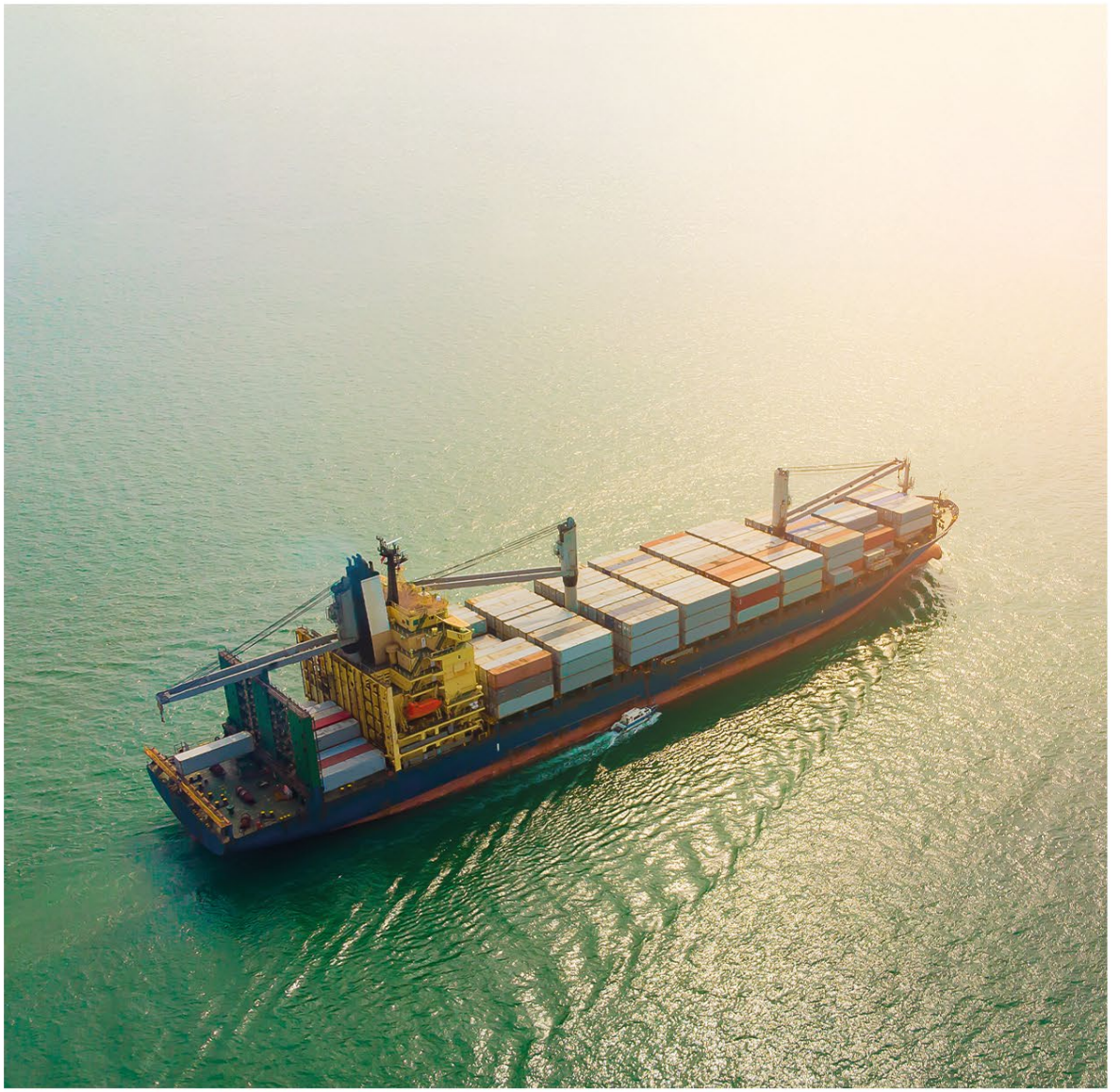
Johannes Impiö • Juhani Risku • Sami Kollanus • Ville Vakkuri
Kai-Kristian Kemell • Joni Kultanen • Joonas Himmanen • Pekka Abrahamsson (Eds.)

Autonomous Maritime Ecosystem:
Digital concepts and business cases

Results from the JYU TJTSM54 Course on Advanced Topics on Systems Development



Contributing to Sea4Value project

JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

Startuplab JYU
LabStartup

ONE SEA
Autonomous maritime ecosystem

JYU
University of Jyväskylä
Faculty of Information Technology

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TJTSM54 course book at JYU, 2019:02

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Content

Foreword

Students as co-creators and co-researchers

The course on Advanced Topics on System Development is a mandatory master's level course in the Information System studies at the Faculty of Information Technology in University of Jyväskylä. Every year about 200 students enrol to the course. Prior to the academic year of 2018-2019 the course was held in a classical seminar/lecture room format where the practical exercise referred to a short essay on a given topic. Course completion included passing an exam. We all are aware of the challenges of creating opportunities for learning in class-room driven teaching supported with a classical essay-type examination.

When given the opportunity to teach the course, I re-designed the structure with the aim to maximize the opportunities to learn. We intentionally engaged with the students as co-researchers rather than merely the subjects of learning. We know that this engagement affects both the product and the process of research. We are hoping that the research becomes an important pedagogical tool for students. By research here we refer to data collection, creation of artefacts and applying pre-designed instruments.

From the didactical viewpoint, we are trying to better understand how the students learn through this type of experiential education. Using students as co-researchers in an action research model is yet quite novel and the literature remains still quite thin on the actual learning outcomes. Our course is seen as a pedagogical tool to impact students' attitudes and understandings towards the real-world industrial complexities in a fail-safe environment. In our case this industrial context was the Autonomous Maritime Ecosystem. Our initial insights reveal that the course was seen quite laborious but rewarding for those actively engaging with the activities.

In Jyväskylä, Feb 16th 2019

Pekka **Abrahamsson**
Professor of Information Systems and Software Engineering
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Digitalization of the Autonomous Maritime Industry approached from the Container perspective

Juhani Risku, Pekka Abrahamsson

The course Advanced Topics on Systems Development at the University of Jyväskylä Information Systems is a mandatory course for all master's students in the field of Information Systems. The student teams in the course have a chance to engage with real-life industrial problems and to develop potential solutions for the benefit of the industry. Students need to be able to physically demonstrate the viability of the solution and present it in a professional manner to a large audience. The course was executed in an intensive time frame with weekly deliverables. The industrial problem domain was adopted from the Sea4Value research project, which focuses on advancing the Autonomous Maritime Ecosystem development. The students could choose any area or detail of the logistic chain in the companies' processes, before, during and after the sail. As a result, 22 of 27 teams selected to work on the container perspective. Smart fairway and open sea problem domains received a few proposals each.

1 Introduction

The maritime industry, the global seaborne trade, has grown four % during the year 2017 along the growth of global economy. Containerized transportation growth was 6.4 per cent. The well running seaborne business is expected to grow by 4.0 per cent in 2018, and nearly the same growth trend is expected up to year 2023 (UNCTAD 2018).

Some uncertainties in seaborne trade exists: the internal culture supports closed policies, and trade protectionism presses the future views (UNCTAD 2018).

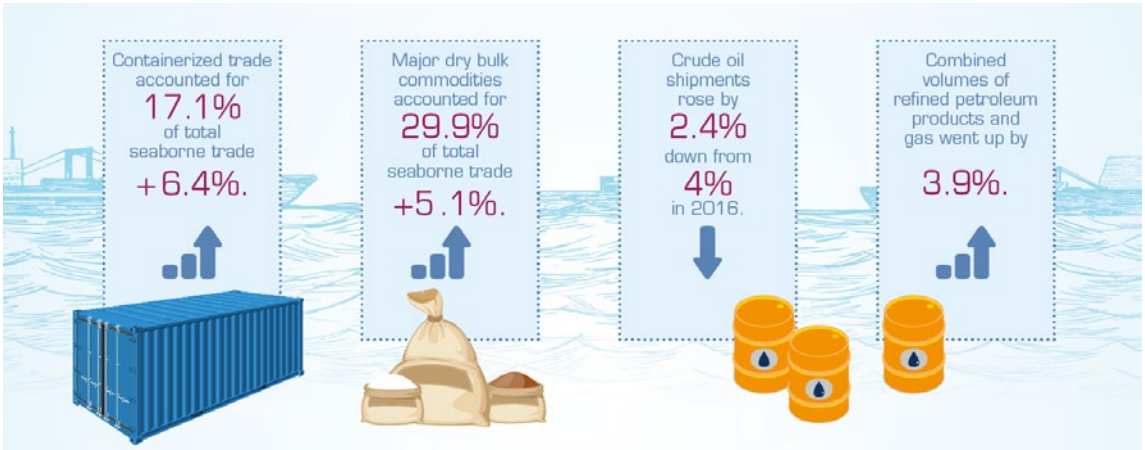


Chart World Seaborne Trade in 2017, UNCTAD 2018, excerpt.

DIMECC Goals of the One Sea vision. The course's target was to concentrate on innovation of service concepts and technical solutions for case companies' challenges presented.

The industrial customer of the course expressed the key challenges and problems in their Smart harbor case from the port, technical and quality directions. Port operative challenges are operations planning, effectiveness, speed and delays. These include sudden and last minute booking changes, information stoppage and corruption or missing. Also weather conditions like storm, rain during sail operations cause problems. Operations reliability issues like interruptions due to stock overflow and lack of trailer capacity cause deviations.

As technical and quality challenges, the customer listed transport equipment's conditions like trailer/container floors, vessel cargo hold condition and weather tightness. Manual forklift and crane handling damages happen before and during loading and unloading the cargo. Cargo damages are of nature visual damages or hidden damages. They may be caused physically by clamp due to human error, contact to cargo unit walls and floor, exposed to weather condition during handling and transit like condensation and storms.

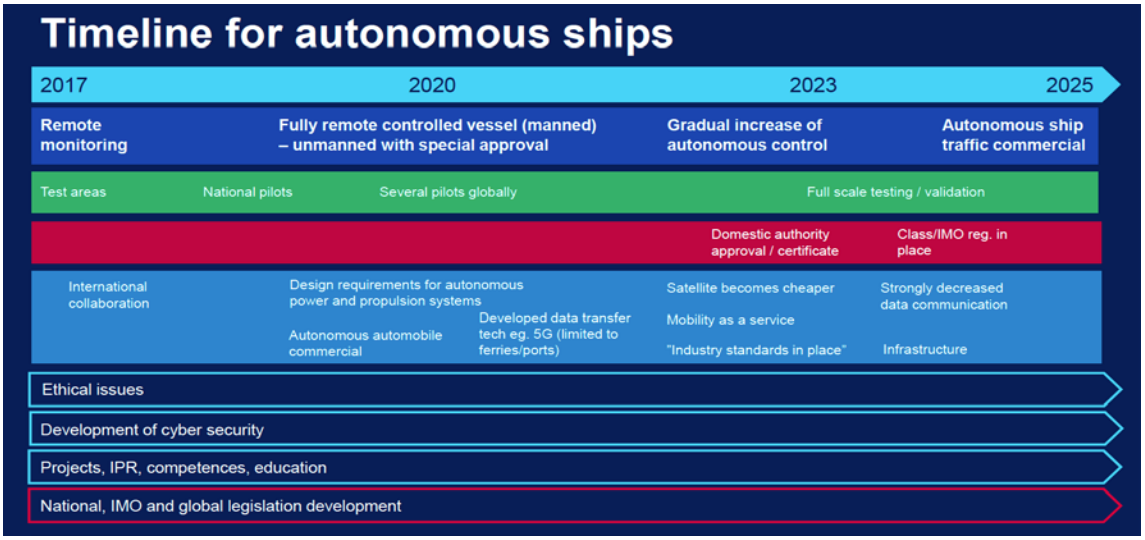
These technical and quality challenges cause the customer increase in primary costs like overtime cost, waiting time costs, and demurrage costs. Secondary cost increase consists of vessel rescheduling, which means increase in fuel costs. General hassle was also mentioned as an unidentified and fuzzy problem. Technical challenges cause increased damage costs approximately 5 M€ annually, increased customer complaints, which means dissatisfaction, reputation loss and volatility in the brand image.

The critical factor for the customer's cargo is the smooth handling of paper reels. The reels are heavy, from 1000 kg upwards. Damage types vary from visual damages to physical damages on the edges, at the flat end side, reel is pressed elliptical, reel getting humidity or water, contamination by dirt, and wrapping damage. Reel damages did not cause remarkable problem in quantity level, but the damages caused lots of extra work and handling for the paper mill and the logistical and transport partners (Kouhia 2010).
Besides the paper reel and container problem, teams did not concentrate on the megatrends as a future demand that the customer pointed, like population growth, urbanization, resource scarcity, role of renewables, climate change and compliance. On the other hand, digitalization, ethics and responsibility were considered in the team works.

The customer described their target for the team works with a clear expression: "How to utilize digitalization, autonomy and technology possibilities in our logistics environment?". This was the vehicle for their mission concentrated to one sentence: " The customer wants to be the forerunner in smart port and maritime ecosystem development".

2 Team works, chosen problems and solutions

Most of the 27 teams, 80 %, chose to concentrate on harbor arrangements and logistics, mainly on the use, automation and security of the container. Three teams worked on the fairway and two teams on open sea issues. This container and damages for the cargo was explained in detail by the customer company, and specifically their logistics unit. Also the container and the paper reel case was clarified by saying its damage costs of millions. The teams could catch the container as a clear topic and detail over the systemic and end-to-end systemic procedures. The customer did not clarify the overall damage and friction costs of other challenges and problems in detail.



Process, Timeline for autonomous ships, DIMECC 2018. The customer positions itself to be the forerunner in smart port and maritime ecosystem development.

When the customer's target for the teams was to find digitalized, autonomic and technological solutions for the company to be forerunner in smart port and maritime ecosystem development, detailed and narrowed topics and solutions offer limited possibilities for the posed ambition.

When discussing with four teams about their selection to innovate solutions from the container's perspective, some reasons were found. First, the container and the paper reel was explained in detail, and it was an understandable topic to choose. Secondly, when asking, do the fourth and fifth year master students know about processes, material flows, industrial engineering and management and industrial cultures, they said that only some overall ideas were taught but no specific courses were available. These topics were considered meant more for engineers. Still, backlogs in information systems could be used to prioritize the importance of different given challenges, and tackle the most important ones. This could have led to choose larger problems to gain more benefit for the customer than the annual few million EUR effects.

Interviewed students felt that the workload of the course was heavy, especially in the limited execution time of the course. Also the customer's problem definitions and mentors' instructions were sometimes seen fuzzy and unclear. On the other hand, when working with real world projects there are often inconsistencies and uncertainties. Data is often blurry and

details come from undefined sources. This requires the skill of balancing between different priorities. These blurry factors give advantage for a great team: They find the most important topics to focus on, they scan the relevant data from academic papers and industrial reports, and they list exact questions to ask from the customer and the mentors. Differentiation can be achieved between the competing teams by communicating on all frontiers: making excellent analyses, basing the solutions on research data and customer needs, fulfilling the requirements and innovating some new, disruptive and futuristic solutions. The teams have to understand that the customers have seen it all in their respective industries. Surprises are sometimes needed to draw attention. When communicating the results, all means have to be realized on highest achievement level: the report, poster, video and presentations have to differentiate from the others. When the customer their system providers, hard competition will be faced. If a poster has to be done, the poster culture is the learning environment. If a video is done, it can scale from serious professional drama to elegantly funny, filling the requirements of tactfulness.

3 Conclusion

As a conclusion, to manage industrial and technically specified problems and solution may require a curriculum of present day engineering topics at the university. The engineering course could be on the key concepts on a global level in chosen technologies such as the Internet of Things (IoT), logistics, city specific solutions and the key processes in engineering. These topics scale to a wider range of global future challenges. Here also the courses of information systems and technology to support the practical dimension of engineering.

The fourth and fifth year students should have knowledge, skills and awareness to solve complex real-world problems. Consultancy is one important future work scene for the students of information systems. When splitting the notion information systems to information and systems, notions like information visualization, clarity, presentations, meetings as sharing information and leadership arise. System equals to complicated structures, trades and their cultures, processes, input-output models, material and human flows, decisions and reasoning. Also priorities, orders of magnitude and monetary aspects like costs and incomes has to be evaluated. The teams managed well in these functions despite that all topics were taught. The teams worked hard, in a tight schedule, and certainly took a giant leap in becoming an independent team.

The solutions to the problems viewed the end-to-end flow of the container, controlled with sensors and software systems communication of the status of the cargo. Some of the teams made, on top of the conceptual solution, a simulation, application demo or process model for the customers problem. In this book, altogether 27 solutions are presented.

References

UNCTAD, Review of Maritime Transport 2018
Sea4Value program, Case UPM Logistics, 2019
DIMECC, 2019, One Sea – Autonomous Maritime Ecosystem
Kouhia, M., 2010, Report on damage caused in Kotka harbours to paper reels produced by UPM – Kymmene Kaukas paper mill and related operating processes, Saimaa University of Applied Sciences (in Finnish)

Ethics in AI

Kai-Kristian Kemell, Ville Vakkuri, Pekka Abrahamsson

Ethics in Artificial Intelligence (AI) is not simply about hypothetical, future scenarios with seemingly little practical relevance to the average developer. It is not only about doomsday scenarios featuring Terminator or other malicious robots, or what will happen once we reach singularity, developing an AI capable of iteratively improving itself and thus rendering humans obsolete as far as technological progress is considered. While it also encompasses such lines of thought, ethics in AI is also about very practical issues of the now that affect us all, or that will soon affect us all.

For example, autonomous vehicles from cars to ships are starting to operate in public roads and other spaces. These Cyber-Physical Systems (CPS) are AI-based. The AIs controlling the vehicles make decisions based on what they have been taught, or what they have learned on their own. To make these systems secure, it is important to always understand why they make certain decisions in certain situations; transparency. For the most part, these decisions are relatively straight-forward. Stay on the road, drive the speed limit, and adhere to the rules set by the traffic signs present in the area.

