Living Labs Case Studies

Estonian Maritime Museum Living Lab

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1. An introduction to your organisation

The Estonian Maritime Museum, located in Tallinn, Estonia, is a prominent cultural institution dedicated to preserving and showcasing Estonia's maritime heritage. Two esteemed permanent exhibitions of the museum are located in the historic Fat Margaret tower and the Seaplane Harbour. The museum is renowned for its extensive collection of maritime artifacts.

As a leading maritime museum in the Baltic Sea region, the Estonian Maritime Museum operates as both a historical repository and an interactive educational space. The institution plays a crucial role in educating the public about maritime history, maritime archaeology, and the evolution of naval technology.

The museum's team comprises approximately 90 dedicated staff members, including historians, curators, educators, and administrative personnel. This diverse group works collaboratively to manage the museum's exhibitions, educational programs, and research activities.

In the context of its Living Lab initiatives, the Estonian Maritime Museum leverages its rich collection and expert staff to drive innovation in museum education and digital technology. The museum's Living Lab aims to explore and implement cutting-edge solutions in museum practices, particularly focusing on enhancing visitor experiences and educational impact through digital tools and collaborative projects with the Estonian digital innovators community.

Before joining the RECHARGE project, the Estonian Maritime Museum (EMM) had some experience with participatory practices, although it had not been a central or structured part of their activities. Participation mainly occurred through involving visitors in museum programs, exhibitions, and educational activities, where feedback was gathered informally and incorporated into future planning.

Also, the museum had experience engaging the community during exhibition development by inviting external experts and stakeholders (such as historians and marine professionals) to contribute their knowledge to content creation.

However, the RECHARGE Living Lab approach represented a significant step forward for EMM by introducing a more structured, intentional, and strategic framework for co-creation and participatory innovation.

1.2 Context and Need for the Living Lab project

One of the Estonian Maritime Museum's objectives over the years has been to incorporate the latest technology into its exhibitions and educational activities, keeping pace with technological advancements. As of today, the museum's permanent exhibitions and temporary displays are among the most advanced in Estonia in terms of digital solutions.

Also an important strategic goal of the Estonian Maritime Museum is to inspire new generations of maritime enthusiasts. The museum's ambition is to reach every educational institution in Estonia, offering exciting activities for children, young people, their instructors, and maritime enthusiasts at large, and to be a leader in museum education in Estonia. Thus, we saw that an interesting challenge for us would be to find digital solutions to reach students.

Aiming to stay at the forefront of technological innovation and museum education, the Estonian Maritime Museum identified key areas for improvement that it seeks to address and enhance through the Living Lab process.

Traditionally, cultural heritage institutions have not been seen as viable partners by the digital innovators´ community for developing new services and solutions. However, these institutions possess valuable expertise, particularly in engaging with end-users, understanding their desires and needs, and conducting tests with them. Many cultural heritage institutions are also excellent storytellers and have extensive networks. Among teachers, for example.

Given that Estonia is one of the world's leaders in technology (with the tech sector projected to contribute approximately 30% of Estonian GDP by 2030), partnering with the start-up community, especially the digital innovators community, presents an opportunity for us to provide input and serve as a testbed for new products and services. This collaboration aims to develop a suitable business model that leverages technical competence within the cultural sector.

Supporting formal education is a significant part of the museum's mission. Traditionally, schools have visited the museum as part of educational programs. However, both Covid-19 and the rapid increase in technology use in daily life have highlighted the need for modern solutions that enable museums to reach classrooms remotely.

Therefore, the Estonian Maritime Museum is focusing on innovating the partnership between the cultural heritage sector, the digital innovators´ community and teachers network to develop digital education solutions.

- Please link the final version of your Canvas **HERE**.

1.3 Any other relevant background information.

In 2020, the Estonian Maritime Museum partnered with Ericsson to develop and test a location-bound platform that uses 5G, Edge and Augmented Reality to share historical events.

The ultimate goal for the Estonian Maritime Museum with further development of the business model, is to become a well-known innovator in the (museum)education sector, as well as a distinguished partner for digital innovators (i.e., (ed)tech companies).

2. Why become a RECHARGE Living Lab?

- Describe why you wanted to adopt a participatory practice to solve your challenge.

One of the Estonian Maritime Museum's long-standing objectives has been to incorporate the latest technology into its exhibitions and educational activities, in order to keep pace with technological advancements. As part of this effort, we identified a compelling challenge: to find effective digital solutions for reaching students, particularly in ways that complement traditional educational methods. Partnering with the start-up community - especially with digital innovators - presents an opportunity for the museum to provide valuable input and serve as a testbed for new products and services. Through this collaboration, we aimed to develop a sustainable business model that effectively leverages technological expertise within the cultural sector.

The Estonian Maritime Museum worked on **the Revenue Sharing Innovation Model**. In this model, CHIs develop cross-sector partnerships by actively involving diverse stakeholders from both the public and private sectors in the process of co-ideating, co-creating, testing, and implementing new products and services for CHIs. The most obvious area of interest in this regard involves digital solutions.

