab spaces for long-term projects.	6.3.2018: 5 participants CoCo toolkit, interviews, discussions and Strategizer platform was used for co-creation.
Äspö Hard Rock Laboratory Oskarshamn Sweden	Spiral tunnel to 460 m depth. Knowledge in clays, hydrogeology, geochemistry, rock mechanics. Drilling, measuring, prototype construction.	13.4.2018: 2 participants CoCo toolkit, interviews, discussions and Strategizer platform was used for co-creation.

The workshops included customer representatives who gave their views on the ULs' current way of functioning, including challenges. A business model describes the logic of how a company intends to maintain its business lucrative, as well as the rationale of how a company or an organisation creates, delivers and captures value. [14] The Business Model Canvas (BMC) consists of nine building blocks: customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships and cost structure. One of its key benefits is bringing clarity to the core aims of an organisation while identifying its strengths, weaknesses and priorities. [14]

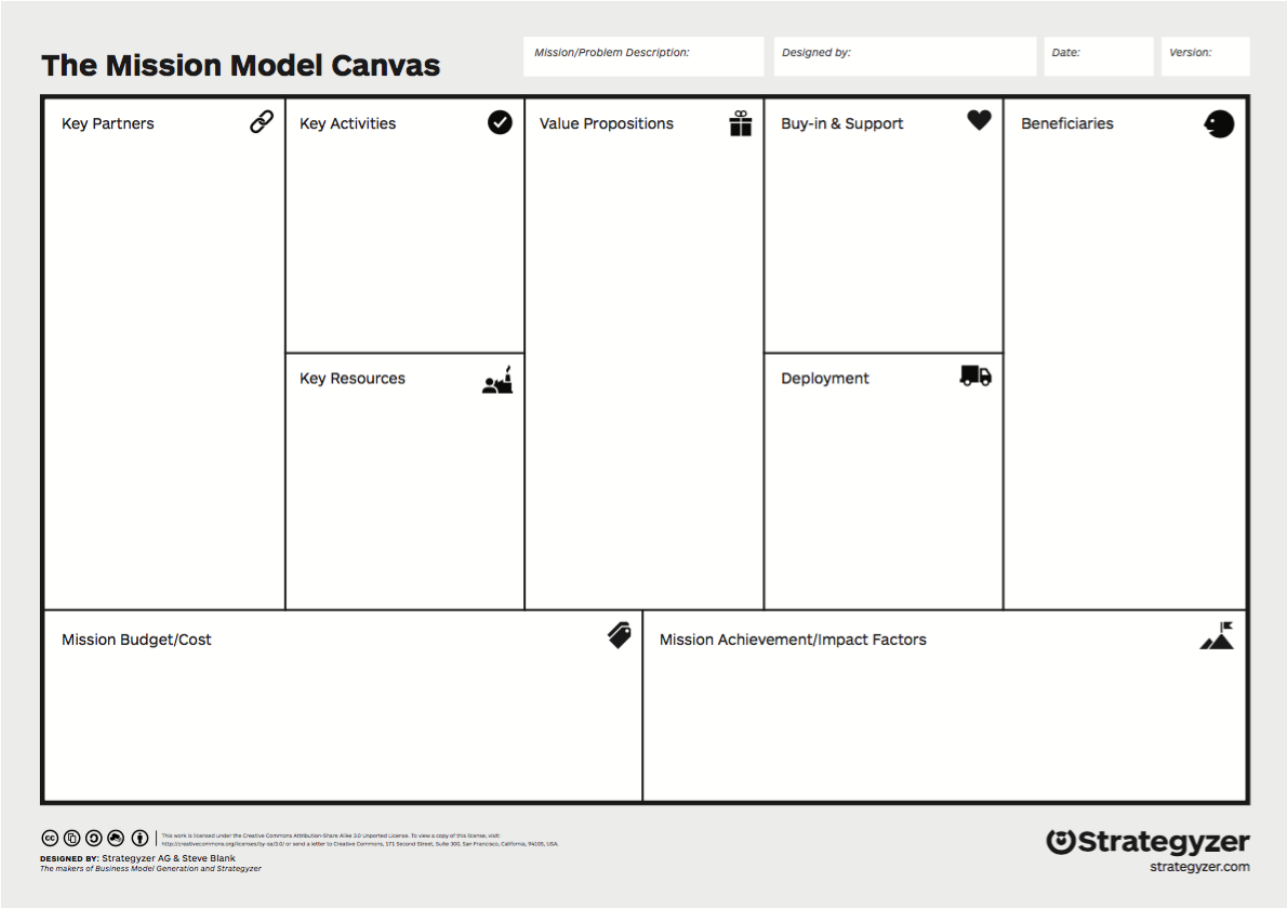

FIGURE 3. The Business Model Canvas (BMC) by Strategyzer [3]

The BMC has been a common business development tool as of the first decade of the 21st century. Yet, it was a new tool to several of the project partners operating in underground and mining contexts, similarly to design thinking and service design as tools and approaches in service business development.

Results

In the exploration stage of the service design process, the current business models via the Busines Model Canvas tool (BMC) of the Underground Labs (ULs) in the Baltic Sea region were described and analysed and their critical aspects were identified. (Photo 1.)