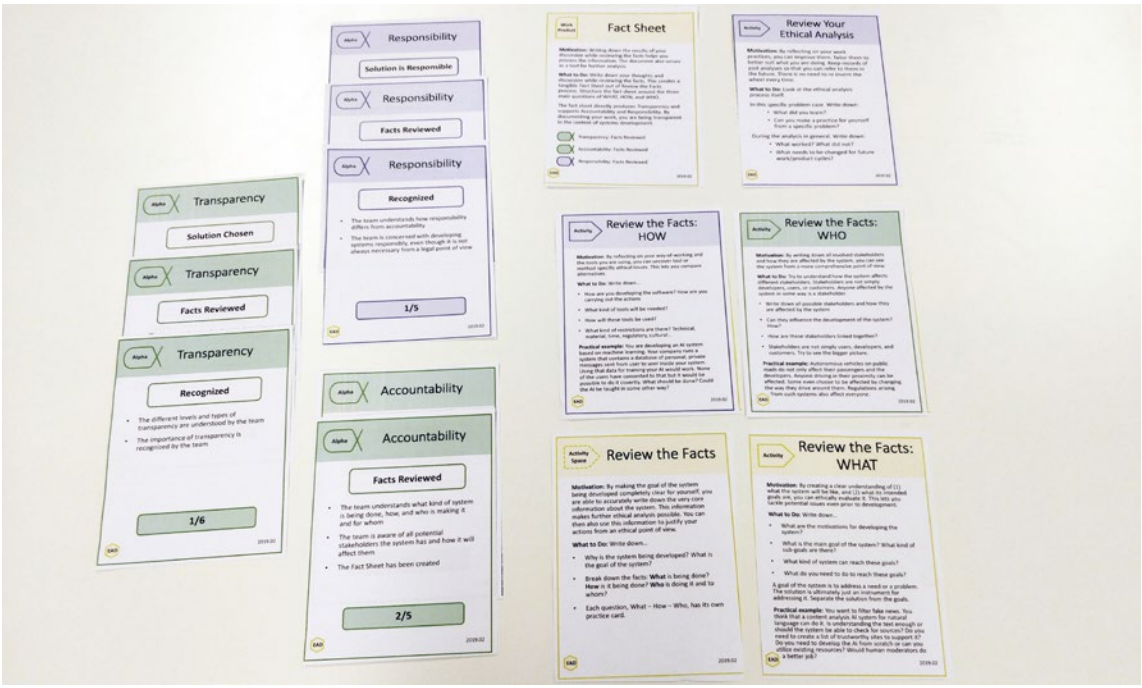
However, one day you may end up in a situation where your autonomous car is about to hit a pedestrian. Perhaps the sensors were blinded by the sun. It is, all the same, too late for the car to brake before collision. In this situation, the car has two options: to hit the pedestrian, or to drive off a cliff to the right in order to avoid collision. The first option would likely result in the demise of the pedestrian, whereas the second option would see the pedestrian survive, but you, the passenger, may end up meeting your demise instead. What should the car do? The AI will decide to do one thing over the other in this scenario, and you, as the hypothetical passenger, are certainly interested in knowing how it will act and why.

Moreover, AI systems are different from conventional software systems from the point of view of what is a "user" as well. Whereas you can simply not use Tinder or Uber if you do not like them, you often cannot opt out of using AI systems, especially indirectly. Even if you do not own an autonomous car, you will still soon be sharing the public roads with them. Corporations scan your job applications using AI systems for filtering them even if you would not want them to do so. Security cameras track your every movement with AI-powered facial recognition systems whether you want them to or not. In this fashion, AI systems interact with the physical world in unforeseen ways, affecting people who are not directly using them. Following recent technological progress in the field, these systems will soon affect everyone.

What can we do, then? For now, these systems are still developed by us humans. We are still presumably rather far away from reaching the point where we can develop AI systems capable of improving themselves autonomously. Thus, the best way to tackle ethical and any other concerns in these systems is to get into contact with the individuals and organizations developing them.

This developer-centric approach to AI Ethics is the approach we have chosen at the Startup Laboratory of the University of Jyväskylä. Our goal is to make the people and organizations developing AI systems understand just how enormous the potential societal impact of these systems is. The developers should understand (1) why ethical issues are important in this context, as well as (2) how they could address them in practice.

In this book, we employed a card deck based on the Essence Theory of Software Engineering intended to support developers in implementing ethics into information system design. During the projects depicted in this book, the teams of students utilized this card deck to discover and address potential ethical issues arising from their design choices. This card deck is currently being developed through academic research in order to encourage developers out in the field to address these issues while also giving them practical tools to help them do so.



Ethic card deck in action.

The Essence Theory of Software Engineering and Essencery

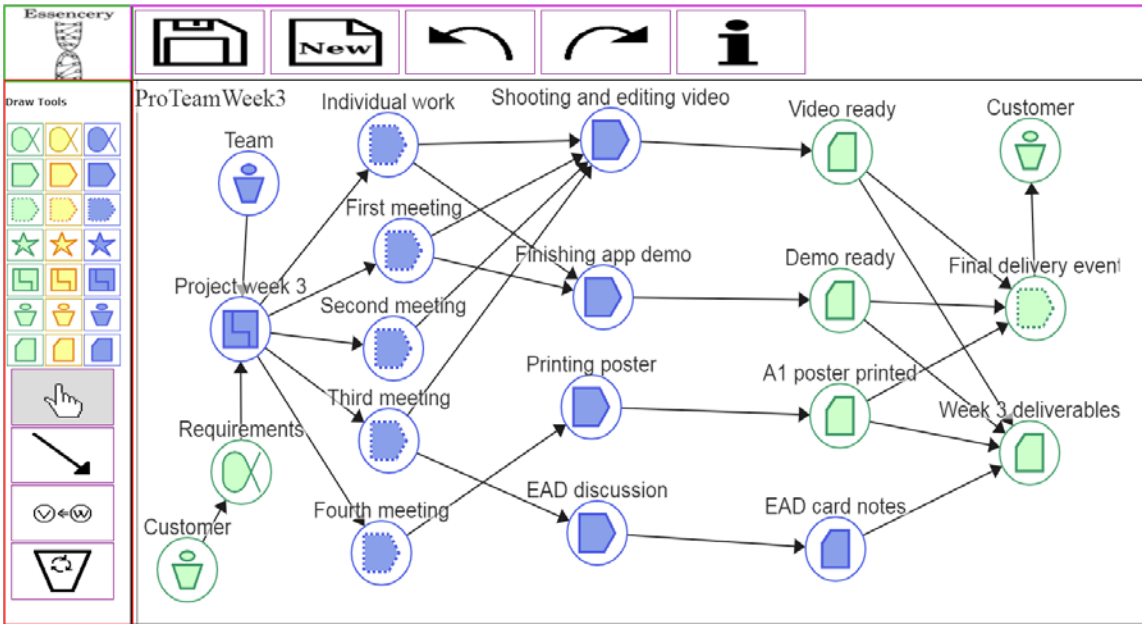
Pekka Abrahamsson, Kai-Kristian Kemell

A foreword regarding Essence taken from Pekka Abrahamsson's post on LinkedIn in 2019, slightly modified:

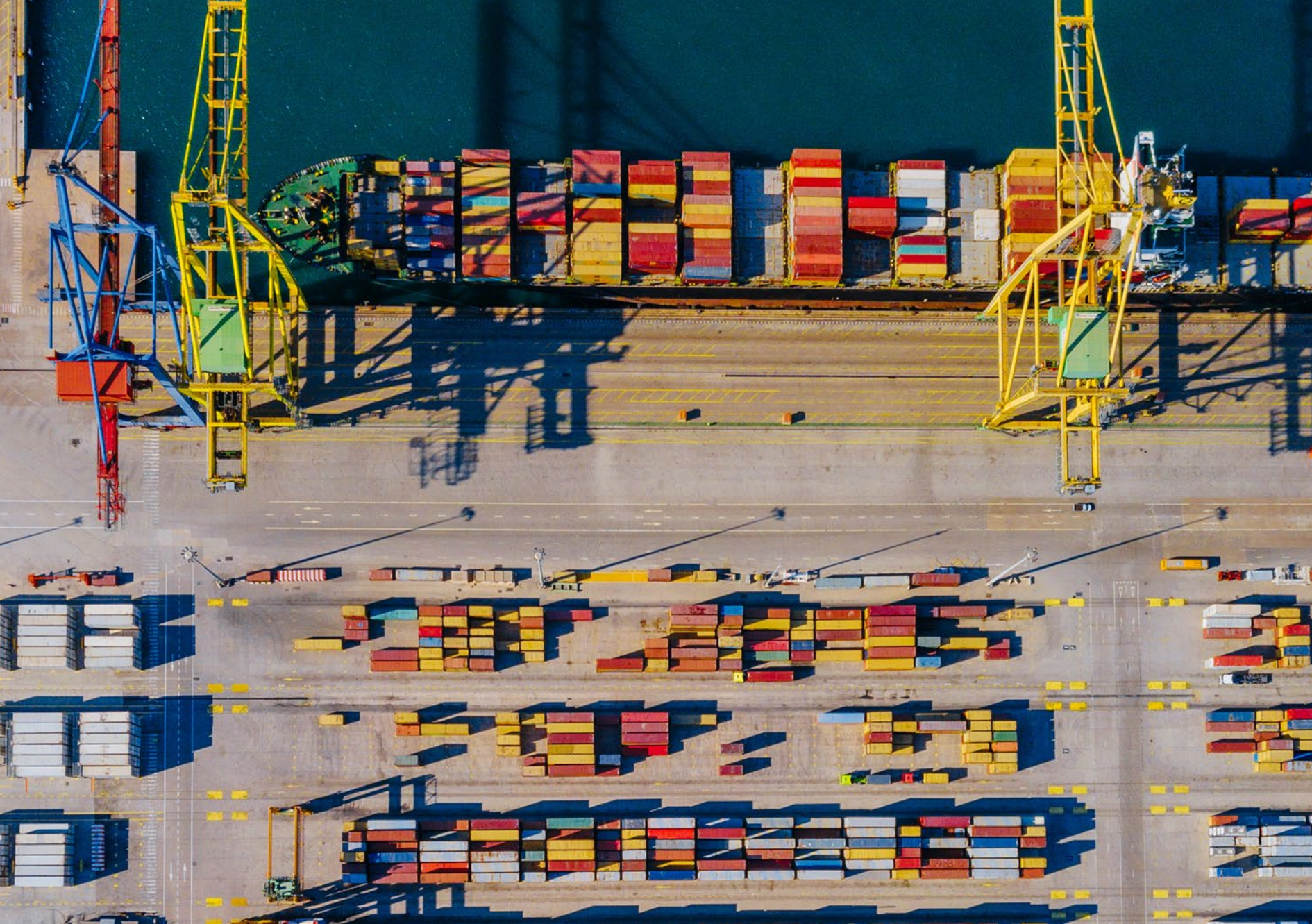
> *I am a software developer by training. I have felt the pain of teaching software engineering in university courses since 1999. Even if I had my PhD in software process improvement, it is incredibly difficult to focus on the essential matters in software engineering since no one had agreed what those essential matters are. I have researched and published about agile software development since the early days. Even if everyone today is developing software using agile methods, we still lack the concrete understanding what it exactly means. We find ourselves placed in a place that is best described as a method prison where fads like Scrum and Kanban dominate our choice of actions. In reality every method needs tailoring to be fit for use. Many years ago, Ivar Jacobson persuaded me to join the SEMAT initiative. I, too, wanted to escape the method prison, so I joined.*
>
> *At NTNU in Norway I had the privilege to teach software engineering to a class with close to 500 students. I essentialized the teaching, threw old textbooks out of the window and followed the Essence thinking throughout the course. We had more than 100 student projects delivering successfully a tangible software project and a product. The task was to develop a software robot that revolutionizes university teaching. These students did not have software engineering experience from before. Essence helped them to see the big picture and placed in control of their own way of working. An article based on this course was published in the PROFES2018 conference.*
>
> *In summary, we have finally a way to move beyond Scrum and Kanban. No more method wars in our campus! Essence is the future in Software Engineering method education.*

Essence, being a progress management and method tailoring tool for SE projects, is a heavy tool to be utilized in a university course only a several weeks long. Thus, rather than utilizing the Essence and its kernel in its entirety, the teams were to familiarize themselves with the specification, and then to use the philosophy of method tailoring behind it to construct their way-of-working. Using Essencery, a lightweight tool for describing the way-of-working of a team by using the Essence notation, they were to model their way-of-working. Then, each week, they were to model it again, encouraging iterative development of their way-of-working.

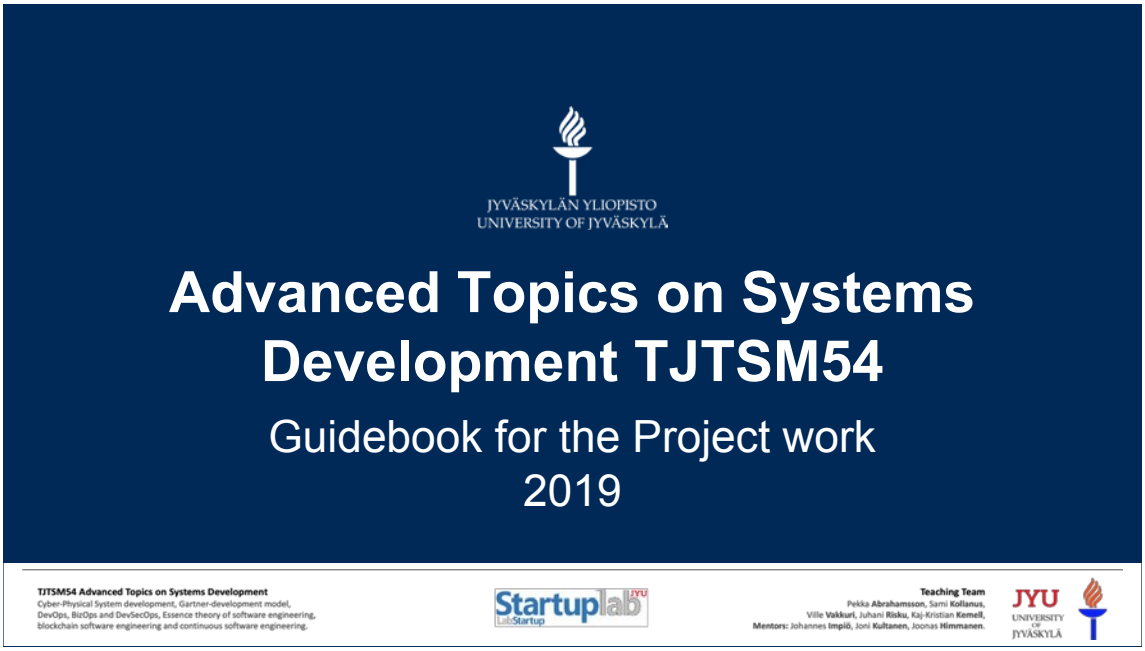
Created by Arthur Evensen during his stay at the Startup Laboratory of University of Jyväskylä in 2018, Essencery is an Open Source alternative for creating graphs using the Essence graphical syntax. The tool can be found online at Essencery.com. It is currently still being developed further. The picture below shows the user interface of Essencery along with a graph drawn by one of the teams during the course.



Screenshot of Essencery from www.essencery.com.



Guidebook for the Project work



Contents

- Guidebook's purpose & intended audience
- Project grading
- Project deliverables
- Deliverable timetable, weekly schedule
- Book instructions
- Demo instructions
- Video instructions
- Essencery instructions
- Ethics card-deck instructions

TJTSM54 Advanced Topics on Systems Development
Cyber-Physical System development, Gartner-development model, DevOps, BizOps and DevSecOps, Essence theory of software engineering, blockchain software engineering and continuous software engineering.
Startuplab
Teaching Team
Pekka Abrahamsson, Sami Kollanus, Ville Vakkuri, Juhani Risku, Kaj-Kristian Kemell, Mentors: Johannes Impiö, Joni Kultanen, Joonas Himmanen.
JYU
UNIVERSITY OF JYVÄSKYLÄ

Guidebook's purpose

- This guidebook is intended for those students who are completing the TJTSM54 course with a **project work**.
- If you are undertaking the same course with either an **individual work** or **supplementary work**, see Moodle for separate instructions.
- This book describes the key **deliverables** with **deadlines** that are expected from each project and identifies some tools that may be helpful in getting the deliverables done.
- There are also some **examples** from earlier courses for inspiration.

Project grading

- Maximum points for the course is 100
- Project counts up to 70 points
  - 25 points Case (book content)
  - 25 points Demo & Video
  - 10 points Ethics-cards
  - 10 points Essencery
- Individual common assignments count for 30 points
  - 15 points Book review
  - 15 points Company interview
- Grades
  - 100-90 = 5, 89-80 = 4, 79-70 = 3, 69-60 = 2, 59-50 = 1

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Overview of deliverables for the project

- 4 pages for the book (see detailed instructions)
- A working demonstration of your solution (to be shown to your clients)
- 90 seconds video of your solution (to be broadcasted live in the final event)
- Application of Ethically Aligned Design (EAD) card deck in the project, deck delivered 1 per week
- Using Essencery, weekly demonstrate the WOW (*way-of-working)* of your group
  - **One picture** to be uploaded in Moodle weekly (3 pictures in total)
  - **One paragraph of text** explaining the group's WOW (way-of-working). WOW is essence terminology (one of the 7 alphas). Essencery is a graphical tool for developing and describing your practices.

Deadlines for Deliverables - Week 1 (dl 5.2.2019)

- First version of the book pages (4 pages)
  - Page 1 of the book FINISHED (other 3 pages as drafts)
  - Print a physical version to show to your mentor
- First version of the demo (v0.1)
  - Mockups, screenshots (or similar)
  - Something that can be shown
- Idea of the video
  - You have thought about how it will be done
  - Perhaps tried a tool or two out
- Weekly deliverables
  - Essencery screenshot + 1 paragraph of text explaining your WOW
  - Ethics-card deck with text in the behind (what type of discussion was initiated by the card)

Deadlines for Deliverables - Week 2 (dl 12.2.2019)

- All pages of the book (4) FINISHED
  - Ready to be sent to print (pdf format, notice the formats 3xA4, 1xA1)
- Demo version 0.5
  - Smoking prototype of your demo is ready to presented
  - Not polished by any means
- Video version 0.1
  - Script for the video ready, or some other way to demonstrate what will happen in the video
  - Video shooting / editing tools are selected and tried out so that they work for you
- Weekly deliverables
  - Essencery screenshot + 1 paragraph of text explaining your WOW
  - Ethics-card deck with text in the behind (what type of discussion was initiated by the card)

Deadlines for Deliverables - Week 3 (dl 19.2.2019)

- Poster (page 2 of the book) printed in A1 size
  - Presented in the final event
- Book will be ready to be admired
- Demo (v1.0) FINISHED
  - Demonstrated in the final event
- Video (v1.0) FINISHED
  - Shown in the final event
- Weekly deliverables
  - Essencery screenshot + 1 paragraph of text explaining your WOW
  - Ethics-card deck with text in the behind (what type of discussion was initiated by the card)
- END OF COURSE

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Startuplab LabStartup JYU

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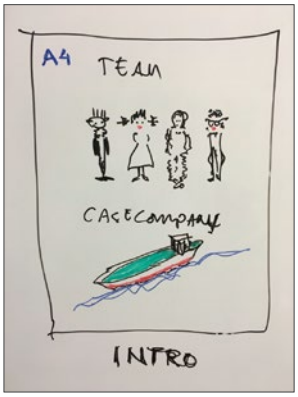
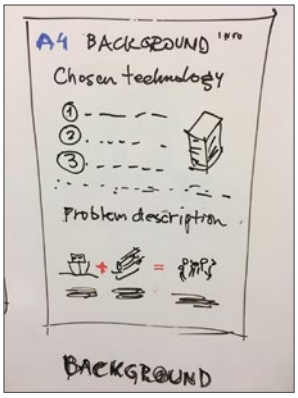
Book Instructions: Page 1 - Intro



This page contains three elements of information

1. Picture of the team and team member names, roles and responsibilities
2. Describe your persona (who will be benefiting from your solution, who is your end-user customer and describe them)
3. Present your way of working here (can be updated weekly) using essencery and take a screenshot. If space permits, you can have 3 screenshots showing how the wow changed over the 3 week period

Book Instructions: Page 3 - Background



Here you provide **contextual information** for the project, identify **the technology** that is required to solve the problem and describe **the problem** itself.