- List the objectives you identified for your Living Lab and describe how you have achieved them, using this table:

Objective	How have you achieved the objective
Challenge the perception of Cultural Heritage Institutions	We explored and demonstrated the potential of cultural heritage institutions as strong and capable partners for the digital innovators' community.

Address the need for tailor-made solutions	We developed and tested custom solutions in collaboration with the digital innovators' community to meet the specific needs of CHIs, ensuring that these solutions are adaptable and regularly updated.
Promote collaboration between CHIs and the digital innovators´ community	We involved CHIs in the development process by using their valuable expertise in interacting with end-users and conducting tests, while also engaging tech startups and the digital innovators' community to co-create innovative products and services.
Enhance educational outreach	We developed and refined digital educational tools and solutions, such as an augmented reality (AR) experience for students, which allows remote engagement and interaction with museum content, thereby overcoming the limitations of traditional one-dimensional virtual lessons.

3. Data collection

- Please add any outstanding data to your KPI documents (Tailored KPIs and Shared KPIs)

KPI identification at EMM was completed through internal consultations and discussions with key team members involved in the Living Lab. The EMM core team (3 people) developed the tailored KPIs based on the specific aims of their pilot project, focused on digital educational solutions and collaboration with the tech community.

Data was collected through various methods:

- **Participation data** was gathered by counting the number of educators and classes involved in the pilot testing phase.

- **Economic KPIs** were measured by monitoring new collaboration talks with partner companies, particularly regarding potential co-ownership or revenue opportunities for EMM.

- **Environmental KPIs** were assessed by calculating the reduction in CO_2 emissions through the use of digital solutions instead of physical visits, based on the estimated avoided bus trips for school classes.

- **Organisational KPIs** were confirmed by checking whether educational collaborations remained highlighted within the museum's updated strategic documents.

Due to the nature of the Living Lab project, qualitative feedback from teachers and students was important. Feedback from participating teachers and schools was gathered through direct discussions and informal reflections after the AR lessons. No formal large-scale surveys were used to ensure participation remained easy and accessible.

In summary:

- Social KPI: *Partially met.* 16 teachers were involved, and 4 classes participated instead of the initially targeted 20 educators and 30 classes. This deviation was mainly due to the shift from a BYOD (Bring Your Own Device) model to using museum-provided devices.

- Economic KPI: *Met.* One new collaboration opportunity with a technology partner is under discussion.

- Environmental KPI: *Partially progressing.* Estimated CO_2 reduction is currently ~100kg (equivalent to 4 avoided bus trips).

- Organisational KPI: *Met.* Education-focused collaborations are mentioned in the museum's strategic documents.

4. Your Living Lab activity

co-creation or co-ideation workshops, prototyping and testing workshops or sessions:

Co-ideation workshop with digital innovators and GLAM representatives

Date: 11 May 2023

Where: Seaplane Harbour, Tallinn, Estonia

With whom:

GLAM Estonian: Health Museum, Children's Literature Centre, National Library, Film Archive and Tartu Elektriteater
Digital innovators: Valge Kuup, BlueRay, VIVITA, Vihmakass ja Kakerdaja, TMD, MOTOR, MobiLab

<u>Agenda:</u>
10-11 introduction & presentation of RECHARGE, goal of the LL, examples of similar projects (CHI+tech company developing a solution)
11-13 workshop
13-13:30 lunch onsite
13:30 guided tour

The first co-creation workshop held at the Living Lab of the Estonian Maritime Museum took place on Thursday 11 May at the historic Tallinn Seaplane Harbour. It saw the participation of 20 people: museum professionals, librarians and representatives of tech companies we want to involve in the project.

The event was moderated by Ragnar Siil from Creativity Lab. First, Ragnar introduced the RECHARGE project and went into details explaining the concept of our core operating system, the Living Labs. He set the stage for co-creation by discussing the currently prevailing - and rather limiting - procurement model, suggesting some potential alternative ways of conceiving collaboration between GLAM and tech.

Then, the participants gathered into 3 mixed groups for discussion. The first round of discussions sought to ignite thinking on novel ways of collaborating. Each of the tables tackled the following topics:
   ❖ Current models of collaboration – what works & what doesn't
   ❖ Co-creation models – possibilities and risks
   ❖ What could be the contribution of museums in the development process
   ❖ Business models to support co-created solutions: sharing the profits as well as the risks

Among the obstacles to co-creation present in the sector, the following aspects were mentioned:
   ❖ Lack of awareness of co-creation possibilities (i.e. of alternatives to the habitual way of doing things)
   ❖ Competing notions between museums (the belief that museums are somehow in competition with each other)
   ❖ The lack of a structure, funds and a standard practice for any 'pre-contract' partnership
   ❖ Limited knowledge of the partner's field of activity and state of the art

Among the shortcomings of the prevailing procurement/contracting model, participants discussed the short-lived nature of the partnerships, and challenges to sustainably updating a project/service once procured.

The second round of discussions continued in the same groups/tables and set out to brainstorm for possible co-creative pilot project ideas. The guiding questions were:

- ❖ What problem are we solving?
- ❖ Who are the partners involved?
- ❖ What might the development process look like?
- ❖ What would be the desired end result?