PHOTO 1. Example of the current BMC of a BSUIN UL (Photo: Aro Päivi)

Based on our content analysis of the ULs' present ways of functioning – on the basis of their BMCs, we concluded that the ULs are in different stages of service business development due to the the different nature of their contexts. Some, e.g. Pyhäsalmi mine in Pyhäjärvi, Finland are still functioning as active mines and have only had the possibility to pilot various re-use alternatives for the UL Callio in the future, while e.g. Reche Zeche in Freiberg, Germany already functions as an educational and research mine, as its mining activity ended as early as in the 1960s. Äspö Hard Rock Laboratory in Sweden has functioned as a testing space for nuclear waste management and will now start opening up more for geo-measurement testing services, while R&D Centre at KGHM Cuprum in Poland is in the stage of conceptual lab development. The Russian ULs are yet another type of case: e.g. the Ruskeala Mining Park used to provide marble until the 1950s from its Marble Quarries to famous Russian buildings, such as St. Isaac's Church in St. Petersburg, but during the past ten years it has developed its services for touristic purposes only.

Based on our analyses of the business model data, we propose the following results: in order to provide lucrative service business, the ULs need more paying customers and more proactive marketing communication. Their most important customer segments at the moment are universities and research institutes, but the revenue streams are not substantial enough for the future. The financial resources are generally scarce in many of the ULs, and yet their fixed costs are significant. However, their strengths lie with their human and intellectual resources: the staff know the ULs' partners well and strong personal relationships with partners are important: they materialise in conferences and joint research publications.

For the purpose of the next stage in the service design process (creation stage), developing new innovation services and related new business models for the ULs, it is important that the ULs share best practices. On the basis of our analysis of the exploration stage, we can claim the following: the ULs have important long-term data sets and related documentation that can be exploited as a basis for developing new services. The ULs are inherently international and have long-term relationships with certain customer segments (such as universities and research institutes); and are generally open to diverse stakeholders, including the general public. Several of the ULs have long acknowledged tourism as potentially lucrative service business for them, as well as educational export related to the special know-how of the UL staff regarding e.g. underground infrastructure. Some of the ULs have already well-planned strategies for the reuse of their underground facilities in the future and have conducted active marketing of the UL's resources, while others see their role as an intermediator for underground services.

Challenges could also be detected for the ULs regarding their future service creation and offering: firstly, work is still needed in order to produce a coherent vision and strategy for the future of the ULs, as this will facilitate finding new business opportunities and attracting new paying customer segments – bearing in mind that the

ULs' cost structure is heavy. Secondly, the organisational structure of the ULs is quite complicated, as well as the modus operandi in general (e.g. safety related) and this requires strong communication and organisational efforts by the ULs, if they are to attract more paying customers. The ULs should consider strengthening their commercial customer relationships, as well as viewing customer understanding more widely in order to understand not only their customers, but as well the needs of their customers' customers. Adopting basic marketing procedures, such as collecting customer feedback more systematically will help improve the ULs' operations.

Conclusions and discussion

From a service business facilitation point of view, we can conclude that the fact that the ULs all operate in quite different contexts and with different oragnisational structures rendered the facilitation process interesting, educational and at times challenging. The ULs operate in different parts of Europe, and the societies in which they operate also differ – due to historical reasons - quite signifantly in their economic structures and this has a bearing on how the ULs' staff view service business development and how much emphasis they are willing to place in such development in their respective UL. The next stage of the service design process involves creating new service concepts for the ULs, so that finally, a joint service offering for the BSUIN network can be co-designed collaboratively by the project partners. This will be completed in the autumn of 2019. Further research will be conducted through applying the case study approach in order to gain more theoretical and practical understanding of using service design in industrial contexts.

Callio Lab Elevator Pitch (video created by Pakkahuone)

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Picture References

1. ^FIGURE 1. The location of the Baltic Sea Innovation Network Unground Labs around the Baltic. In Baltic Sea Underground Innovation Network. Revised. Referred 3.9.2019. http://bsuin.eu/underground-labs/
2. ^FIGURE 2. The framework for co-creation used in the CoCo Design Game. In Keränen, K., Dusch, B. & Ojasalo, K. 2013. CoCo Tool Kit Version 1.0. A co-creation workbook and a collection of tools for service businesses. Laurea University of Applied Sciences, Espoo.
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Metatiedot

Nimeke: Creating New Innovation Services for Underground Labs in the Baltic Sea Region via Service Design: Part 1: Exploration

Tekijä: Aro Päivi; Ahola Helena; Vuorela Taina

Aihe, asiasanat: liiketoimintamallit, palvelumuotoilu, business models, service design, service development, value proposition

Tiivistelmä: The Baltic Sea Innovation Network is developing the Baltic Sea region by finding new uses for underground spaces. This involves creating an innovation platform based on the facilities and research equipment in the Underground Labs (ULs) of relevant universities and research institutes in the region. Service design was used in the process of developing a joint service offering, as its visual tools and customer orientation are believed to benefit such industrial service development. Besides customer orientation, service design emphasises the importance of the lucrativeness of the services being developed. This is of interest to the owners of the ULs, as maintaining such spaces requires both expertise and funding. The present paper focuses on the exploration phase, during which the currents business models of the ULs were described and analysed in order to identify their critical aspects, which require special attention in the creation phase of the new services.

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