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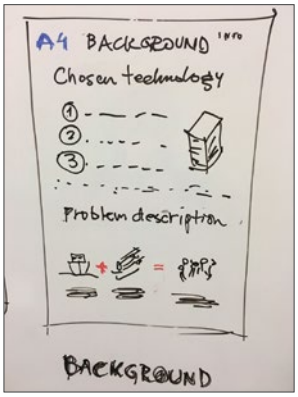
Book Instructions: Page 3 - Background



Here you provide **contextual information** for the project, identify **the technology** that is required to solve the problem and describe **the problem** itself.

Book Instructions: Page 4 - Solution

- Page 4 is reserved for **technical details** (or **business details**) of your solution. Provide as much information as you can so by reading this the reader should have a good understanding of your solution.
- You should identify the **key ethical concerns** that you identified and how they were tackled.

Book Instructions: Brand look and feel

- All four pages should have a consistent brand appearance
  - This is to differentiate your work from other teams
- You may choose and create a brand look and feel of your own liking, as long as it remains the same throughout all the four pages
- Things to consider when creating a brand:
  - Logo, colors, titles, background, fonts, visuals by your own, charts, tables, graphs etc.
- For inspiration, check the links in the following two slides

Examples for posters

Examples for posters and how to design them from Pekka's earlier course. (Be inspired and use those ideas you like and if you do not like something, don't use it.)

Download:

https://figshare.com/articles/100_Open_Sourced_Software_Robots_for_Tomorrow_s_Education_Revolutionizing_the_University_Learning_Experience_with_Bot_Technologies/5597983

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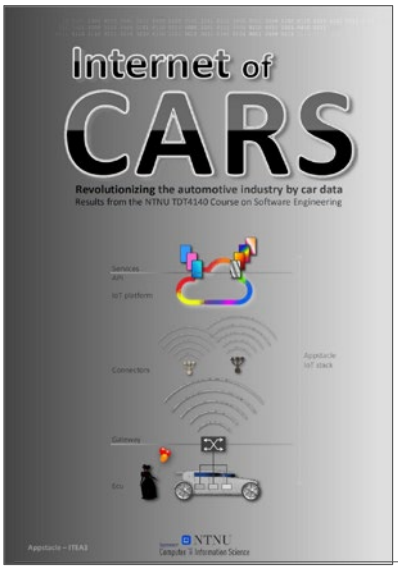

Examples for posters

Download:

https://figshare.com/articles/Internet-of-Cars_-_revolutionizing_the_automotive_industry_by_car_data_-_results_from_the_NTNU_TDT4140_course_on_software_engineering/3497681

Tools for Poster

- https://www.canva.com/create/posters
- https://www.gimp.org/
  - Free photo editor
- Powerpoint
- https://rasterbator.net/
  - Tool for dividing the poster into smaller parts
- Adobe Photoshop CC
  - Free trial available

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Demo instructions

- A working demonstration of your solution is expected in the course
- Some level of INTERACTION is expected in the demo
- You can freely choose your own way to demonstrate your solution
  - It can be e.g. mockup application with interaction (using *app generator* of your choice)
  - Automated powerpoint mockup (screenshots)
  - Physical demonstration (e.g. 3D-printers at your disposal at Startuplab)
  - Anything else you could think of

Tools for Demo

- Fluid
  - Create Web and Mobile Prototypes
- Balsamic Cloud
  - UX tool
- Adobe XD cc
  - Design and prototyping tool
- Blender
  - For both 3D modeling and video editing (free)
- AutoCAD
  - 2D documenting and 3D Modeling, free trial available

TJTSM54 Advanced Topics on Systems Development
Cyber-Physical System development, Gartner-development model, DevOps, BizOps and DevSecOps, Essence theory of software engineering, blockchain software engineering and continuous software engineering.
Startuplab LabStartup JYU
Teaching Team
Pekka Abrahamsson, Sami Kollanus, Ville Vakkuri, Juhani Risku, Kaj-Kristian Kemell, Mentors: Johannes Impiö, Joni Kultanen, Joonas Himmanen.
JYU UNIVERSITY OF JYVÄSKYLÄ

Video instructions

- 90 second presentation of your solution in a video form
- Presents the solution which includes showing the demo of the solution
- Will be shown live on the final event
- Style is up to you, but it has to look and feel professional
- There are plenty of examples of 90s movies at https://youtu.be/y-uVRatiE3k?t=1320 (at 22:00)

Tools for Video

- https://www.blackmagicdesign.com/products/davinciresolve/
  - Davinci Resolve - A free video editor
- https://www.blender.org/download/
  - Blender - For both 3D modeling and video editing (free)
- Adobe Premiere Pro CC
  - Powerful, but not so free video editor (Free trial available)
- Vegas Studio 15
  - Also not free, but trial available
- https://www.bensound.com/royalty-free-music/corporate-pop
  - Royalty free music

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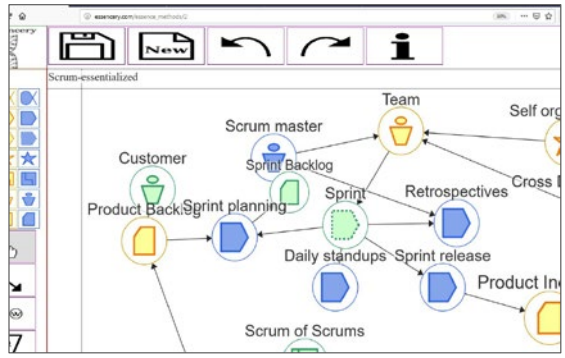
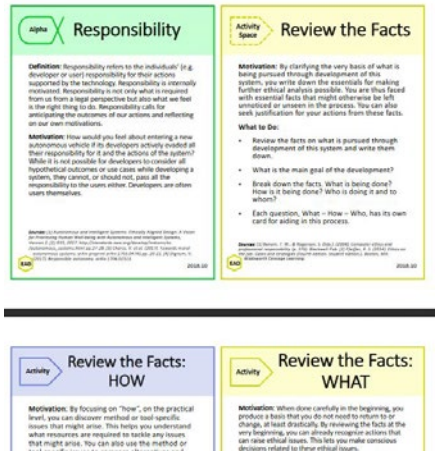
Essencery

- Use Essencery (www.essencery.com) to describe your WOW
- Study the notation from your Essence book. It is simple. There are only 7 symbols.
- Diagram should be realistic and can change from one week to another
- With this tool, you can use any method and practice you like!



Ethically Aligned Design (EAD) card deck

- Intention is to make you
  - 1) aware of EAD practices
  - 2) to have an idea how they can be used in practice
  - 3) to improve your product concept design with EAD
- There are 11 cards for you to use for practicing EAD in your project. They should make you discuss.
- From the Essence book, you should know what Alpha, Activity space, Activity are.
- We are revising the cards, so every week you will get a new deck (with revision) to help you to accomplish your work.
- **Write (by hand) behind each card what type of discussion was initiated by the card.**
  (if you are using pdf cards, then wherever there is space)



Teachers and Mentors of the course

Course teachers and mentors from left; Kai-Kristian, Johannes, Sami, Joonas, Joni, Ville, Juhani and Pekka.

Kai-Kristian Kemell is doctoral student and researcher at JYU, and currently working at JYU StartupLab.

Johannes Impiö is second-year student of Information Science at JYU and currently working as research assistant and laboratory engineer at JYU StartupLab.

Sami Kollanus, PhD, is a researcher and he work as an advisor and a coordinator for post-doctoral studies at the IT-Faculty in JYU.

Joonas Himmanen is fourth-year student of Information Science at JYU and he is currently working as research assistant at JYU StartupLab.

Joni Kultanen is master degree student of Information Science at JYU, specializing in cyber security. He is currently working as research assistant at JYU StartupLab.

Ville Vakkuri is doctoral student and researcher at JYU, and currently working at JYU StartupLab.

Juhani Risku is doctoral student and researcher at JYU, and is vice director of JYU StartupLab. He is an architect, acoustician and designer.

Pekka Abrahamsson is professor of Information Systems and Software Engineering at JYU. He is also founder and director of JYU StartupLab and Software Startup Lab.

Vesa Uotila
- System Architect

Paavo Väänänen
- Team Leader

Johannes Haapaniemi
- Application Specialist

Miika Lahti
- Audio Visual Design

MERI.IO

A NEW WAY OF SHARING INFORMATION IN THE MARITIME INDUSTRY

CREATING A NETWORK OF VESSELS FOR SMARTER FAIRWAY NAVIGATION

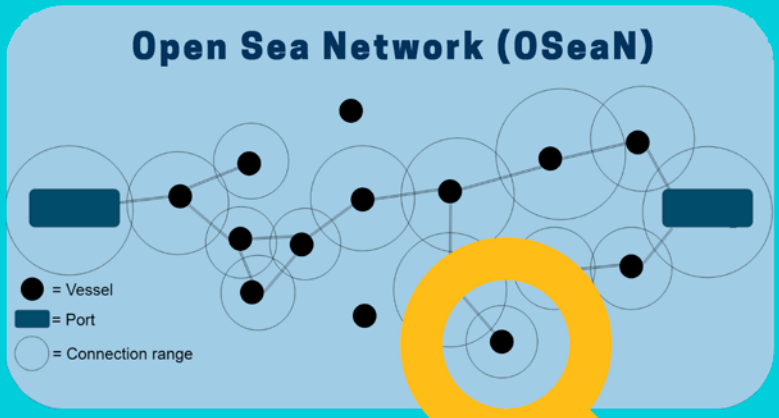
Project: Autonomous Maritime Ecosystem

OPEN SEA

Open Sea is a solution for maritime industry to meet challenges of the future.

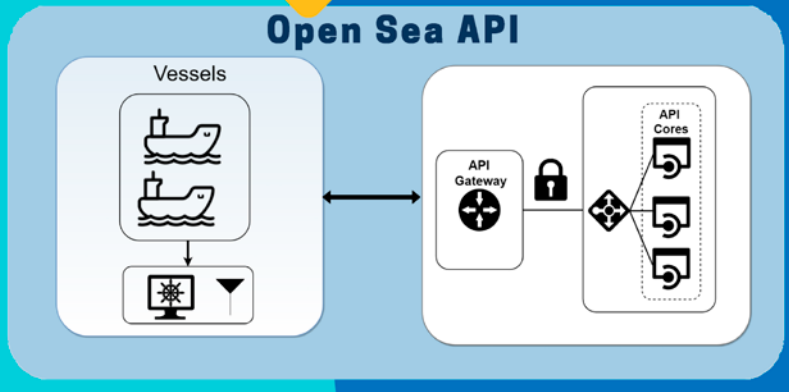
Currently there is no efficient way to transfer data in the open sea. OpenSeaAPI makes this possible by creating a network between vessels in places where internet is not available.

The foundation for smart and autonomous maritime traffic is here.



OSeaN:
Open Sea Network is created by all vessels that use OpenSeaAPI and have equipment to create connection to surrounding vessels.
This way all vessels from a large cargo ships to smaller private boats would act as a node in a large network, OseaN.

OpenSeaAPI:
The interface for all communication in Open Sea Network is OpenSeaAPI. The data collected by different sensors in the vessel is sent via API to other APIs connected to same network.
If there is no vessel with API found in the network the API stores data until connection is found. The data shared via OpenSeaAPI has no limits. It can be anything i.e. position information, weather conditions, cargo status, and even all information needed for autonomous operating.



- Open-source
- Global
- Scalable

MERI.IO
Johannes **Haapaniemi**, Miika **Lahti**, Vesa **Uotila**, Paavo **Väänänen**

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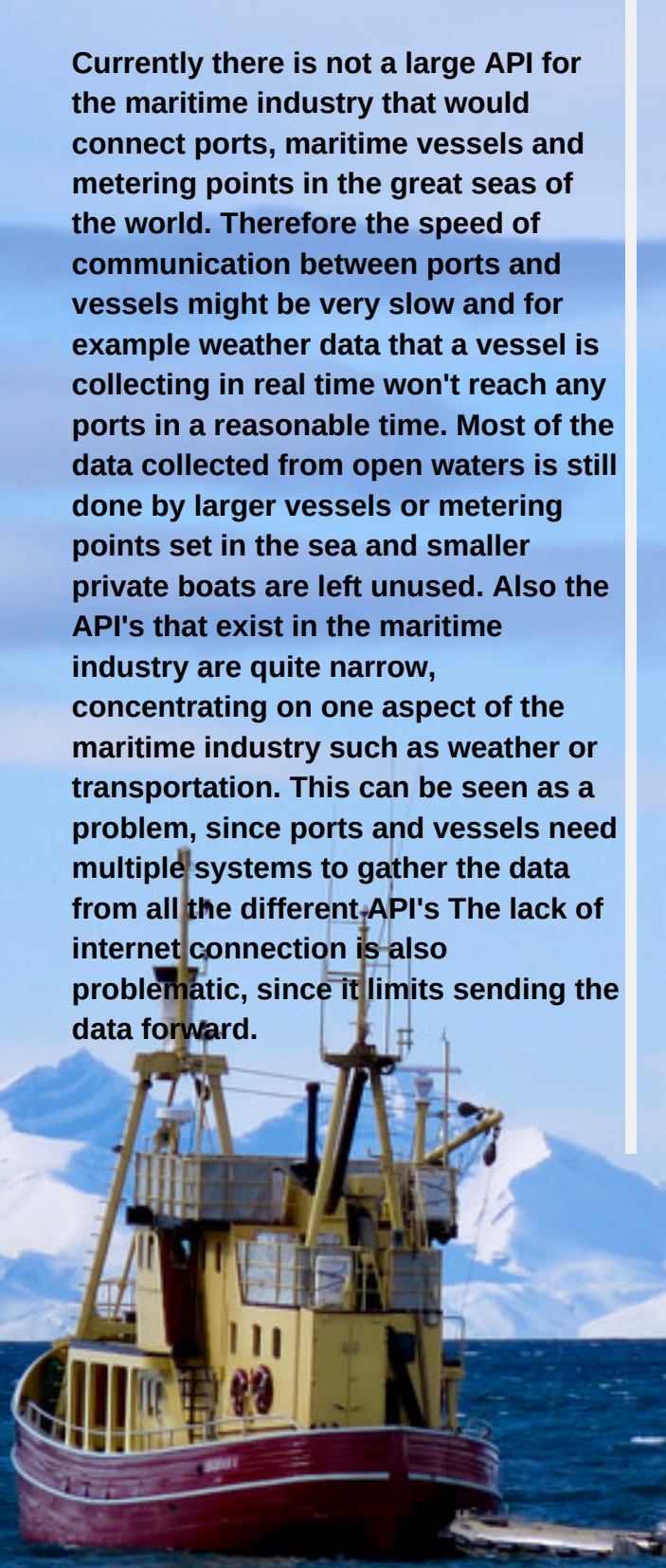
Currently there is not a large API for the maritime industry that would connect ports, maritime vessels and metering points in the great seas of the world. Therefore the speed of communication between ports and vessels might be very slow and for example weather data that a vessel is collecting in real time won't reach any ports in a reasonable time. Most of the data collected from open waters is still done by larger vessels or metering points set in the sea and smaller private boats are left unused. Also the API's that exist in the maritime industry are quite narrow, concentrating on one aspect of the maritime industry such as weather or transportation. This can be seen as a problem, since ports and vessels need multiple systems to gather the data from all the different API's The lack of internet connection is also problematic, since it limits sending the data forward.



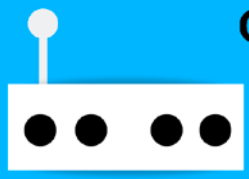
Our solution is to build an API that would be universally used in the maritime industry. From large cargo ships to smaller private boats, OpenSeaAPI would act as the interface where every single maritime vessel would send and receive the data that is collected on open waters. This will accelerate the communication in open waters, since every vessel acts as a node in a large network, sending collected data to the nearest vessel, which in return sends it to the next one until the data reaches the nearest port. The data sent via the API would not be limited to just weather or identification, but instead cover all aspects of the maritime industry. To achieve these goals, we suggest that in addition of building an API, the maritime industry should invest on developing a device that would be suitable for remote measurement and would be applicable to all kinds of maritime vessels. These devices should also be able to communicate with each other. This would be how automated ships would be able to identify smaller boats and minimize the risk of collusion. Automated ships wouldn't have to rely on radars to detect how close another ship is since the devices in vessels could talk to each other. Allowing vessels to talk to each other would also minimize problems occurred from communication problems or language barriers between the ships crews.

THE SOLUTION

The API implementations consists of combinations of 4 key components

Open Sea Lookout

Looks out for listeners within range, sends API request and saves the data served by listeners to the data source.



Open Sea Listener

Listens and serves the API-requests sent by lookouts by fetching data from the data source and passing it in a format defined by the API.

Open Sea API

A standardized interface implemented in listeners. Helps listeners and lookouts to communicate with each other in an unified way.

Data source

Storage for the data gathered by lookouts, sensors, navigational systems or other systems connected to the data source.