Amongst the 3 tables, a total of 5 ideas for pilot projects were discussed, a mix of fresh new ideas and previous ideas that participants had once had but could not fulfil, mainly due to a lack of a collaborative framework. RECHARGE could be the framework in which these ideas come back to life again. The museum will develop 1 or 2 of the project ideas and further work on the creative and business model aspects in the next Living Lab sessions, which will be held on the first half of June. The event concluded with a special tour of EMM's current exhibition "Venice, Queen of the Sea" for the Living Lab participants.

Co-creation workshop with young adults, digital innovators, GLAM representatives

Date: 15 June 2023

Where: In the studios of the VIVITA Creativity Accelerator for youth

With whom:
DI: MobiLab, Vihmakass ja Kakerdaja, BlueRay
GLAM: VIVITA, Health Museum
Young adults aged 11 to 22. 4 boys, 3 girls

Agenda:
9 - 11:00 workshop with company Vihmakass ja Kakerdaja
11.30 - 13:30 workshop with company Blue Ray
14:00 - 16:00 workshop with Reality Maker

On June 15, EMM held their second LL workshop, this time in the studios of the VIVITA Creativity Accelerator for youth. The workshop was carried out in cooperation with VIVITA. Children and young adults between the ages 11-23 … were invited along as co-creators (and eventual end users) of the designed pilot product. Also this is the age group that is considered as most likely not to come to museums, as teachers no longer make school visits and they are not parents themselves. Other workshop participants included GLAM sector representatives and three digital innovators, companies that engage in extended reality solutions.

The aim of the second LL workshop was to brainstorm for creative solutions that open up and breathe new life into the Maritime Museum's exhibits. The full-day workshop unfolded in three consecutive sessions, each inspired by one tech company and their creative background, the introduction was followed by a presentation by EMM trying to give some ingredients about the exhibits to guide the brainstorming in the right direction.

The first session focused on a 'large', but not well presented exhibit – the 16th century shipwreck displayed at the Seaplane Harbour. Participants engaged in exercise 'Crazy Eight' (8 ideas in 8 minutes) to come up with solutions for how to present the wreck in interesting and educational ways.

The same process was repeated with two other digital innovators taking the lead – the second session focused on bringing a 'large space' or museum building to life (the Seaplane Harbour hangar), and the third – on a 'smaller exhibit,' an historic naval mine.

The second session was led by BlueRay, who presented their VR History Solution. EMM showed the promotion video of Seaplane Harbour.

The third workshop was led by MobiLab, during the whole day participants played with two tablets that had Reality Maker installed. The participants brainstormed on different objects in Seaplane Harbour permanent exhibition. To get the ideas going EMM showed an animation about how a naval mine actually works, how mines are installed to the sea and what happens if a ship hits a naval mine.

Co-creation workshop "Museums Empowering Learning with AR" with Teachers, museum educators

Date: 17-18 August 2023

Where: Laulasmaa Seaside Resort, Harjumaa, Estonia

With whom:
DI: MobiLab
Museums/project: EMM; Estonian Art Museum; CLAB; Estonian Health museum (also teacher in Saku)
Educators: Tallinna Pae Gümnaasium (www.pae.tln.edu.ee)
Gustav Adolf Grammar School (gag.ee)
Pärnu Tammsaare Kool (www.tammsaarekool.parnu.ee)
Tallinna 32. Keskkool (www.32kk.edu.ee)
Estonian Business School(ebs.ee/gumnaasium)
PROTO Invention Factory (prototehas.ee)
Tallinna Muusika- ja Balletikool (muba.edu.ee)
Saku Gümnaasium (saku.edu.ee)
Audentes Private School (audentes.ee)

Agenda:

17 august 2023

12:00 Lunch
13:00 Start of workshop session (introduction, get to know, the LL process and workshops so far)
13:30 Demo of Reality Maker
14:00 Feedback and discussion
15:00 Break
15:30 Co-creation workshop in groups, ideas to put in practice in AR
Presentations
Discussion
Conclusions
17:30 end of day 1
18:00 dinner

18 August 2023

9:00 Breakfast
10:00 Agreeing next steps in an informal setting
12:00 end of workshop

The purpose of this workshop is to collaboratively come up with digital education solutions to be used both in museum and classroom settings. The co-creation process ideally results in a pilot project that is put to practice using the Reality Maker AR platform.

EMM's third Living Lab workshop took place in Laulasmaa, a peaceful seaside resort near Tallinn.
·   The workshop was called "Empowering Learning with AR", and it focussed on hearing from and involving teachers. EMM set out to chart the needs of teachers and collectively generate ideas for an AR (augmented reality) solution that could bring museum content into the classroom in captivating and educationally effective ways. The goal of the EMM Living Lab pilot is for museums and tech companies to co-create educational digital content that would enhance museum education and that teachers could use in class.
·   The main idea developed in the workshop was using an AR solution to add virtual layers of visual information into any physical space (e.g. classroom). Available on most devices, the solution constitutes a highly usable and practical path to transmitting educational content, and makes for an exciting user experience, where pupils can actively create and contribute, as opposed to passively receiving content.
·   Group sessions saw teachers brainstorm around which content could best match teaching programs, museum offerings, and a participatory AR presentation, rendering historical information more "alive", relevant and emotion-inducing to pupils. The participants discussed and sought for the best "overlap" – in theme and form – between museums, school curricula and pupils' interests.