TEAM KAMME

TECHPILOT

MAKE PILOTAGE SAFE AGAIN

DEVELOPMENT TEAM

Alex Virtanen
Team Leader

Kaisa Rantanen
Scrum Master

Ella-Maria Mikkola
Harbour System Expert

Matti Selkämaa
Technology Lead

Markus Rajala
Integration Expert

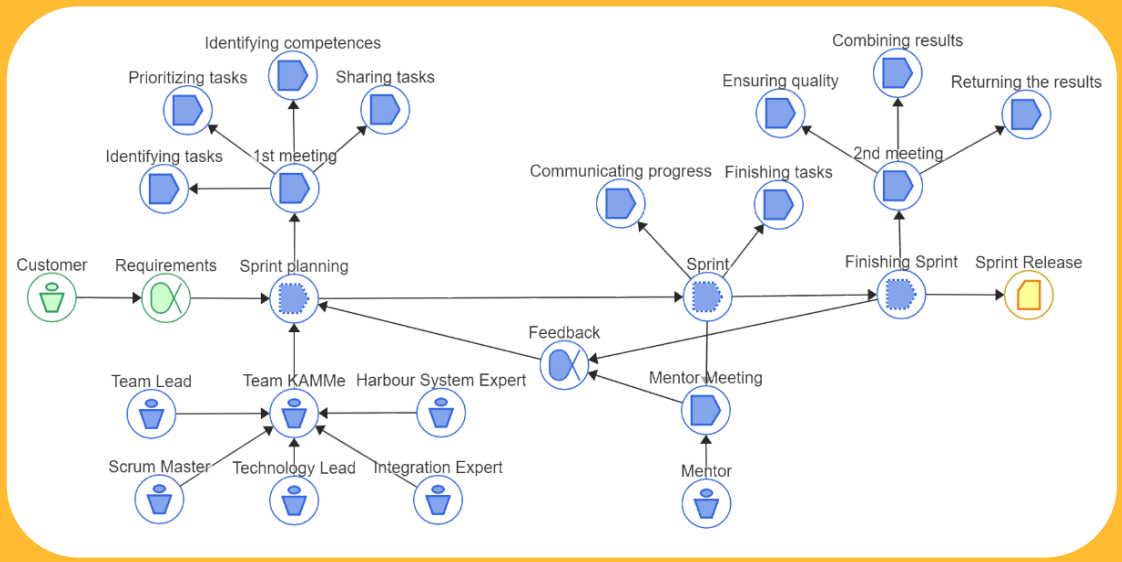
OUR VISION

Harbour pilotage is fully manual work and performed by one company in Finland, owned by the government. Renewing this, the industry could provide not only more efficient but also more reliable, sustainable and safe fairway navigation.

PERSONA

Our solution will benefit anyone in the maritime industry - Autonomous or not. We want to bring to our end-user more safer and efficient way to operate in the fairway domain. Harbour operators, ship companies and logistics crew will benefit from this break through system.

HOW DO WE WORK?



TEAM KAMME

TECHPILOT

MAKE PILOTAGE SAFE AGAIN

Ensuring the safety and efficiency of maritime navigation with technology-driven innovation

- **2017** • Remote monitoring
- **2020** • Fully remote controlled vessel (manned) • Unmanned with special approval
- **2023** • Gradual increase of autonomous control
- **2025** • Autonomous ship traffic commercial


The Fairway Buoy Sensor

BACKGROUND

In the future, ships will be sailing on their own via 5G data link or by using artificial intelligence in 10 to 15 years.

We in KAMMe believe in this and to make autonomous maritime industry a little more better, we have come up with a solution.

Since every harbour is approached differently, a dedicated pilot arrives from the harbour to help the ship navigate and dock to the port.

Our solution, TechPilot, is made to improve the industry in smart harbour fairway domain. Our project team has designed an idea of an autonomous pilotage for smart fairway that can be used in every harbour and with any kind of vessel.

SOLUTION

TechPilot uses the newest technology to secure fairway navigation by automating the piloting of ships to the harbour.

Our solution relies on the fairway buoys which are communicating with the sensors installed on the ship. Buoys creates a secure path for ships to approach, dock and depart from the harbour.

This solution relies on communication technology, VLF radio waves in low kilohertz frequency that ensures that radio waves penetrate seawater approximately to a depth of 20 meters. Sensors provide data for software to use in our application. When communication is established, the software application will create new session where ship operators and harbour operators can monitor approach, dock and departure of the ship.

GOAL

Our goal at TechPilot is to ensure efficient, reliable, sustainable and safe maritime transporting.

TechPilot uses the newest technology to secure fairway navigation when cargo ships are approaching the harbour.

Combination of sensors, radio wave technology and monitoring software creates a comprehensive solution for smart fairway navigation.

TEAM

ALEX VIRTANEN
Team lead

KAISA RANTANEN
Scrum Master

ELLA-MARIA MIKKOLA
Harbour System Expert

MATTI SELKÄMAA
Technology lead

MARKUS RAJALA
Integration Expert

TECHNOLOGY

SENSORS
Our sensor type is working underwater and endures pressure.

RADIO WAVES
Sensors communicate with radio waves in low frequency to ensure that they are working underwater.

SOFTWARE
Software is monitoring sensors both in buoys and vessels and provides real-time information for the ship crew and harbour operator about the route of the ship.

BENEFITS

MORE SECURE NEVIGATION
Technology-driven system secures the traffic in every harbour by ensuring every ship stays on the route and avoiding congestion

IMPROVED EFFICIENCY
By assistance of TechPilot, harbours are able to improve work efficiency by focusing resources on the right cargo in timely manner.

ECOLOGICAL BENEFITS
Lessen fuel consumption in fairway navigation by optimizing efficiency

STAKEHOLDERS

END-USERS
Ship operators
Ship crew
Harbour operators

OTHER STAKEHOLDERS
Ship manufacturers
Harbour owners
Cities
Governments
Unions
Societies

TEAM KAMME

TECHPILOT

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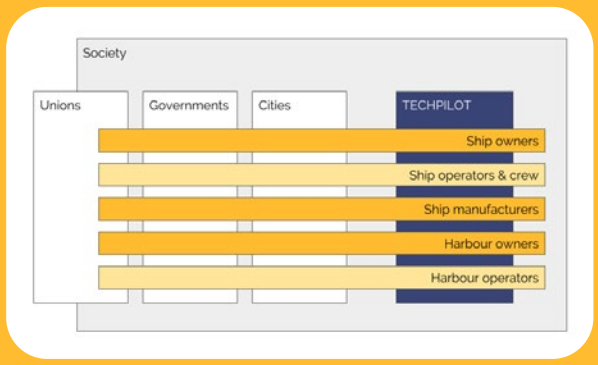
SOLUTION

Our solution, TechPilot, is made to improve the industry in smart harbour fairway domain. Our project team has designed an idea of an autonomous pilotage for smart fairway that can be used in every harbour and with any kind of vessel. TechPilot uses the newest technology to secure fairway navigation by automating the piloting of ships to the harbour. Our solution relies on the fairway buoys which are communicating with the sensors installed both on the ship and the buoys. Buoys creates a secure path for ships to approach, dock and depart from the harbour. Sensor technology relies on xxx in order to ensure the communication between ship and buoys. Location data of the ship is transmitted to the software which is used by ship crew and harbour operator.

STAKEHOLDERS



TECHNICAL DETAILS

Our technical solution is based on software and sensors in sea and on the ships. This solution relies on communication technology, VLF radio waves in low kilohertz frequency that ensures that radio waves penetrate seawater approximately to a depth of 20 meters. These sensors can both send and receive data. These sensors provide data for software to use in our application. When communication is established, the software application will create new session where ship operators and harbour operators can monitor approach, dock and departure of the ship.

ETHICAL ISSUES

DATA

Data usage can be complicated and we at KAMME want to make our data solutions as transparent and safe as possible. With help of areal regulations and standards we can collect, use and store data ethical ways.

DEVELOPMENT

When developing a complex systems the project can contain numerous people. That's why responsibility must be stated and tracked in every situation of the project.

OWNERSHIP

There may be situations where the ownership of the systems can be equivocal. If the business process contains many actors, there must be clear line between responsible organisation to handle each situation.

The Fairway Buoy Sensor

TEAM KAMME

TECHPILOT

MAKE PILOTAGE SAFE AGAIN

PROBLEM

Ships that sail today can be used for decades onwards. Simultaneously there are numerous of projects that aim to fully automate maritime transport with autonomous ships and smart maritime navigation. So how can technology be utilized in ships that were not meant to sail autonomously? With our solution, even decades old vessels with few modifications can sail through the fairway in more safe and efficient way. No manually operated pilot boats needed!

BACKGROUND

Fairway is the navigation channel by which the existing vessels and future autonomous ships use to travel safely in the transfer of goods. Currently when approaching the harbour every vessel needs its own pilot boat with two pilots in order to steer the vessel safely to the harbour. Currently pilotage is entirely manual work and slows down fairway operations. Piloting is extremely demanding and responsible work and human errors can cause enormous losses. We believe that pilotage can be fully automatized.

TECHNOLOGIES

SENSORS IN VESSEL

With sensor technology the ship can recognize where it is sailing in the fairway.

IPX rated sensors can be put underwater.

SENSORS IN SEA

Combining sensors on vessels and in sea the precise location and route of the ship can be defined and guided safely to the dock.

COMMUNICATION

Sensors are communicating with each other with low VLF radio wave frequency in order to penetrate the sea water

SOFTWARE

The location data is analyzed in the software for creating a safe route for the ship. Software monitors the arrival and docking of the vessel.

Project:Autonomous Maritime Ecosystem

HC essence

MONICA

Project manager of HC essence. Monica manages deadlines and team productivity.

JOEL

Graphic designer and marketing manager of HC essence. Joel plans the Design of marketing tools.

VILJAMI

Project leader of HC essence and leads the project outcomes.

ERIK

Erik is Full-stack developer, Eriks responsibility is front-end and back-end development

Smart

Effecient

Safe

DIMECC

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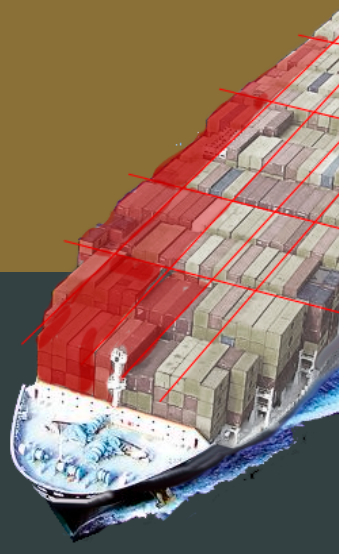
SMART

The software system knows place, weight and content of every container in the ship and decreases the human work and errors.

EFFICIENT

System saves time and resources. Automatized system estimates the time of loading and unloading the ship which leads to Savings in time and money



SAFE

One of the main benefits is the safety. Balanced and automatized loading and unloading guarantees safety in the harbour and on the journey.

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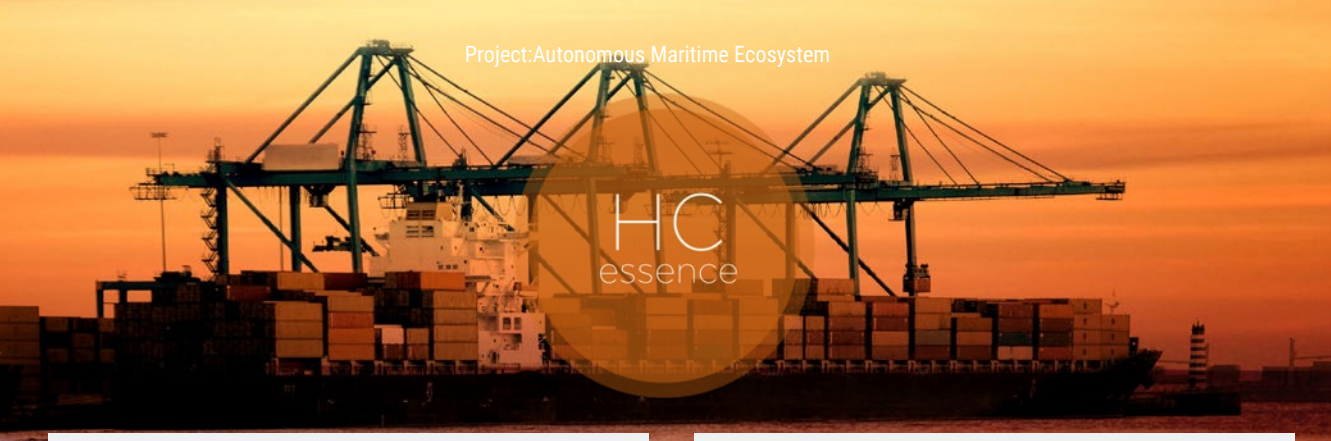


DIMECC

DIMECC (Digital, Internet, Materials & Engineering Co-Creation) is the leading breakthrough-oriented co-creation ecosystem that speeds up time to market.Their network consists of 2.000+ R&D&I professionals, 400+ organizations, 69 shareholders and 10+ co-creation facilitators.

Problem

Dimecc has problems with visibility of cargo information as a part of their Smart Harbour project. These problems include

1) Need for redesigning processes for operational optimization and improved safety.

2) Need of intelligent package, cargo space inspection, loading operations and cargo handling to be made semi or fully automated.

3) Better estimations in cargo loading and unloading times.

Solution

Our solution is SABAR -
Safe Autonomous Balancing Robotics

1) Cargo handling robot weights the cargo communicates with algorithm that will know where to move the cargo on the boat. Algorithm helps keep track of weight distributed on the vessel in real time

2) Algorithm calculates the best order for cargo to load on vessel estimates the time to load the vessel

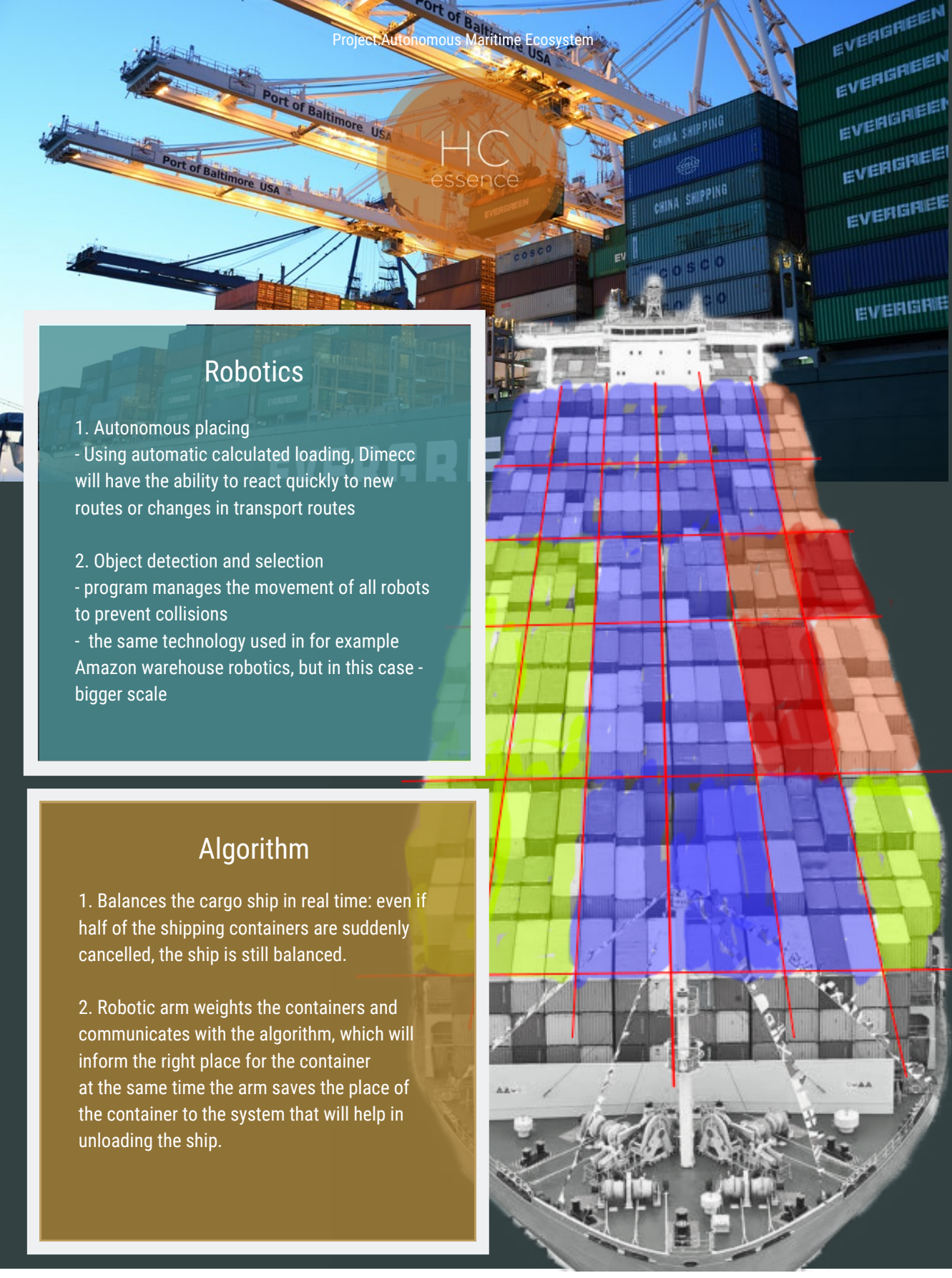
Why

This will help in redesigning processes for operational optimization, by decreasing the human work.

System also improves safety in the Harbor area and on the journey.

With the algorithm and the robotic arm, Dimecc will have better information handling of their cargo.

This can also help in knowing the need of cargo space. Smart tool is specially designed to help make loading operations and cargo handling semi automized and in future can with added robotics make it fully automised.



Robotics

1. Autonomous placing
- Using automatic calculated loading, Dimecc will have the ability to react quickly to new routes or changes in transport routes

2. Object detection and selection
- program manages the movement of all robots to prevent collisions
- the same technology used in for example Amazon warehouse robotics, but in this case - bigger scale

Algorithm

1. Balances the cargo ship in real time: even if half of the shipping containers are suddenly cancelled, the ship is still balanced.

2. Robotic arm weights the containers and communicates with the algorithm, which will inform the right place for the container
at the same time the arm saves the place of the container to the system that will help in unloading the ship.

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RAUSKU CONSULTING

PRODUCT DEVELOPMENT TEAM

Henri Salmela
Team Leader

Olli Peltola
Analyst

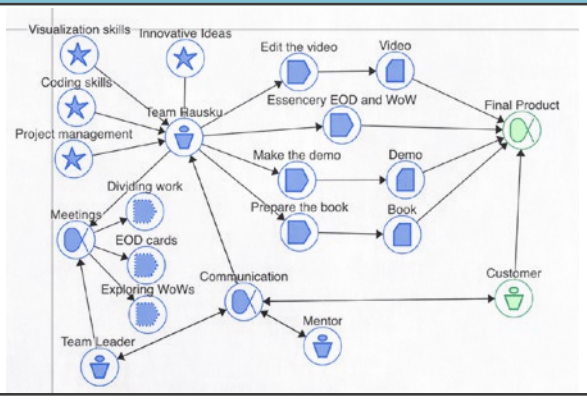
Joni Karjalainen
Developer

Sampo Noponen
Designer

PERSONA

Matt Erikson is a senior cargo quality manager at UPM logistics. He is located in Vlissignen, Netherlands. His job is to make sure that cargo will reach end-users in the same condition as they were when they left from the harbour. It would be great if he had access to real-time data of current condition of cargo.