· The thematic content available at the Maritime Museum provides for ample opportunity to engage in playful learning, e.g. via role play or reenactments of historical events.

· Teachers made for enthusiastic participants and generated a wealth of ideas. The group included: teachers of history, social studies, natural sciences, plus education and communication specialists from other GLAM institutions, representatives of the Reality Maker AR platform and Creativity Lab, and, of course, the Maritime Museum's RECHARGE team as well as the curator of the museum's education programs, two visitor experience specialists and guides.

· Teachers noted that:

❖ Museum classes as they exist in the museum's offering are universal and broad, but teachers would like to employ more specific content

❖ The new school curricula valorize skills and capacities

❖ The highest satisfaction rating is enjoyed by museum classes that are essentially needs-based

❖ Some schools integrate museums into their study plans by covering the cost of pupils' visits to museums

❖ Museum education has grown and developed exponentially since 1993, but one must note that schools have remained essentially the same

❖ Using own devices might strengthen pupils' active participation in museum-related school classes

· Teachers' expectations for museum education were revealed as follows:

❖ Aligning teachers' needs with the museum's offer, and ensuring that what is delivered is of high quality

❖ The time it takes to get to the museum with the pupils makes a physical class visit difficult – a (digital) workaround would be welcome

❖ One option might be that pupils visit museums independently and teachers have a method for checking their learning outcomes after the fact

❖ Museum classes could be complemented with "before" and "after" work sheets

❖ New information must be acquired, and learning outcomes must be measurable

❖ A digital competency component would be welcome – it is vital, though, that teachers know how to support the learning experience

❖ The value of an AR tool in the museum education setting would be in bringing content closer to the new generations, tearing down walls from between the museum and the "real world", and offering a combined study experience involving classroom use and physical museum visits.

❖ Ideas for captivating content: bringing historical events to the classroom, maritime battles, marine archeology, searching games, simulation games, escape games, chronology challenges.

❖ The highest praise for a teacher – and thus the goal of our solution – is when a pupil remarks at the end of the class: "This was really interesting!".

❖ The next step in the project for the Maritime Museum is to complete a pilot by creating an AR solution that supports learning and thematically links to physical objects in the museum, thus also inviting pupils to continue their exploration in the physical museum space at a later time.

❖

Prototype phase

<u>In person meetings:</u> 06.09.2023; 19.09.2023; 26.09.2023; 09.10.2023; 13.10.2023

The first testing of the pilot AR solution involved key team members of the Estonian Maritime Museum team, an AR solution provider, and an experienced teacher/learning architect.

In the first meeting on September 6th, 2023, we discussed the potential content of the AR solution to be offered to schools. We settled on the Middle Ages and its trade. The Estonian Maritime Museum already has an existing educational program on this era, with a focus on one of the museum's key exhibits, the medieval cog. Therefore, it provides a solid foundation for further development in this area.

On September 19, 2023, we analysed the potential benefits of using AR in education. We also discussed initial thoughts on the substantive concept of the AR solution: what form the activities could take, what students should do, and what technical solutions should be created for the pilot. We concluded that the task could involve filling a ship with medieval goods and artifacts. Subsequently, students would create a story based on their work, justifying their choices. In our vision, the story could be recorded either with voice or by adding labels with text to the objects.

During our third meeting on September 26, 2023, we were joined by Priit Lätti, a researcher at the Maritime Museum with experience in underwater archaeology and teaching. His expertise was of great assistance. During the meeting, we conducted real-time searches on the web (using Sketchfab, Turbosquid and CGTrader) for 3D models of medieval and other historical objects that could be used in the classroom to solve the AR pilot task. Priit provided expert commentary on the objects and choices.

On October 9, 2023, we reviewed the recently created 3D objects and tested their functionality in the room using the device. Based on this, we drew conclusions about what changes should be made in the selection of objects and what should be further developed, among other things.

On October 13, 2023, we tested the augmented reality advancements with the device and the improvements made in the meantime. We formulated and refined the content of the classroom pilot project, including instructions and objectives. Additionally, we developed various learning scenarios.

As a result of these meetings, we have made great progress, and we are sure that our project will be a real breakthrough in education. The ultimate goal for the Estonian Maritime Museum with the Living Lab and the piloting and further

development of the business model, is to become a well-known innovator in the (museum)education sector, as well as a distinguished partner for digital innovators (i.e., tech companies).

Testing phase

20 Nov 2023
Testing the pilot with 8th-grade students of Tallinn Pae Gymnasium onsite
Total: 24 participants
EMM RECHARGE team members, teacher and students from Tallinn Pae Gymnasium

24 Nov 2023
Testing the pilot with 7th-grade students of Tallinn Pelgulinna Gymnasium onsite
Total: 23 participants
EMM RECHARGE team members, teacher and students from Tallinn Pelgulinna Gymnasium

17 Jan 2024
Testing the pilot with 7th-grade students of Tallinn Pae Gymnasium onsite
Total: 26 participants
EMM RECHARGE team members, teacher and students from Tallinn Pae Gymnasium

30 Jan 2024
Testing the pilot with 5th-grade students from Muraste elementary school onsite
Total: 22 participants
EMM RECHARGE team members, teacher and students from Muraste elementary school

How did you test your project?

The Estonian Maritime Museum conducted tests of its augmented reality (AR) pilot solution with the project's target audience—school students in several schools. The goal was to evaluate the effectiveness and engagement level of the AR educational tool in a real classroom environment.

Where:
The testing took place onsite in various schools.

Main Goals:

- To bridge the gap between the museum and education sectors.
- To enhance classroom learning through an inclusive educational solution.
- To gather user feedback for further refinement of the AR solution.

Activities:

- Interactive Lessons: Students engaged in tasks that involved filling a ship with medieval goods and artifacts using AR technology.
- Feedback Sessions: Collecting insights and feedback from students and teachers on their experience with the AR tool.

Tools:

- Technological Tools: AR devices, Unity for AR development, and educational software.
- Traditional Tools: Surveys and feedback forms for collecting user insights.

Outputs:

- User Feedback Reports: Detailed reports on user experiences, highlighting areas for improvement.
- Iterative Prototypes: Refined versions of the AR solution and worksheet based on the feedback received.
- Engagement Metrics: Data on student engagement and participation levels during the testing.

The initial tests were successful, with students quickly understanding how the solution works and participating enthusiastically. Even during the last class of the day, AR generated a lot of excitement, and students expressed that such activities could be incorporated into various subjects.

An immersion class, where students' native language was Russian but the instruction was in Estonian, also found the tool useful for practicing Estonian terms. However, challenges included a scarcity of devices and a need for clearer instructional material. There is also potential to explore more engaging ways to verify correct answers.

This structured approach ensures that the prototype is both engaging and educational, meeting the goals of the project and addressing the needs of its diverse stakeholders.

4.2. Iterative use of the canvas referring to the various phases

Co-ideation phase: EMM created the participatory business model canvas after the co-ideation meeting. This meeting provided valuable input and insights that helped shape our value proposition, identify key target audiences, address challenges, and more. In the subsequent phases of our project, we continued to validate and refine our canvas through co-creation, prototyping, and testing stages. This iterative process allowed us to ensure that our initial co-ideation workshop accurately identified and addressed key challenges and opportunities.

During our workshops, EMM did rapid prototyping: implemented rapid prototyping techniques to quickly develop initial versions of proposed solutions for immediate feedback. In the prototype phase, EMM employed tools like Sketchfab, Turbosquid, and CGTrader to source and create 3D models for AR applications and brought the experts on board (learning architect) to ensure the accuracy and relevance of the content being developed.

Testing Phase:

- ❖ AR devices: EMM deployed AR devices in classroom settings to test the practical application of the developed solutions.
- ❖ Educational software: EMM integrated educational software to enhance the learning experience and ensure compatibility with existing classroom technologies.
- ❖ Iterative testing: EMM conducted multiple rounds of testing with different student groups to gather comprehensive feedback and make necessary refinements.

- How did you identify your stakeholders? Do you think the living Lab methodology assisted you in developing meaningful relationships with stakeholders? Describe how you maintain these relationships.

The Estonian Maritime Museum identified its stakeholders primarily based on the goals of the Living Lab project: to develop innovative educational solutions and enhance collaboration with the digital innovators' community. Key stakeholder groups included teachers, schoolchildren, museum educators, and representatives from the startup and digital innovation communities.

Stakeholders were identified through existing networks, previous collaborations (particularly with educators), recommendations from partners, and direct outreach to communities working at the intersection of culture and technology.

The Living Lab methodology significantly assisted EMM in building meaningful relationships with stakeholders. By following a structured co-ideation and co-creation process, stakeholders were not only consulted but genuinely involved in shaping the project's direction. Workshops, discussions, and feedback sessions ensured that stakeholders' needs and ideas were heard and integrated.

To maintain these relationships, EMM emphasizes ongoing communication and collaboration. Discussions are ongoing about extending the cooperation beyond the RECHARGE project, including possibilities for future projects like Erasmus cooperation and broader innovation initiatives with schools and startup communities.

- **Describe any unforeseen challenges that have occurred in your living Lab activities. How did you solve these?**

Throughout the implementation of the EMM Living Lab, several problems and challenges were encountered across the different phases, each of which required specific solutions.

During the co-ideation phase, we faced the challenge of limited awareness among participants regarding the possibilities of co-creation and alternative collaboration models. This lack of awareness often led to hesitation and uncertainty about the process. Additionally, there was a perception among some participants that museums were in competition with each other, which hindered collaborative efforts. To address these issues, we organized detailed sessions aimed at explaining the co-creation models and showcasing successful examples from other projects. These sessions helped participants understand the benefits and potential of co-creation. Furthermore, we facilitated moderated discussions that helped overcome competition prejudice and emphasized the collective benefits of collaboration, fostering a more cooperative environment.