WAY OF WORKING



Way of working is built upon reciprocal trust within the team. Each team member has a specific task to do, and by communicating effectively, team members are up-to-date of what is going on within the team. A shared Google Drive folder ensures that progress is being updated in real time. Additionally, ersonal strenghts are utilized, so that a more experienced person in graphics design takes care of the poster, a more analytic mind focuses on the research, etc.

RAUSKU CONSULTING

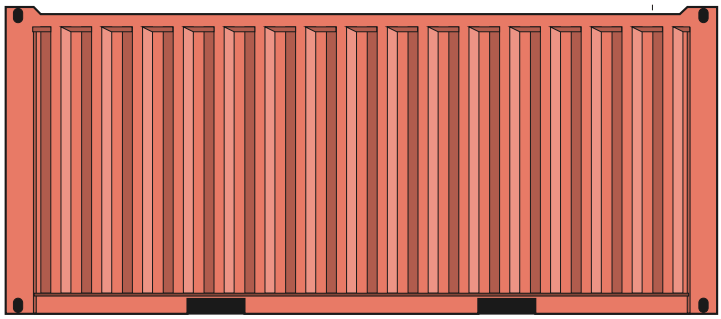
Autonomous maritime Ecosystem

CARGO TRACKING SYSTEM

Case: **UPM Logistics**

Joni Karjalainen | Sampo Noponen | Olli Peltola | Henri Salmela

PROBLEM AREA



Communication.
UPM does not have access to real-time information regarding conditions of shipped cargo. Hence, it is impossible to inform customer if a container gets damaged during the sea voyage, let alone how the damage occurred. Consequently, customer satisfaction declines.

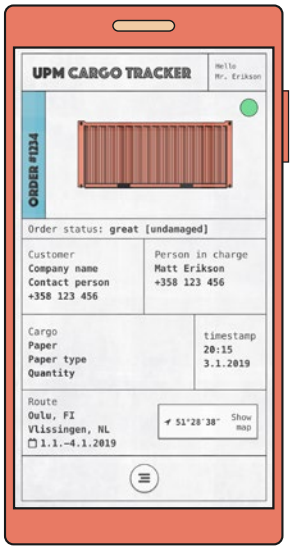
Damage information.
Damaged cargo causes financial losses and decline of customer satisfaction. There's no data showing how and at what point of shipping damages occur. Annually cargo damages cost millions of euros to UPM. In long-term, damage information could help reducing these costs.

DISCARDED IDEAS

Here are listed some results of our brainstorming. Some of these ideas are possible to include into the system at later stage. Right now these are not the priorities.

- Designing assembly line for unloading multiple containers at a time. Would save & money tremendously.
- AI to make predictions how probable it is to have damaged cargo in certain setting.
- Platform for instant communication with the customer.
- Saving the information gathered by sensors to blockchain.

SOLUTION



CARGO TRACKER

Our proposition to improve performance of UPM logistics is with web-based information system with sensor integration. It tracks where the cargo is at any moment and provides the basic information of the cargo order, such as **customer of order, person in charge, route, order status.** The system also alerts the end-user (UPM employee) when cargo is damaged.

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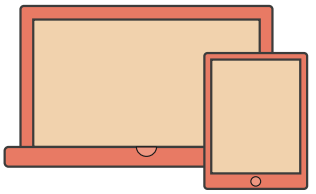
RAUSKU CONSULTING

BACKGROUND

TECHNOLOGY

1

Data tracking system.
Software that allows stakeholders to track conditions of cargo. Cargo sensors are integrated to the system. Order data should be automatically uploaded to system.



Dataflow

2

Cargo detectors.
Custom build sensors that track cargo, and sends data via 5g internet to Data Tracking System.

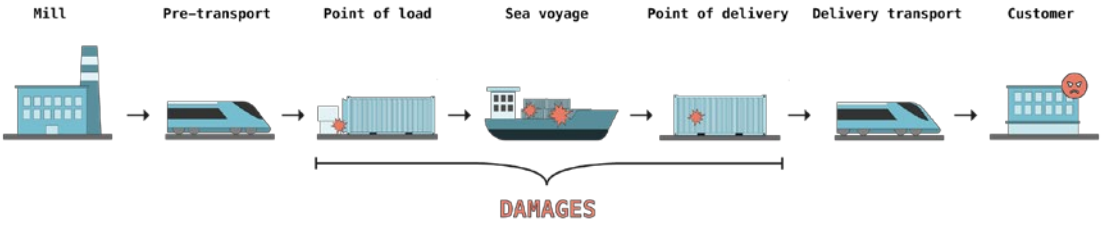
What it tracks:

- Air humidity
- Pressure
- Sailing speed
- Cargo transportation angle
- Light
- External blow impact on cargo

PROBLEM DESCRIPTION

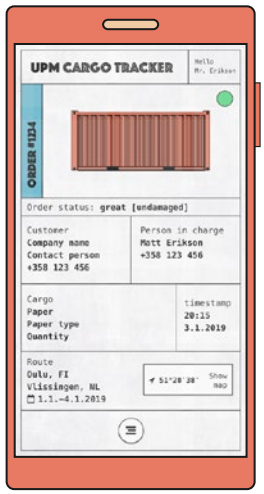
UPM does not have access to real-time information regarding conditions of shipped cargo. Hence, it is impossible to inform customer if a container gets damaged during the sea voyage.

Damaged cargo causes financial losses and decline of customer satisfaction. There's no data showing how and at what point of shipping damages occur. Annually cargo damages cost millions of euros.



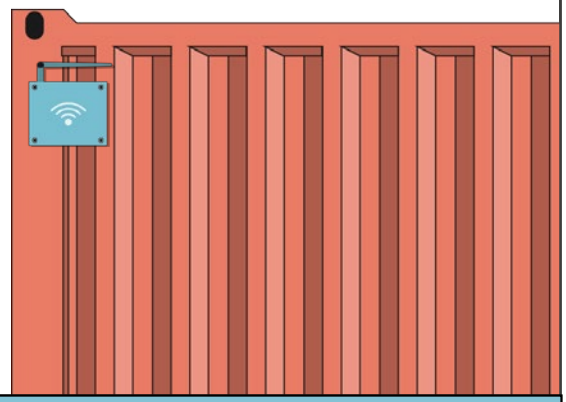
RAUSKU CONSULTING

SOLUTION



Cargo tracking system.
Tracks where the cargo is at any moment and gives out the basic information of the cargo. In addition of tracking the location of the cargo, the system displays how's the weather at that location. The system also alerts the end-user (UPM employee) when cargo is damaged.

Integration of sensors.
Sensors are attached to a corner of container. The purpose of sensors are to let UPM know live when cargo is damaged. The sensors track humidity, external strike impact magnitude, angle of a container, speed of a cargo ship, light, and pressure.



ETHICAL CONCERNS

1. Information security.
Unwanted 3rd party might get access to cargo data. Someone could use the sensors to send information that UPM uses to make uneducated decisions.

Can be solved by hiring an security expert to find possible security risks and fix them.

2. Mishandling of the system.
Mishandling of system and sensors, and not reporting broken sensors.

Problem can be tackled by training and motivating people to use the system and handle the sensors appropriately.

3. System errors.
For instance, a sensor could mistakenly put out error messages claiming that the cargo is damaged even though it isn't.

Can be solved by assigning dock workers to check the reportedly damaged container.

Team Codemonkeys

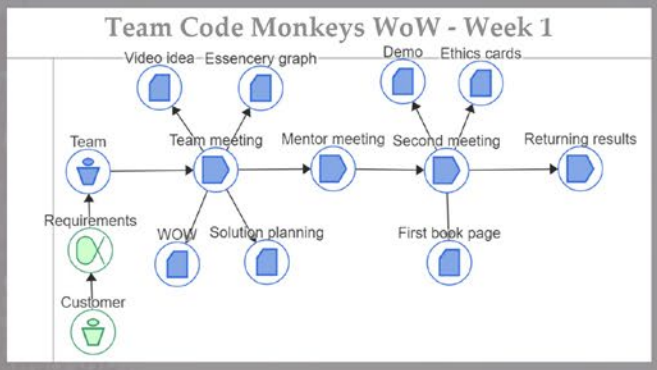

Tommi Riipinen

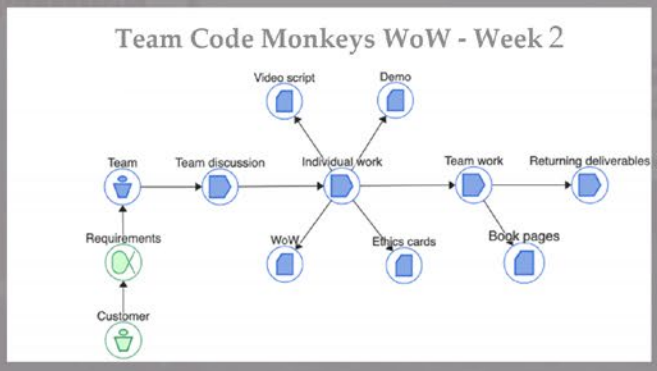

Tuomo Hopia


Jarkko Teriö


Jere Petäjä

Natural language communication between manned and unmanned seavessels





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Startuplab JYU LabStartup

Teaching Team
Pekka **Abrahamsson**, Sami **Kollanus**, Ville **Vakkuri**, Juhani **Risku**, Kaj-Kristian **Kemell**.
Mentors: Johannes **Impiö**, Joni **Kultanen**, Joonas **Himmanen**.

JYU UNIVERSITY OF JYVÄSKYLÄ

Project: Autonomous Maritime Ecosystem

Natural Language Communication Between Manned and Unmanned Seavessels

Code Monkeys: Tuomo Hopia, Jere Petäjä, Tommi Riipinen, Jarkko Teriö

One of the challenges autonomous maritime faces is the communication with traditional manned seavessels.

Our solution enables interaction between these two generations with the help of newest state-of-the-art technologies.

Human makes radio contact to the ship

AI Analyzes the radio transmission

Situation analysis and decision making

System answers in natural language

I. Our solution steps in when the Captain of a ship contacts the autonomous seavessel

II. The AI planted in our seavessel translates the radio message into text for further actions

III. From the text the AI deciphers the meaning behind the message and analyzes the situation using all available information it has about weather, surroundings and other factors

IV. Based on the results, AI takes a course of action and informs it's decisions to the Captain

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JYU UNIVERSITY OF JYVÄSKYLÄ

Natural Language Communication Between Manned and Unmanned Seavessels

The Background

Code Monkeys: Tuomo Hopia, Jere Petäjä, Tommi Riipinen, Jarkko Teriö

As more autonomous ships start operating in the worlds sea routes we will encounter a new, critical problem.

"How can manned and unmanned vessels effectively communicate to ensure and improve safety?"

Our goal is to solve this problem by utilizing state-of-the-art natural language processing and artificial intelligence technologies to enable fluent verbal communication between autonomic and manned ships.

All communication occurs through traditional VHF radios using natural language.

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JYU UNIVERSITY OF JYVÄSKYLÄ

Natural Language Communication Between Manned and Unmanned Seavessels

The Solution

Code Monkeys: Tuomo Hopia, Jere Petäjä, Tommi Riipinen, Jarkko Teriö

As our solution uses traditional radios as human interface devices

No new software or hardware is required

All VHF enabled manned vessels are already sufficiently equipped.

Autonomous ships use

Multiple natural language processing technologies

to understand and produce spoken language, analyze intentions and form sentences.

A rule based system is responsible of

Decision making

regarding communication and navigation.

Our solution uploads all logs to the cloud, enabling

Self-learning, cognitive functionality.

AI models are automatically retrained based on all available collective data, benefiting from the scalable resources provided.

Combining these technologies we can make

Marine transport safer and more efficient,

and solve large problems concerning autonomous vessels.

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JYU UNIVERSITY OF JYVÄSKYLÄ

Project: Autonomous Maritime Ecosystem

SMARTCAM SYSTEMS

Julia Fågel
Developer

Creative graphic designer, the brains behind visual outcomes

Anni Junkkarinen
Developer

Skilful photographer and video editor, guarantees high quality

Otto Lankia
Team Leader

Talented leader, keeps the group on track

Anna Kaulio
Developer

Supportive Essencery Master, raises the team spirit

Lilli Vidgren
Developer

Awesome writer, takes care of the documentation

PERSONA

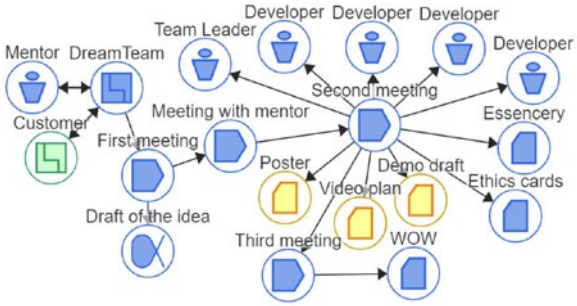
The damage detection process of containers is outdated. In 2019, the workers are still walking around the harbour, using a paper and a pencil to write down the detected damages for documentation. Their safety, time and efficiency are wasted in this old-fashioned process.

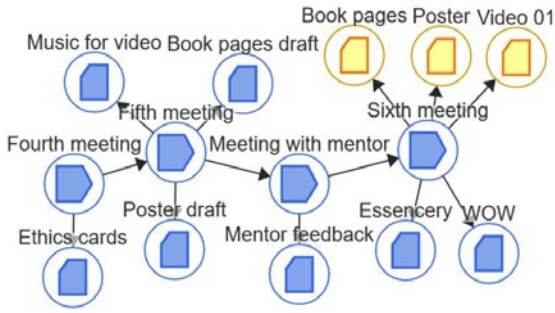
HOW WE HELP?

Our solution will digitalize the process of cargo damage detection by using smart cameras. To the gate attached smart cameras will detect the damage during the container's movements around the harbour. This way, the process will be more cost-effective, easier, faster and safer.

SCS SmartCam Systems
SINCE 2019

WAY OF WORKING





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JYU UNIVERSITY OF JYVÄSKYLÄ

Project: Autonomous Maritime Ecosystem

UPM is a part of the Sea4value project, in which the goal is to create digitalized and automated maritime transport system. UPM wishes, that with digitalization, autonomy and technology possibilities it would be possible to better their business processes and be the forerunner in smart port and maritime ecosystem development.

SMART CAMERA SYSTEM

DETECTS THE DAMAGE BEFORE YOU EVEN SEE IT

WHY?

When UPM told us, that the workers are detecting the outside damages of the containers just by walking around the harbour and detect them only with eyes. We decided to create a solution that will digitalize this process. We wanted that with technology it would be possible to decrease the costs of the outside damages, make the process more cost-effective and even safer for the workers.

SmartCam Systems
SINCE 2019

WHAT?

Our chosen technology is smart camera which utilizes artificial intelligence. The technology identifies the containers and detects the damages or abnormalities of containers.

HOW?

We have designed a gate, equipped with smart cameras, what will detect the outside damages on the containers. The smart camera will recognize the container identification code, so it is easy to monitor the movements of containers and to locate the damaged ones. All this valuable data is gathered and provided to UPM.

DreamTeam: Julia Fågel, Anni Junkkarinen, Otto Lankia, Anna Kaulio & Lilli Vidgren

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Startuplab LabStartup JYU

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JYU UNIVERSITY OF JYVÄSKYLÄ

BACKGROUND

PROBLEM DESCRIPTION

The Sea4value project aims to digitalize and automate maritime transport system with a lot of companies involved. One of the development areas is Smart Harbour, in which the target is to develop the processes with technology. UPM wants us to develop and introduce innovative solutions with the latest technology, and to goal to better business processes and outcomes.

According to UPM, container transport model covers 34% of all sea transports in Finland. The containers may get damaged during the transportation. When the detection process is slow and manual, it may cause financial losses for the UPM company. UPM is also concerned about the customer dissatisfaction and reputation loss caused by the delays or unsuccessful product transportation.

Until this day, the process of damage detection has been done manually: the workers walk around the harbour with paper and pencil. We want to make this process digitalized.

CHOSEN TECHNOLOGY

One of the latest technologies is artificial intelligence, which is used for example in smart cameras. Typical areas of smart camera applications are for example automated inspection for quality assurance and identification. In this case these are used to identify the containers and detect the damages or abnormalities of containers.

SCS SmartCam Systems
SINCE 2019

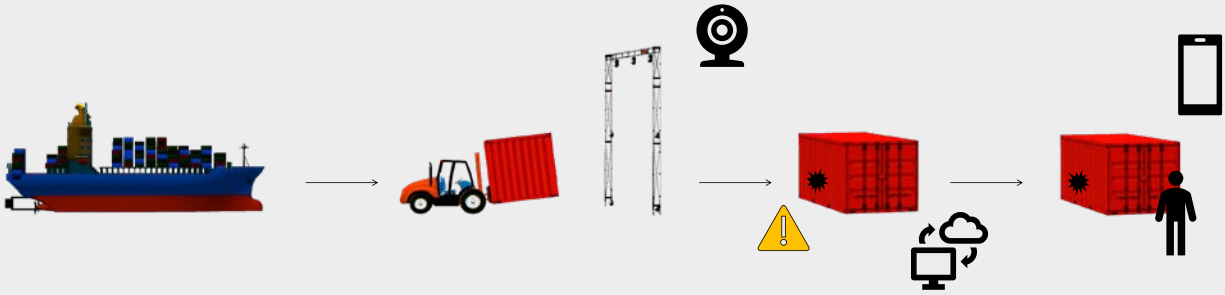
SOLUTION

MAIN IDEA

We have designed special gates with smart cameras attached. When the forklift moves the container, it will drive through the gate and the cameras will detect the possible outside damage of the container. The gates are situated in a multiple location around the harbour, for example near the ship loading area and outside the warehouse. We want to build the gates to the places where the containers move the most: to the routes the forklifts are driving.

IDENTIFICATION & DATA

The smart camera will recognize the container identification code, so that is easy to identify the containers and locate the damaged ones. The identification also helps UPM to monitor the movements of the containers. A lot of valuable information is gathered: how fast the container moves from A to B, where most of the damages come from, how many containers get damaged and do the containers stay a lot of time in a one place. All this information is gathered by smart cameras and provided straight to UPM.



END-USER

The smart cameras observe the containers, and if there are any outside damages, the pictures of the damages are sent to the system and database. The workers utilize a user interface, for example computer or smart phone, to monitor the information of containers and the pictures of damages.

By using smart cameras, it is possible to detect the damages more cost-effective, faster and easier.

SCS SmartCam Systems
SINCE 2019

KVGL

Juho Leskinen
Project Manager

Anton Geier
Visual Manager

Aino Väli-Klemelä
Ethics Manager

Eemil Karkulahti
Essence Architect

Oona Hyvönen
Solution Manager

MARITIME PROJECT

Idea:

Smart containers equipped with sensors for damage monitoring

The end-users:

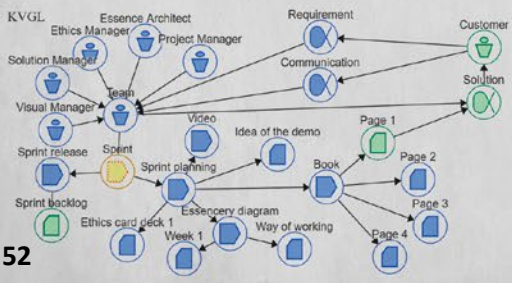
The logistics employees

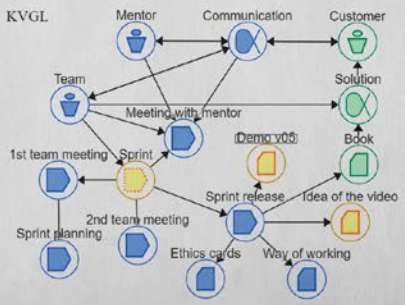
Our solution will benefit:

Employees: working will get easier and more efficient

Customers: less product damages & faster and more reliable delivery

ESSENCERY DIAGRAMS

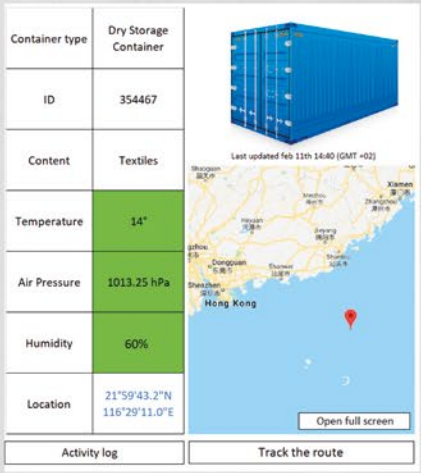




Project: Autonomous Maritime Ecosystem

smart containers.

Anton **Geier**, Oona **Hyvönen**, Eemil **Karkulahti**,
Juho **Leskinen**, Aino **Väli-Klemelä**



Live monitoring

- Sensors track the conditions of the container
- GPS tracks the location of the container

Damage control

- Automatic systems alter container conditions and prevent damages
- Easy to detect when, where and why damage has happened

Increased efficiency

- Data can be used to create patterns and forecasts
- Transportation can be made more reliable predictable

Future applications

- Automation using IoT applications
- Augmented reality as a tool to increase efficiency

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JYU UNIVERSITY OF JYVÄSKYLÄ

BACKGROUND

PROBLEM DESCRIPTION

Current challenges can be divided into port *operative challenges* and *technical/quality challenges*. Port operative challenges are related to operations planning, operations effectiveness and speed, weather conditions and operation delays which can be caused by last minute booking changes or information stoppage. There are also challenges around operation reliability as stock overflow and lack of trailer capacity are causing interruptions to operations. These challenges are causing cost increases arising from overtime costs, waiting time costs and demurrage costs. Addi tionally, these challenges are causing vessel rescheduling which results increased fuel costs.

The conditions of transport equipment, such as trailers on containers floors or vessel cargo hold, are the main reasons for technical/quality challenges. There are also cargo damages, which can be caused by clamp (human error) or due to contact to cargo unit walls or floor. It is also possible that the cargo is exposed to weather conditions during handling or transit. These challenges are causing increasing damage costs, which can rise up to 5 million euros annually. They are also increasing customer complaints and dissatisfaction.

TECHNOLOGY

Technology of these smart containers includes sensors to measure temperature, humidity and air pressure. The sensors inside the containers are detecting the hits the cargo receives during the transport. GPS is installed to locate the containers and a small computer to send the gathered information forward to the databases.

The gathered data can be accessed by computer or mobile devices through a web application. All of the gathered data is accessed by system owners, while clients can have access to the data that is essential for them. The interfaces are designed in a way that enables to enlarge the software or connect it to other softwares. Technology inside the container enables it to be connected to the internet and to future IoT applications. In the future the technology inside the containers also enables augmented reality applications that are based on location technologies.

SOLUTION

DETAILS

The sensors inside the containers which are measuring temperature, humidity, air pressure etc. enabe a system that automatically maintains the conditions inside the containers optimal for its content. The situation of a specific container can be monitored remotely and if limiting values are met, the system gives a warning about it and remedial actions can be carried out.

These features are also enabling the system to detect when, where and why cargo is damaged and to prevent the damages in the future. All of the gathered data can be used to analyze patterns and regularities when cargo receives some sort of damage. By capitalizing this information, it is possible to reduce the amount of damages during the transportation process. The gathered information can be shared with clients through the application, which can add value for the customers. For example live updates on the locations can help to maximize the efficiency on ground as well, when these updates combined with previous data can offer precise forecasts for when the cargo is delivered.

Containers are equipped with smart applications in a manner that enables them to be connected to automation systems supported by IoT applications. These smart containers can then be a part of more and more efficient transportation systems. Smart containers can also be enriched by applications that use augmented reality (AR) to increase the efficiency in the harbor area. For example AR can help to detect which specific container has the specific content.

ETHICAL DISCUSSION

The key ethical problems in our project are transparency and data privacy. According to the ACM Code of Ethics, a computing professional should be transparent and provide full disclosure of all pertinent system capabilities, limitations, and potential problems to the appropriate parties. In this project, transparency is ensured by informing all the related stakeholders about the steps of the project, even about possible problems. Transparency is also ensured by carefully documenting the decisions made to make sure that it is known by whom and why these decisions were made. These documents are afforded to all the parties involved on demand. Data privacy is ensured by using necessary information security systems to prevent unauthorized access to the data. These information security systems are used both in the sensors and in the application provided to the end users. Data privacy is also taken in notice when creating the systems for the clients. If any unlisted client data or nonpublic business strategies are learnt by the project team, this information is kept as a secret and all the documents considering it are secured.

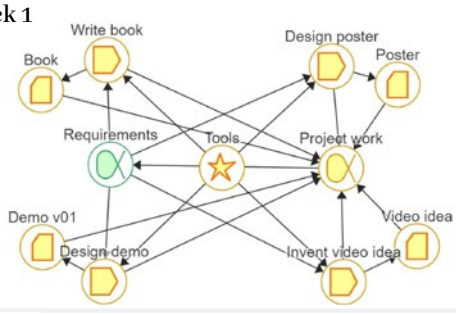
KV
GL

FICE
Olivia Luttinen: video wizard
Jenna Seppä: demo wizard's apprentice
Emmi Laukkarinen: demo wizard
Annika Jokisuu: team lead, poster wizard
Elina Savilaakso: Essence wizard

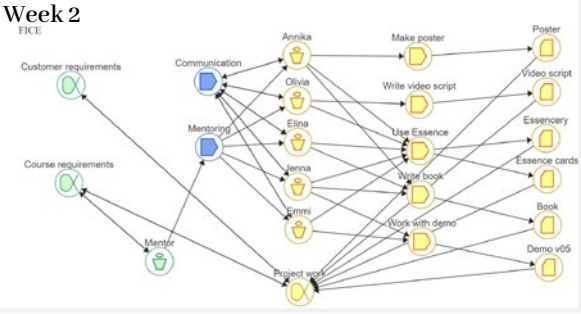
UPM

The case was provided by UPM. Our solution will benefit not only UPM but also their customers and other stakeholders. Our solution will provide UPM information which can used by UPM employees, dock workers, transportation providers, factories and UPM customers depending on its distribution. Essentially, the end users will be people from several fields such as office workers, management, dockworkers, truck drivers and factory management. The distribution of the information is decided by a human-computer duo, and its aim is to replace goods which are damaged en route to the customer as quickly as possible.

Week 1



Week 2



PROJECT: AUTONOMOUS MARITIME ECOSYSTEM

SMART SENSOR SYSTEM

TELLS YOU ABOUT DAMAGED GOODS

ANNIKA JOKISUU, EMMI LAUKKARINEN, OLIVIA LUTTINEN, ELINA SAVILAAKSO & JENNA SEPPÄ

CONTEXT

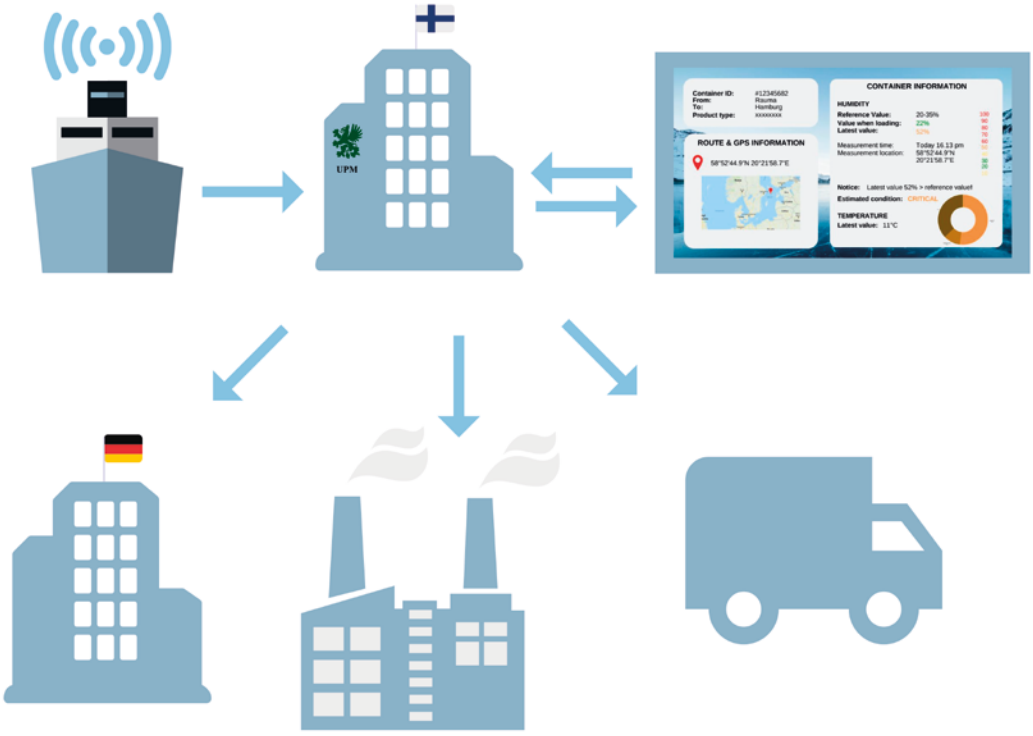
Cargo gets damaged in the containers due to weather conditions such as humidity, but it isn't noticed by UPM until the customer files a complaint. This costs time and money, because the product needs to be replaced and shipped again

TECHNOLOGY

Internet of things is a network of objects connected to the internet, which are able to communicate with each other. Objects can be non-electronic objects such as containers which have sensors embedded in them (Wireless Sensor Network).

SOLUTION

Humidity, temperature and location measuring sensors are embedded to the containers. They alert the tracking application if the conditions in the container differ from the reference values. This information can then be used by UPM and they can alert e.g. their customer, their factories or their transportation partners.



+ SAVINGS + EFFICIENCY + ENVIRONMENT + REPUTATION + CUSTOMER SATISFACTION

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JYU UNIVERSITY OF JYVÄSKYLÄ

BACKGROUND

CONTEXT

We wanted to tackle the technical and quality challenges that are present in the logistic puzzle presented by UPM. Our solution focuses on cargo damages which are caused by weather conditions, for example increased humidity through condensation. We want to apply sensors with IoT technology to the containers and develop an application that then transforms the data to valuable information to help monitor the cargo and its state. The products transported are delicate and therefore damaged easily. This causes significant operating loss due to damaged goods which are not discovered before the end destination. This also affects the company's reputation and customer satisfaction. Increased data on cargo can help decision making and become a valuable asset for the company when making effort on increasing the service level. Based on the data the sensors produce, then transformed into useful information with our application, an appropriate response can be executed and alerts sent in real time, if the situation is critical. Currently there is no data of the cargo or its state available and all possible check-ups must be made manually. That increases the workload in the harbour and can cause delays, which again causes extra costs. We also wanted to choose a solution that is easy to install, replace and re-install and thereby all containers must not be replaced at once, and the transition can be made in phases. This way the solution is sustainable and the containers currently in use can be used until the end of their lifespan before moving to eg. completely smart containers. The phases also help the company adapt to new technology, test out desired features, and in addition resistance to change can be reduced.

TECHNOLOGY

Internet of things (IoT) can be defined as “An open and comprehensive network of intelligent objects that have the capacity to auto-organize, share information, data and resources, reacting and acting in face of situations and changes in the environment”. In other words, this means that internet of things is a network of objects communicating with each other and reacting to the information they receive. Objects don’t necessarily need to be electronic devices such as computers but instead they may be ordinary objects such as containers which have sensors embedded in them. The sensors are then connected to wireless network which often is the Internet. [1] This wireless sensor network is a key aspect in the future of IoT. [2] The ever-expanding availability of the Internet allows the internet of things to spread all over the world. This will give globally active companies a chance to follow their items wherever they go. This in turn will help companies “become more efficient, speed up processes, reduce error and prevent theft.” [1,3]

[1] Madakam, S., Ramaswamy, R. and Tripathi, S. (2015). Internet of Things (IoT): A Literature Review. Journal of Computer and Communications, 3, 164-173
[2] Kelly, S. D. T., Suryadevara, N. K., and Mukhopadhyay, S. C. (2013). Towards the Implementation of IoT for Environmental Condition Monitoring in Homes. IEEE Sensors Journal, 13(10), 3846-3853.
[3] Ferguson, T. (2002). Have Your Objects Call My Object. Harvard Business Review, June, 1-7

SOLUTION

BUSINESS DETAILS

This solution helps to track and potentially save cargo that might have been destroyed without the information provided by the sensors. This solution enables the information about damaged cargo and its location to reach the right persons much faster than before. This makes it easier to make decisions about the damaged goods, and the customer can be notified about the situation in advance. This helps the customer to prepare and make changes in their schedule and therefore increase customer satisfaction. In addition, the damaged cargo won't necessarily reach the end-customer because the damage can be detected during the transport process. This frees the customer from doing the manual notification of damaged products that arrive to the end-destination. We predict that the largest business benefit of this solution can be the positive effect on UPM's reputation. Although there are various reasons why defining the value of an industrial IoT application project is challenging. The added value typically accumulates over time, and shows up gradually when introducing a new process. The value is usually difficult to quantify because of complex processes and multiple interactions, and at the same time it creates both hard and soft benefits, that are tough to determine. Value can be formed through a combination of IoT applications with other processes or systems, and can result to new interactions or human behaviour eg. ways of working. [4]

TECHNICAL DETAILS

Sensors are installed to the containers that are used when transporting the cargo. The sensors measure humidity and temperature from the containers. These sensors also provide a GPS signal, so the precise location of the container can be known. The data which is measured by the sensors is compared to the reference value and then the condition of the products are estimated based on this comparison. The possible conditions of the products are: Good, Compromised, Critical and Damaged. When the humidity of a container is more than the reference value, the system will send a notification to the application.
The technology we are suggesting is NB-IoT. There are many possible benefits of using this technology, for example extended coverage, the battery life can be over 10 years, massive number of connected devices at once (ca. 50000 per a 180 kHz cell) and low device costs. [5]

ETHICAL CONCERNS

The biggest ethical concern related to this solution is data security. If the system isn't secure enough, unauthorized persons might gain access to the data and misuse it. Unauthorized persons might alter the data or use the information the way it is not intended, eg. the GPS signal of the container or the customer information. The solution for this concern is to make the system as secure as possible, store the data in a secure place and pay attention to this aspect already during the development process.
In addition, the system is used by humans so there is always a possibility for human error if someone interprets the information incorrectly. This might cause extra costs or even environmental problems. This can be resolved with proper training for those who are using the application. Also the users can't just rely on the data from the sensors. They need to use their own judgement and professional skills to justify decisions.

[4]Fantana, N. K., Riedel, T., Schlick, J., Ferber, S., Hupp, J., Miles, S., Michahelles, F. & Svensson, S. (2013). IoT applications—value creation for industry. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, 153-206
[5] Malarski, K. M., Bardram, A., Larsen, M. D., Thrane, J., Petersen, M. N., Moeller, L., & Ruepp, S. (2018, November). Demonstration of NB-IoT for Maritime Use Cases. In 2018 9th International Conference on the Network of the Future (NOF)(pp. 106-108). IEEE.

ContaGo application provides an easy tool for UPM employees to understand container traffic at harbours.

Design by ProTeam, a group of five Finnish students from the University of Jyväskylä.

OUR VISION

To be the No. 1 innovative solution provider that creates evolving AI systems to help with the management of container logistics.

OUR TEAM

Anton Tammenoja
Team Leader

Henri Krats
Essence Master

Valtteri Lohi
Developer

Heidi Vasanoja
Marketing Manager

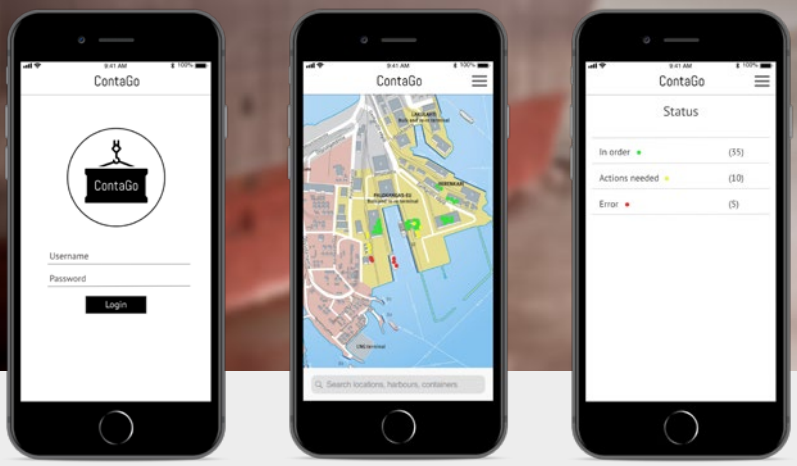
Sanni Teukku
Developer

Project: UPM Smart Harbour

ContaGo Application

Understand your container traffic easily!

ProTeam: Anton Tammenoja, Henri Krats, Valtteri Lohi, Heidi Vasanoja & Sanni Teukku



Visualized tracking

See your containers' locations and status with just a glance.