In the prototype phase, we faced technical limitations, particularly in sourcing and creating appropriate 3D models and integrating them into augmented reality (AR) solutions. Ensuring the accuracy and educational value of the content was another significant challenge, requiring substantial input from experts. We addressed these issues by engaging closely with museum researchers and experts who could provide the necessary insights and ensure the content was accurate and relevant. An iterative approach to prototype development was adopted, allowing for continuous refinement based on expert feedback. Additionally, we had to change our initial plan of using students' own mobile devices for the AR solution. The AR technology required high-end devices with advanced technical specifications, which many students did not have. As a result, we shifted our approach to providing classrooms with our own devices for student use. This ensured that all students had access to the necessary technology to fully engage with the AR solution.

The testing phase presented challenges such as the limited availability of AR devices, which made extensive testing difficult. Additionally, the initial instructional materials were not clear enough, complicating their adoption by teachers and students. To resolve these issues, we implemented staggered testing sessions to make the most of the available AR devices. This approach allowed us to conduct thorough testing despite the limited resources. We also developed clearer and more detailed instructional materials based on feedback from the initial testing sessions. These improved materials facilitated easier understanding and use by teachers and students, enhancing the overall testing process.

5. Output(s) and impact

- Describe your Living Labs' output(s) here. E.g. Services, products, visitor experiences, exhibitions etc. Please upload photographs and videos here naming them like this: "HUNT_Cocreation_17.06.23"

The main output of EMM's Living Lab was the development of a **prototype digital educational solution** that integrates augmented reality (AR) technology into museum learning experiences. This tool was designed in collaboration with teachers and students to enhance classroom education by bringing museum exhibits "to life"

remotely, providing an engaging alternative to traditional one-dimensional virtual lessons.

Additionally, the Living Lab process produced several secondary outputs:

- **Strengthened relationships with educators** through co-ideation and testing workshops.

- **New partnerships with digital innovators** and technology startups, exploring future collaboration possibilities.

- **Knowledge and models for user-centred development processes**, which EMM can use in future exhibition and education projects.

- **Internal organisational learning** about managing participatory processes and adapting educational activities for remote and hybrid learning environments.

- **Environmental benefit** through the potential reduction in the carbon footprint, by providing digital alternatives to school field trips.

This combination of a tangible product (the AR educational prototype) and intangible benefits (relationships, organisational learning, environmental impact) significantly enriched EMM's capacity to innovate and serve its audiences more effectively.

- Please write a brief description of the value that your Living Lab created for your organisation and community. Reflect on your initial objectives and approach towards impact areas relevant to you. Would you design your desired impact the same way today?

The Living Lab created significant value for the Estonian Maritime Museum by enabling stronger connections with the educational community and providing a tested prototype for innovative digital learning tools that can be adapted for future museum education projects. The co-creation process helped EMM to better understand the needs of teachers and students, leading to solutions that are more user-centred, accessible, and engaging.
For the broader community, particularly the education sector, the Living Lab introduced new digital resources that make museum content more accessible, especially for schools located farther from Tallinn, thereby reducing logistical and environmental burdens. This also expanded the museum's reach beyond its physical visitors.
Reflecting on the initial objectives—such as challenging the perception of CHIs, promoting collaboration with digital innovators, and enhancing educational outreach—the Living Lab helped EMM achieve progress in each area, though certain challenges, like the pace of technology development and resource constraints, were noted.
If we were to design the desired impact today, we would focus much more on **testing solutions in smaller steps and at multiple stages**. Frequent piloting would allow us to collect feedback earlier, make improvements continuously, and react more flexibly

to changes or challenges. Our second iteration experience — trying to expand collaboration, align projects with national needs, and adjust technical and educational aspects — showed us that a more gradual, modular approach could have helped mitigate risks, especially when facing unexpected barriers like funding cuts or partnership issues. More frequent, smaller-scale testing would strengthen stakeholder relationships, ensure the final solution matches real needs, and build greater resilience against external uncertainties.

Living Lab self-assessment and level of satisfaction on its achievements.

Objectives	Result description	Achievement level (scale of 1-5)	Sustainability level (1-5)	Internal Impact level (organization) (1-5)	External Impact level (community) (1-5)
Challenge the perception of Cultural Heritage Institutions	Shifted the digital innovators´ community's view to recognize CHIs as active and innovative partners in developing new services and solutions.	3	2	3	3
Address the need for tailor-made solutions	Developed and implemented customised technological solutions that meet the specific requirements and constraints of cultural heritage institutions.	2	1	3	4
Promote collaboration between CHIs and the digital innovators´ community	Established strong, ongoing partnerships between cultural heritage institutions and tech companies, leading to joint ventures and innovative projects.	3	3	3	3
Enhance educational outreach	Increased the effectiveness and reach of educational programs by integrating advanced technological tools and methods, thereby engaging a wider and more diverse audience.	3	3	3	3

Achievement Level: *Where 1 is Poor: The objective was not met. The outcomes fell significantly short of expectations, with minimal or no progress made.*

6. Iteration

The last test of the pilot took place on January 30th, 2024, and due to technical and staffing issues Estonian Maritime Museum entered the second iteration phase in August 2024, when the National Heritage Board opened the funding round called Museum Accelerator.