Powerful search system

A simple search field to search locations, harbours and containers.

ContaGo is a simple application which helps employees to understand container traffic easily. Employees of different levels can use ContaGo to send container requests to the staff. ContaGo requires that each container has a tracker which sends information to the system. The solution makes controlling of the containers at the harbour area significantly easier.

Task manager

Check your containers' status and make urgent actions right in the application.

Auto updating

All changes are updated automatically which enables every user to see them almost immediately.

Background & Current challenges

REQUIRED TECHNOLOGY

The solution is ready to use with the current tracking technology but future development of especially AI technology makes the solution grow stronger.

Solution

+

=

EFFICIENCY
TIME SAVING
PROFIT

TRACKERS & AI

Trackers are attached to the containers to recognize their location on map and in the vertical direction. This enables the evaluation of time and resources needed to handle the container.

The learning AI will be able to automatically change the status of containers and suggest actions.

PROFITS

Time and costs are saved thanks to the effective operations and reduced waiting costs. Decisions can be made fast with the support of the system and the need for demurrage and vessel rescheduling decrease.

APPLICATION

Information flows fast which is crucial in case of last minute booking changes and delays or errors in container handling operations.

The application shows logistical problems clearly so that they can be recognized and solved fast.

- In order
- Actions needed
- Error

ETHICAL CONCERNS

AND HOW TO TACKLE THEM

To keep the information safe from unauthorized use, the system requires defining who is authorized to access and modify which piece of information by using different employee roles.

CONTINUITY

Applying IoT solutions to the maritime envorment

INTRODUCTION

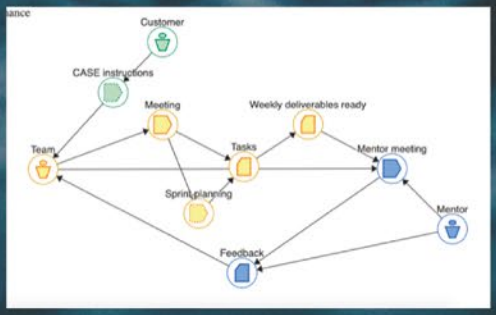
Team performance: Kalle Kolho Developer , Petra Hillilä Team leader, Niko Koivisto Digitalization expert, Mikko Lehkonen Designer and Kristiina Kareno Architect (not in picture)

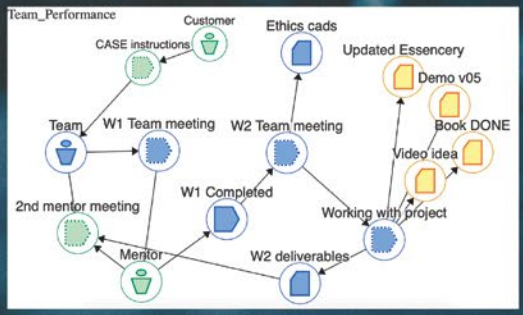
PERSONA

AA BB is a member of the logistics department of UPM. His/Her work mostly consists of managing the transportation of goods and solving issues concerning damaged or lost goods. He/She would like to have more information on the state of the goods during the tranportation. This way he/she would be able to make better decisions when faced with problems.

WOW

Week 1: We had one face to face meeting with the team. In the meeting we discussed about the problem and what would be a solution. Tasks were shared between the members. All work was done individually and we discussed via WhatsApp. For example, Petra was in charge of the book pages, Mikko designed the software UI and Kalle created 3D modeled drawing of our solution. Kristiina was in charge of the Essencery. In mentor meeting the team will get some feedback and instructions how to continue with the case.





CONTINUITY

Applying IoT solutions to the maritime envorment

BACKGROUND

Logistics company UPM-Logistics responsible for logistics solutions in the forest industry seeks to increase performance and reduce costs in maritime logistics with the help of future technological applications.

PROBLEM

Visual and hidden damage during transportation

No way of knowing when the damage was inflicted

Costs of approximately 5 million annually

Dissatisfied customers

TECHNICAL REQUIREMENTS

Weatherproof

Uses existing infrastructure

Ability to measure

Ability to use measured data

TECHNOLOGY AND SOLUTION

Weatherproof packaging material applied with sensors

Ability to track the cargo, and it's condition for moisture and temperature

Close to live tracking of the cargo through GPS

AI monitors the values and alarms the user if predetermined values change

.

OUTCOME

All weather protected packaging for existing logistic infrastructure

Reduction of losses & Increased customer satisfaction

Active condition monitoring of cargo

TJTSM54 Advanced Topics on Systems Development
Cyber-Physical System development, Gartner-development model, DevOps, BizOps and DevSecOps, Essence theory of software engineering, blockchain software engineering and continuous software engineering.

Startuplab LabStartup JYU

Teaching Team
Pekka **Abrahamsson**, Sami **Kollanus**, Ville **Vakkuri**, Juhani **Risku**, Kaj-Kristian **Kemell**,
Mentors: Johannes **Impiö**, Joni **Kultanen**, Joonas **Himmanen**.

JYU UNIVERSITY OF JYVÄSKYLÄ

CONTINUITY

Applying IoT solutions to the maritime envorment

BACKGROUND

COMPANY

UPM Logistics is a logistics company responsible for the logistic services of the UPM-group and heavily involved in maritime trade as well as port networks that include operations all over the globe.

PROBLEM

The current UPM Logistics sea transport modes are multiple step processes that require advanced monitoring for them to succeed as intended. Currently the transportable goods are transported in three different ways, which all include a sea voyage. These current methods face multiple problems during the logistic chain. One of these problems is that the variety of processes can cause problems with the safety and quality of the transportable goods as they can be damaged during loading and transportation. In addition it is problematic that efficient monitoring methods are missing which makes it difficult to know when possible damage happens during transportation. These damages cause UPM losses of multiple millions annually and cause problems with customer relations.

TECHNICAL REQUIREMENTS

To solve these problems we identified specific requirements for technical solutions.

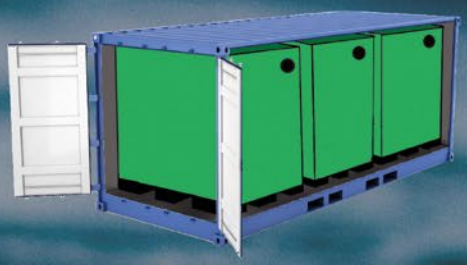
These requirements are:

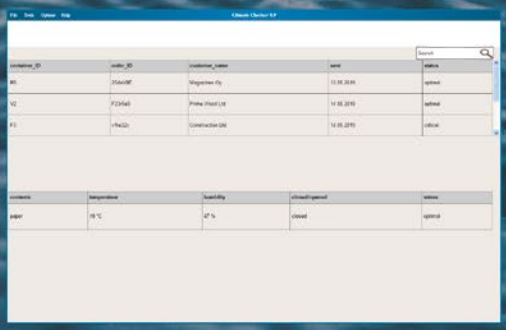
- A new weatherproof traceable transport solution that can be used with current infrastructure.
- Sensors that are able to measure pressure, temperature and moisture during transportation.
- Artificial Intelligence that is able to read sensor data and inform of possible damages

CONTINUITY

Applying IoT solutions to the maritime envorment

SOLUTION





TECHNICAL DETAILS

Our solution suggests, that the goods transported in containers should be packed with lightweight yet durable in shells that are equipped with censors. The shells should be plastic, light weight yet durable. They should not take too much space from the container, and they should create lean processes for logistics. The visualization of the shells can be seen in the first picture. The containers shall be attached to the container with drive belts to ensure safety. The censors attached will observe the temperature and the moisture level of the container. This information is observed automatically with AI, and only values exceeding the limits are alerted to user. The values are transported via satellites, to provide near to real time information. Logistic users are alerted via UI providing the information about the values, location, information of who has opened the container and what it contains. Our solution suggests that UPM should create the shells, and not try to modify the containers. This is, because same containers are used company wide, and all companies are probably not willing to commit to sensors. They will provide information on that can help to decide which sub-contractors are best for goods safety. When noticed if goods are damaged, the compensatory products can be sent and customer can be notified earlier. This will elad to better customer satisfaction.

INTERNET OF THINGS AND SENSORS

Internet of things solutions will bring strategic edge and work as a game changer. These infrastructures will play critical role in transforming our society to "smart economy". There can be found four main capabilities in internet of things. They are monitoring, control, optimization and autonomy. Our solution focuses mainly on monitoring, where sensors collect external data and enable monitoring. This enables our alerts and change notifications. IoT can be seen as a game changer, as data has been collected previously in closed systems. With IoT and operational systems, data can be managed quick and cost effectively. This allows UPM to monitor and optimize their containers.

KEY ETHICAL CONCERNS

DATA PRIVACY

It is an ethical concern, who can see and modify the data that the sensors collect.
These are issues that must be included in UPMs policies. This will ensure accurate and unbias data and decisions.

AI ACCURACY

It can be an ethical concern, if the Ai, that is implemented to the solution is not working properly. Because of this, the developers and testers have great impact on providing accurate Ai solution.

LOCATION INFORMATION

When tracking the containers, we are also locating the workers for example truck drivers. This can create an ethical issue. Because of this, it the data policies regarding the location are important. It is also crucial to communicate all sub-contractors, example the drivers, that they are not monitored, but the cargo is, and used only to ease logistic chain.

Project Work: Autonomous Maritime Ecosystem

MAKE CARGO SMART WITH SENSORS

Our Customer

Our customer is UPM Logistics. Their responsible for cargo safety will be benefiting the most from our sensor technology. He has access to the sensor control center, application and database.

Our Team

Way of Working

Our team is using cooperation and project management to control our way of working. We are planning weekly sprints based on requirements given by customer. During sprint planning we create/check out our TO DO list that we can be aware of all things that must be done.

Sprint activity space includes activities as contacting via Whatsapp (this includes EAD card discussion and updating WOW), meeting with mentor, and sprint release. The skills we need during sprint release are design and innovation skills.

This activity's purpose is to plan work products and work with them; demo, video and book pages. These work products are done to demonstrate and introduce the actual product; sensor system (alpha).

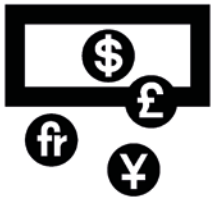
BY HELPPOO JA KIVAA

TJTSM54 Project Work: Autonomous Maritime Ecosystem

MAKE CARGO SMART WITH SENSORS

1. We collect the data from cargo containers in every phase of the distribution process, including loading in the harbor, transport by the seas and delivery for the customers.

2 We collect sensor data of the cargo container that measures the humidity levels, gyration, location and physical contact with other cargo units in order to determine the sources for damages.



3. The main values that the solution provides are lower costs, better damage analysis, optimization of actions and the role as forerunner in maritime ecosystem development.

BY HELPPOO JA KIVAA

TJTSM54 Advanced Topics on Systems Development
Cyber-Physical System development, Gartner-development model, DevOps, BizOps and DevSecOps, Essence theory of software engineering, blockchain software engineering and continuous software engineering.

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Project Work: Autonomous Maritime Ecosystem

MAKE CARGO SMART WITH SENSORS

Contextual info

Our project team is suggesting a solution for maritime industry which is a part of Autonomous Maritime Ecosystem project in order to tackle the challenges the company is facing utilizing current technology and development methods, giving room for future innovation endeavors facilitated by our solution.

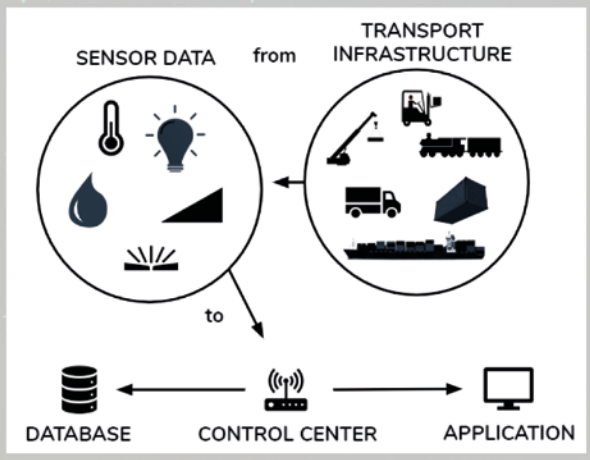
Problem

The problem maritime industry is facing is cargo damages. Damages can be caused by weather condition, physical contact with other cargo units or by human error. These damages increase costs and decrease company's reputation. Customers demand high quality service, and these damages makes satisfying customers harder. Cargo damages may be visible or invisible, which makes damage control challenging.

Technology

We chose to use sensor technology. It could solve the problem with cargo damages. It can easily detect conditions that might lead to damages and inform about them quickly.

Sensor technology utilizes Internet of Things which requires working Internet connection during voyages. As the network connection functionality during voyages is an issue at the time of our project, we will develop a solution with current technological restrictions in mind.



BY HELPPOO JA KIVAA

Project Work: Autonomous Maritime Ecosystem

MAKE CARGO SMART WITH SENSORS

Ethical concerns

The main concerns about out project ethics are linked with transparency, accountability and resposibility of the data our solution provides. The data is only used to inform about cargo damages and therefore help our customer UPM to strengthen its logistic process and reputation as reliable supplier. The data has no other use and it won't be available for anyone else.

Business details

The goal is to develop a sensor system that can detect why damages happens. Hence, it is possible to prevent them.

The main values that the solution provides are lower costs, better damage analysis, optimization of actions and the role as forerunner in maritime ecosystem development.

Technical details

Our answer is sensor technology, utilizing the Internet of things through smart cargo, which would detect, for example humidity within containers related to weather conditions and container tightness. It would also help figuring out possible causes and scenarios resulting in visual and hidden damages, for example if there is contact to cargo unit walls and floor.

We collect sensor data of the cargo container that measures the humidity levels, gyration, location and physical contact with other cargo units in order to determine the sources for damages that could lead to visible or invisible defects, facilitating decision making. The data can be biased from sensor defects, such as the sensor getting wet and giving higher levels for humidity, which can be corrected with repairs.

BY HELPPOO JA KIVAA

NAMELESS

GOAL:

Using technology and sensor-based data to enhance processes in harbors, and to reduce the number of damages during the shipping process. Also, this solution will reduce the amount of corrupted data.

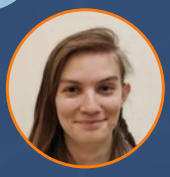
SOLUTION:

Enhance the maritime industries smart harbor system by providing sensor data from the container. Sensors collect data from within the container during shipping and this data is processed to a QR-tag. There is a QR-tag attached to every container which can be read by an automatic camera system. Data will be saved to a cloud service, where it can be analyzed and utilized.

END-USER:

End-users for this solution is UPM Logistics, and all the workers who are connected to this logistic channel including the harbor workers, and subcontractors in the supply chain.

OUR TEAM:



Laura Koskinen

TEAM LEADER

Toni Järvinen

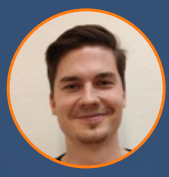
DESIGNER

Kasperi Kokko

DEVELOPER

Anna-Maria Parviainen

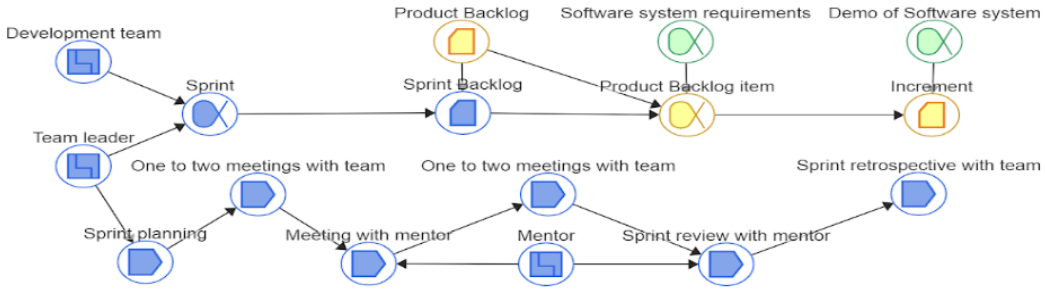
DEVELOPER



Jesse Putkonen

DEVELOPER

OUR-WAY-OF-WORKING



Project: Autonomous Maritime Ecosystem

CARGOLESS

NAMELESS: Laura Koskinen, Toni Järvinen, Kasperi Kokko, Anna-Maria Parviainen, Jesse Putkonen

The current maritime industry processes at harbors are too slow and ineffective. There is too much loss of goods and information which leads to more expenses. Using technology and sensor-based data will enhance processes in harbors and help track the damages occurring during the shipping process. The sensors inside the containers collect data during shipping. This data is then read through a QR code situated on the side of the container by an automatic camera system at the harbor. The data helps identify the causes for possible cargo damage and reasons for delays in shipping, as well as solve responsibility and accountability issues.

TEMPERATURE

Detects if the temperature inside the container goes too high or too low to prevent the risk of damaging the cargo

SHOCKS

Detects the possible shocks and hits that happen in the container and therefore reducing the damages happening for cargo

TILT

Detects the movement of the container, logging any that might harm the contents of the container

SOLUTION:

POWERED BY: Logmore

QR data logger tag

Sensor data is readable through a QR code

AUTOMATIC CAMERA SYSTEM

The camera system uses image processing technology to read and automatize the data collecting from the containers

HUMIDITY

Detects if the humidity inside the container is too high and may cause damage to the cargo

LOCATION

Detects the accurate location of the container, showing it on a map in the app

AMBIENT LIGHT

Detects if the container has been opened during the logistic chain

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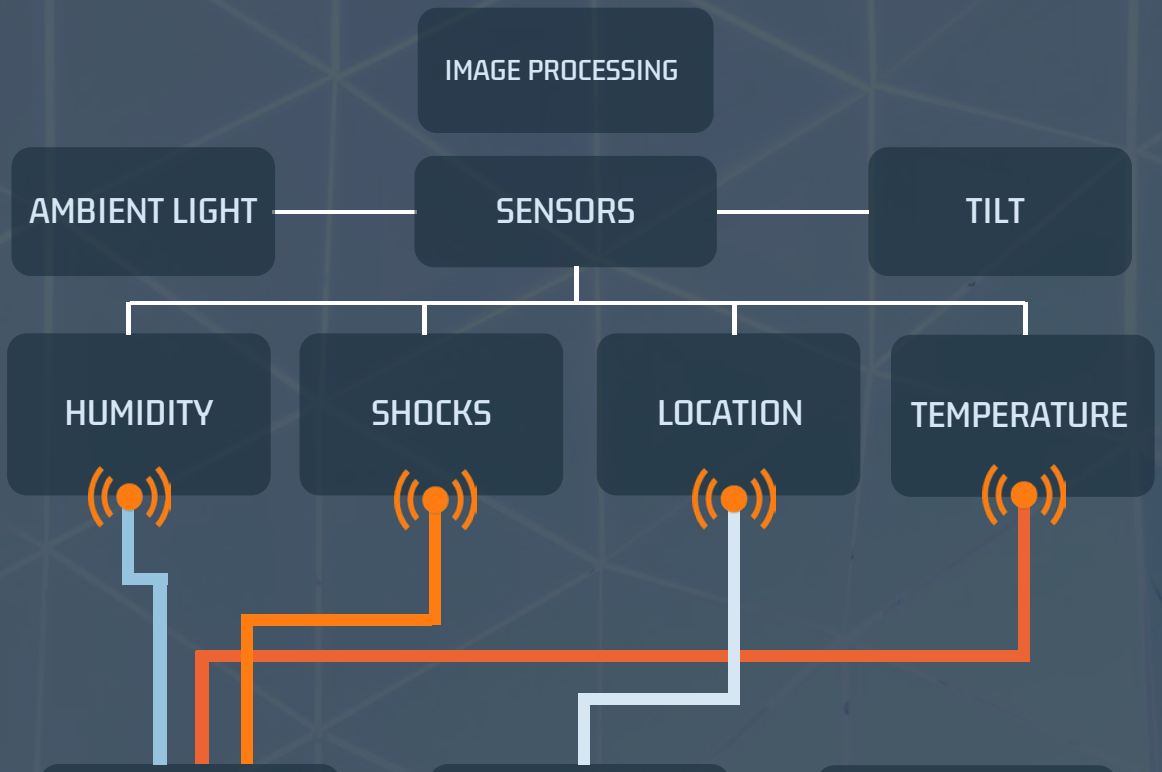
TECHNOLOGY



DAMAGED CARGO

SLOWNESS OF HANDLING CONTAINERS

CORRUPTED INFORMATION

Current processes are too slow and ineffective. There is also too much loss of goods and information which leads to more expenses.