For EMM it was clear that the application would be more successful if more museums would join, and we contacted Estonian Health Museum who developed an idea for an AR solution for their autopsy museum class during the Living Lab. Unfortunately, they were already applying with another project and declined the offer. MobiLab, the technical partner for the pilot, then suggested that we contact Estonian Museum of Architecture as they had a 3D project in mind, but the project had no educational element, so we discontinued the idea.

We then analysed our own needs and as one of the biggest developments with the renewal of our permanent exhibition in Seaplane Harbour (reopened in May 2024) was adding the history of Estonian Navy as a theme area, we contacted The War Museum to see if they would be interested in joining the project for the application. With the War Museum we soon found that if combined, the two locations (Seaplane Harbour and War Museum) with their exhibits and when adding a layer of AR to revive the stories of people involved in these events, the outcome would be an exemplary museum class to support the national defence education.

The War Museum also hosted a roundtable with the teachers of the national defence course in the end of September 2024 and it was clear that they had high expectations for the museums to come up with curricula-supporting museum classes. Museums learned that focusing on the naval themes is essential, as the school curricula is more focused on the war events taking place on land.

In the application the revenue sharing innovation model was described and a pre-agreement with the potential technical partner was made to share the rights of

the intellectual property. The technical partner would be chosen through a public procurement after funding was confirmed (in 2025). In the cost/benefit analysis the largest income would come from resale of the AR component to other museums. The application had support letters from the Ministry of Defence and the Society of Estonian History and Social Education Teachers (members of that society also took part of the Living Lab). The budget included also the equipment (iPads) as we learned during the testing of the pilot that the latest tech is needed for support AR.

The application was submitted on November 15^{th,} and we got the decision on 30th of December, that the project was not funded and had to stop the second iteration. Museums in Estonia faced a budget cut of 4% until 2028 and the budget for 2025 is already tense. The unexpected budget cut from the ministry shows the importance of finding other sustainable possibilities for revenues.

7. Reflection and conclusions

Please describe the added value of participatory practices according to your Living Lab experience

The participatory practices in the Estonian Maritime Museum's Living Lab have significantly enriched the development process. The first co-creation workshop demonstrated the value of engaging diverse stakeholders, including museum professionals, tech companies, and the public, in exploring collaborative solutions. This approach revealed the potential for innovative partnerships and highlighted the importance of breaking down traditional competition barriers within the sector.

Involving students and teachers in subsequent workshops allowed for real-time feedback on augmented reality solutions, ensuring that the developments were practical and aligned with educational needs. This inclusive process facilitated a more effective and responsive design of digital tools, enhancing both their relevance and usability. The co-creation workshop with teachers offered a rare opportunity for teachers to express their expectations and needs for museum education offerings directly to museum representatives. It was eye opening for the EMM education team as well.

We learned that there is a demand for a specific, narrow context offering on contrary a wider array of themes museum classes combine. Also, it was noted that the quality of the museum offerings is uneven, depending on the concrete employee and it only takes one bad experience for the teacher and their peers to never visit that museum again.

The ideas teachers had, helped EMM to continue with the Pilot with the main takeouts being the time-consuming museum visit versus a digital workaround being

more that welcome; the possible digital solution allowing the pupils to make a museum visit independently, but at the same time enabling teachers to check the learning outcomes in a measurable way.

Furthermore, the iterative nature of the workshops and pilot testing phases enabled continuous refinement of the AR solutions, addressing challenges and leveraging collective expertise. These participatory practices have fostered a dynamic environment for innovation, positioning the Estonian Maritime Museum as a proactive leader in integrating digital solutions into museum education.

Please summarise your Key Findings

The key findings from the Estonian Maritime Museum's Living Lab process are as follows:

1. **Potential for co-creation**

   The Living Lab demonstrated that cultural heritage institutions can be effective co-creators of digital solutions, challenging the traditional view of them as mere clients. The workshops highlighted the value of leveraging CHIs' expertise in content and user engagement for innovative tech solutions.

2. **Value of participatory practices**

   The participatory approach proved beneficial, with workshops involving diverse stakeholders—such as museum professionals, tech companies, students, and teachers—leading to valuable insights and creative ideas for AR solutions. This collaborative environment facilitated the development of solutions better aligned with users' needs.

3. **Challenges in collaboration**

   Key obstacles included a lack of awareness about co-creation possibilities, competition among museums, and the absence of structured frameworks for collaboration. These challenges underscored the need for new models of partnership and resource sharing.

4. **Engagement with tech companies**

   The engagement with tech companies showed promise, with a positive openness to collaboration despite initial challenges. This engagement is crucial for developing innovative solutions and scaling them effectively.

5. **Legal and policy barriers**

   Legal restrictions for state-owned institutions, including limitations on commercial ventures and profit-sharing agreements, emerged as significant

barriers. Addressing these through consultation with legal experts and policymakers will be essential for sustainable development.

6. **Insights from workshops**

The workshops revealed that:

- ❖ Teachers and students are enthusiastic about integrating AR solutions into education, with a focus on enhancing museum content and classroom engagement.
- ❖ Future cycles should focus on refining collaboration models, addressing legal constraints, and scaling successful pilot projects to reach broader audiences.

7. **Small-step testing is crucial**

One of the main lessons learned is that solutions should be tested in smaller, more frequent stages to allow for earlier feedback, greater flexibility, and better alignment with stakeholder needs and technological specifics.

Inputs for future directions and new cycles (what will you do differently? What was the main lesson learned that you will not do again!?

One of the main lessons learned was that while EMM initially believed that a loosely structured, independent approach could work effectively, true innovation and scaling require systematic collaboration and network-building. There is significant untapped potential within existing networks in the CHI community for collaborative solutions. In the future, EMM will focus more strategically on leveraging partnerships from the beginning, ensuring all necessary stakeholders are involved early and that resources and expertise are pooled efficiently. Additionally, EMM recognized the need to address legal and structural challenges earlier in the process, especially regarding cooperation models and profit-sharing limitations for state institutions. Ensuring legal feasibility from the outset will be a priority for new cycles.

Describe how you see the Long-term sustainability of your project and possibilities for scaling Up

The long-term sustainability of the Estonian Maritime Museum's Living Lab project is supported by several key factors. First, the project benefits from a collaborative framework involving diverse stakeholders, including museum professionals, tech companies, educators, and students. This broad engagement ensures that the developed solutions are well-aligned with user needs and can adapt to future changes.

The iterative nature of the co-creation workshops and pilot testing phases has allowed for ongoing refinement of the AR solutions, ensuring they remain relevant and effective. The museum's commitment to integrating these solutions into both educational and museum settings provides a solid foundation for their continued use and development.

For scaling up, the project leverages the Estonian Maritime Museum's established networks and reputation within the cultural and tech communities. The success of the initial pilot and the demonstrated value of the AR solutions offer a compelling case for expanding the project to other institutions and regions. Potential scaling opportunities include partnering with additional museums, extending the AR solutions to other educational contexts, and exploring commercial avenues to support further innovation and development.

By addressing legal and logistical challenges, and maintaining a focus on collaborative and adaptive practices, the project is well-positioned to achieve long-term sustainability and broader impact.

What recommendations would you give another similar organisation for potential replication of the Living Lab methodology?

❖   Identify your organization's strengths: determine what makes your organization unique and valuable. This could be your extensive network, the data you collect, long-term experience, digitalized collections (such as 3D models), development expertise, or visitor service skills. Clearly articulating these strengths will help you present a compelling value proposition to potential partners. For instance, the EMM found that approaching entrepreneurs with a vague idea often did not capture their interest. However, by presenting well-defined, strategic ideas, it became easier to "sell" the concept and find partners willing to invest their time and resources.

❖   Set strategic and necessary goals: ensure that the tasks and projects you undertake are strategically important to your organization. This alignment helps maintain motivation and ensures that the goals are pursued vigorously. Projects that align with your core mission and strategic objectives are more likely to receive support and yield successful outcomes.

❖   Leverage existing solutions: you do not always have to create something from scratch. Assess whether you can enhance or support an existing solution or product with your knowledge, skills, and networks. Adding value to an already existing product can often be more efficient and impactful. For example, EMM has found success in enhancing existing educational tools with their specialized knowledge and resources.

❖   Engage community organizations: to effectively engage communities, seek help from organizations that already connect various community groups. These organizations can provide access to contacts and networks that you might not reach on your own. Building these relationships can significantly expand your outreach and engagement efforts.

❖   Assign stakeholder contacts: within your team, designate specific individuals to maintain contact with particular stakeholders. This approach ensures that relationships are nurtured consistently and effectively. Persistence is key; if you do not succeed in establishing contact on the first attempt, do not give up.

❖ Be agile: flexibility is crucial in both the co-creation workshops and the broader process. Be prepared to make quick changes if the initial plan does not work. For instance, if a planned co-creation workshop exercise is not effective, pivot quickly to another method. Similarly, if a central aspect of the project does not yield results, find a new solution rather than pushing ahead with a failing strategy.

❖ Involve experts: while you might have a broad understanding of the tools and processes, involve specialists for specific tasks. For example, even if you know how to use a wrench, let a specialist handle complex tasks like changing car brakes. At EMM, involving domain experts has been crucial for ensuring the accuracy and quality of their projects.

8. Appendices

- Please upload the signed Informed Consent Forms here, labeling them as follow: "HUNT_ICF_Cocreation_17.06.23"
- Please upload the Participant Lists here, labeling them as follow: "HUNT_PL_Cocreation_17.06.23"

- Supplementary data sources

Name of the document	Content	Link

- Supplementary Materials

Revenue, risk, and profit sharing in revenue sharing innovation model