PROBLEM

TECHNICAL SOLUTION

SENSORS & QR DATA LOGGER TAG

Logmore QR data logger tags and sensors are installed to every container. The product is a sensor that delivers crucial information regarding the inside of the container. It measures humidity, temperature, location, shocks, tilt and ambient light. The information regarding the container is sent to a cloud service after the QR code is read with image processing technology..

AUTOMATIC CAMERA SYSTEM

An automatic camera system will be installed to every harbor. This system uses image processing technology that reads the QR code and collects the data from the container. Automatisation of the current processes makes shipping faster and more effective. It also enables to track damages to the cargo.

KEY ETHICAL CONCERNS

When dealing with information technology it is always necessary to invest in information security. The information gathered from the containers or the camera feed from the harbor should not be available to third parties. In addition, the camera system should not be used for anything else than its original purpose i.e. scanning container QR codes. This can be avoided by making sure the system is secure enough and only authorized people have access to the system. Authorized personnel should have proper training in the usage of the system. It needs to be clear who is accountable for possible misuse of the system.

TOPI'S DOGS

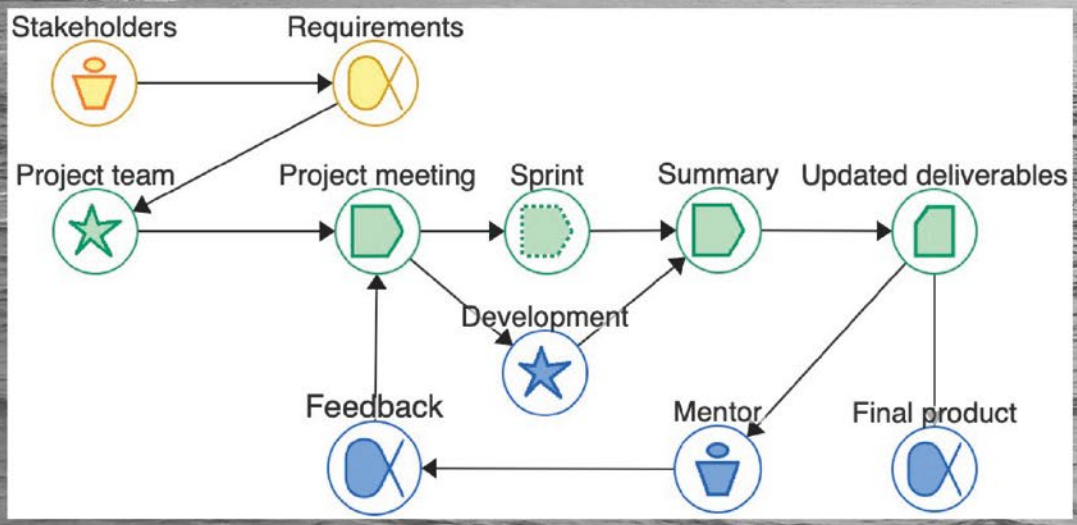
Anssi Lahtinen
Team Leader

Roope Koitola
Concept Architect

Topi Tikkanen
Developer

Santeri Ulander
Developer

Our Way Of Working



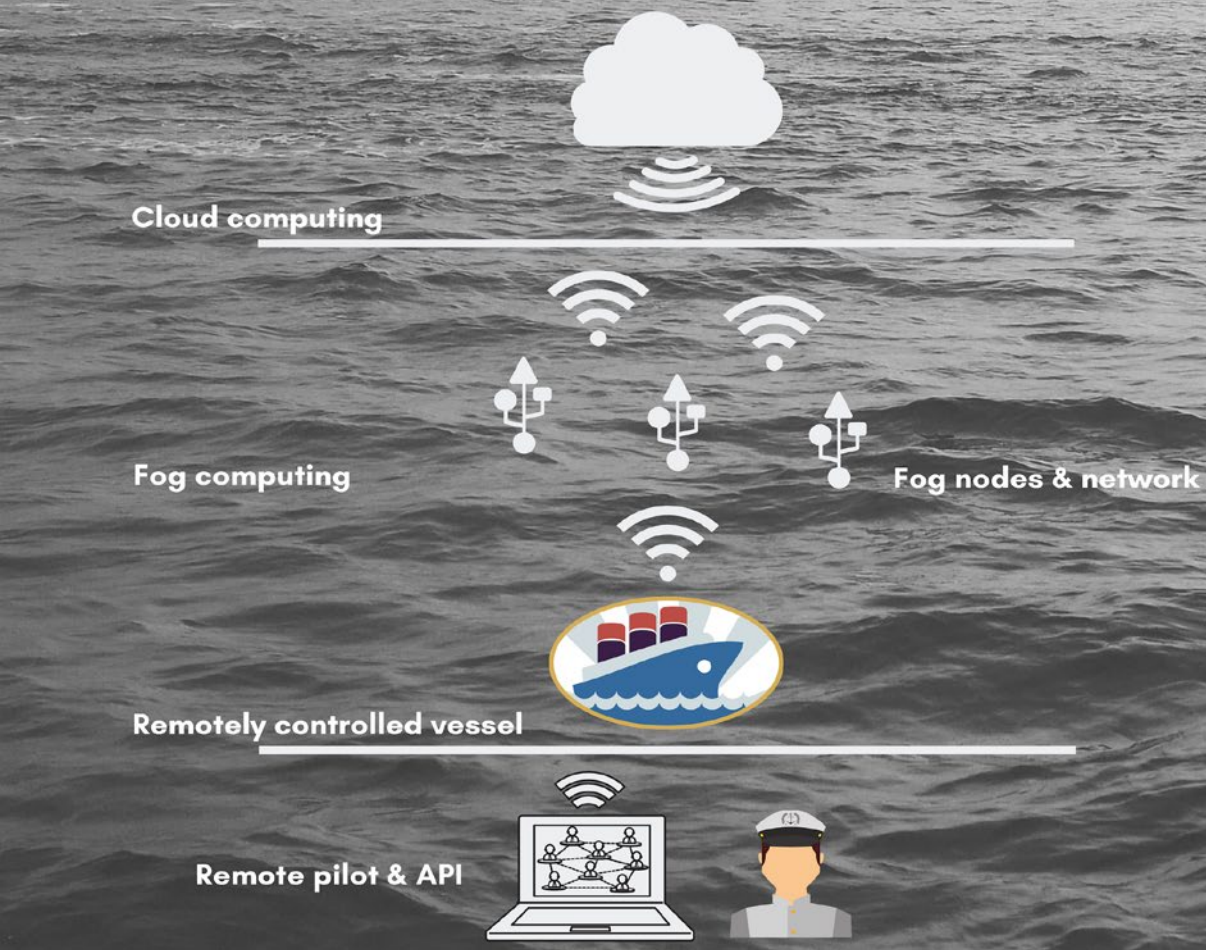
SEA4VALUE: SMART HIGHWAY NAVIGATION

Our solution is to create a system for efficient and safe way of guiding vessels through environmentally problematic areas. The system will enable remote pilotage and eventually automatize maritime navigation in these areas and harbors. These areas also include shallow and narrow parts of oceans and lakes where the vessels might have problems to navigate. Our system will benefit all the logistics companies which utilizes maritime logistics. The target customer of this system is any logistics company that utilizes ships and vessels in their transportation methods.

Project: Autonomous Maritime Ecosystem

GOFOG

Revolutionizing maritime navigation utilizing system powered by fog networks and computing. The system enables safe navigation through challenging environments



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CHOSEN TECHNOLOGY

Fog computing

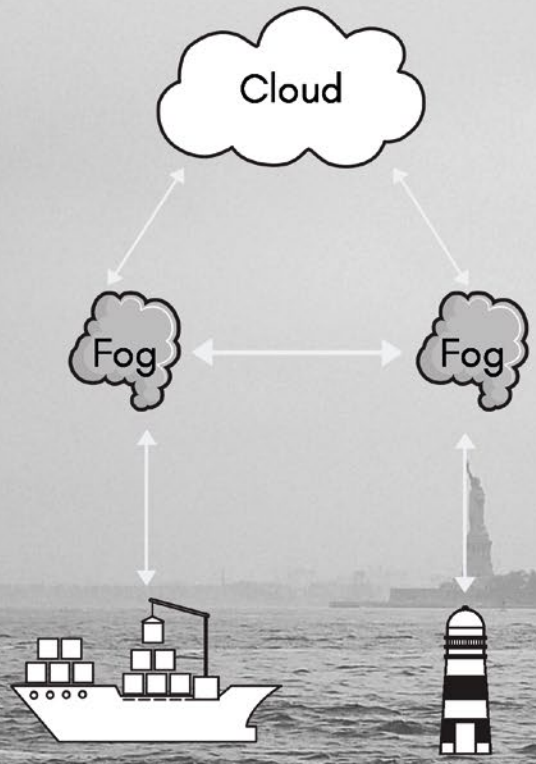
- Fog Computing is an architecture that utilizes network devices on the edge of the network to do computation tasks and route communication forward

Fog network & nods

- The network consisting of connected devices is called fog network
- The devices connected to the fog network are called fog nodes
- Fog node can be for example 5g router

System built on fog network

- The fog network offers infrastructure for the system to be built on
- The system is maintained by the whole network and by every fog node
- The system expands the network to bigger landscape by utilizing all the fog nodes



PROBLEM DESCRIPTION

- No infrastructure for the system to be built on
- Manual navigating required especially in challenging environments (archipelago, harbour)
- Limited communication methods

SOLUTION

How the system works?

- System utilizes fog computing
- Fog nodes, which maintains the system and fog network, located in the vessels, islands, harbors and shoals
- Fog nodes communicate and share the network with each other
- System enables maritime tracking and remote pilotage
- System collects data and by utilizing AI enables autonomous navigating in the future

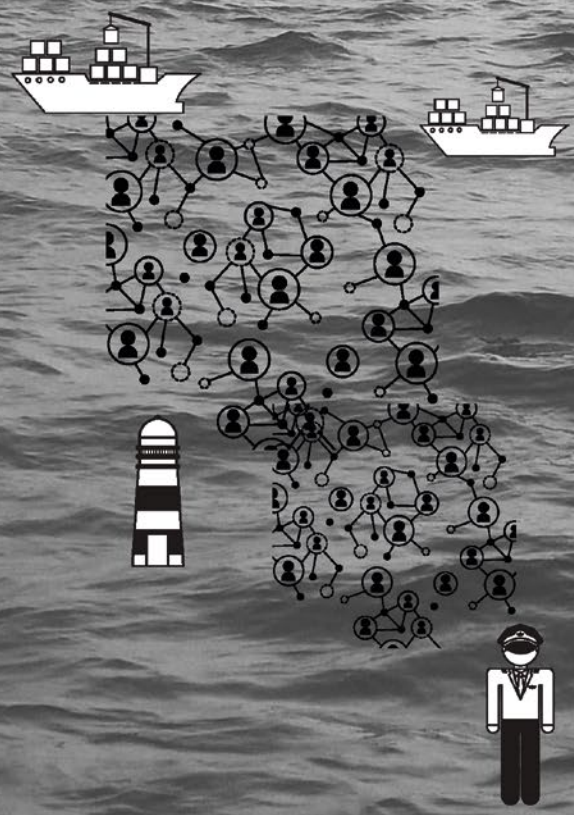
ETHICAL ASPECT

In case of an accident, who is responsible?

- Remote pilotage -> Pilot
- Autonomous vessel -> Service provider

How to tackle these issues?

- Comprehensive testing of the system with emergency pilots on board



SAMUEL
HUOTARI

Development supervisor

Managing quality of the developed products through the project

JOONA
KAUPPINEN

Project leader

Managing the project team and the timeline

HEIKKI
PEKKALA

Case supervisor

Managing the important stakeholders through the project timeline

TIMO
STADIUS

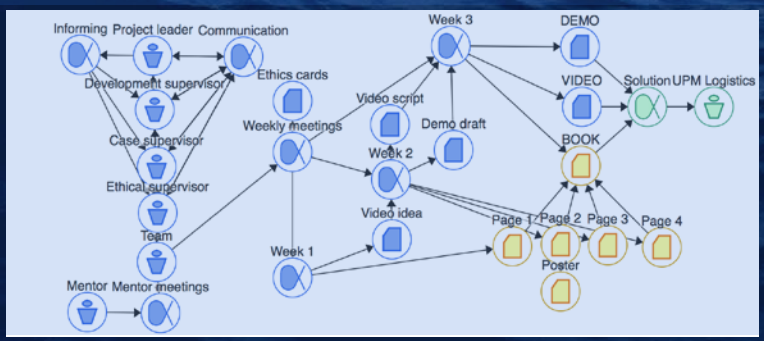
Ethical supervisor

Managing technical ethics through the project scope.

how to make harbour more intelligent?

SMART HARBOUR

Our product will be beneficial for numerous parties. It will be produced for UPM logistics and therefore their business operations will be the main focus for this project. Indirectly there will be also benefits to the harbour as a whole as they can also improve performance. Finnish maritime industry will gain benefits from the developed system as a whole in a larger scale. UPM logistics and its stakeholders in maritime industry will be the end user for the developed concept.



Concept

SMART HARBOUR

Technological background

- A lot of meanless data floating around the operations
- Analogical data collection and data changing in the operations
- Major part of data usage is done manually
- End customers are generating tight requirements for operators in the harbour

Technologies in the solution

- Cloud based system with 5G capabilities
- Sensors are creating data autonomously
- Secure platform in which information is exchanged
- Web enabled devices are acting without human interaction

Industry background

- Traditional operations development methods are not enough to achieve further results
- UPM wants to be the forerunner in smart port and maritime ecosystem development
- Smart harbour operations and logistics connect the road, rail and maritime transport systems and enable multimodal transportation.
- Maritime transport is the catalyst for economic development and prosperity.
- The major problem in the industry is how to utilize digitalization, autonomy and technology possibilities

Solution in general

Intelligent loading points for trucks and trains

- Data from the loading points with sensors
- Weather conditions
- More efficient of maintenance
- Reduced downtime

Navigation in real time

- Traffic flow
- Personalized navigation
- Traffic situations inside the port
- Creating overall image about the harbour situation

Mobile sensors

- Finding closest free crane or forklift
- Weather changes tracked with sensors
- Smarter maintenance of vehicles

Harbour monitor software

- Application for the harbour stakeholders
- Collection of the data is centralized
- Possible to share data with stakeholders

Technology background & Challenges

Technology background

Cloud based system

- Applications and services are offered over the Internet
- Provides network connectivity between applications and resources that are present on a cloud

5G

- Fifth-generation wireless networking architecture
- Improvements in speed, capacity and latency compared to 4G
- Enables multiple new use cases that are impossible to be done via older network standards

Sensors to create data

- Devices that detects and responds to some type of input from the physical environment
- Send the data over network for further processing

Web enabled devices

- Web-enabled devices that use embedded processors and sensors to collect, send and act on data they acquire from their environments
- The devices do most of the work without human intervention

Challenges in the harbour

Operational

- **Last minute changes** to major details
- **Missing details** in container information
- **Changing weather conditions** in harbours
- **Stock overflow and capacity** are major factors for operations reliability

Technical

- Due to ever changing weather conditions **equipment condition** plays significant role
- When harbour equipments are manually handled **human errors** can occur
- Cargo might form **visual or hidden damages** in different supply chain parts

Solution & Ethical concerns

Solution

Intelligent loading points for trucks and trains

- Data is transmitted from the loading points with sensors through the cloud
- With digitalizing loading points condition tracking the downtime of various platforms can be lowered because condition can be tracked and maintenance is becoming more efficient
- Using sensors and embedded systems to track weather changes it is possible to prepare for changes in the loading points

Navigation in real time

- To ensure safety and efficiency traffic flow data is combined from various sources
- Personalized navigation and traffic situations inside the harbour area
- With data it is possible to create overall image about the harbour situation

All purpose mobile sensors

- All purpose sensor could be use to find the closest free crane or forklift. GPS tracking could create information about the closest emergency vehicles
- Changes in weather could be tracked through the mobile sensors. Trackable variables could include temperature, humidity, wind speed and direction and pollution
- Including sensors in everything smarter maintenance of vehicles

Harbour monitor software

- Application for the harbour stakeholders to get the needed information and keep them updated with information provided with created system
- Data is centrally gathered and it can be accessed remotely. Gathered data is shared with stakeholders when needed

Ethical concerns

Accountability

Who is to keep accountable, if something goes wrong?

- The solution system is to be build such a way, that it is possible to trace, who is to be held accounted for certain phase in the logistics chain. This puts the accountability of certain phases to the stakeholders
- UPM Logistics still can be held accountable, if given precepts are not clear

Responsibility

Who are those responsible for implementation, legality etc?

- In the big picture, it is UPM Logistics who are responsible for this solution. Again, stakeholders are to carry responsibility from their share of the processes, for example, following new directions, legality and conduct the training
- UPM Logistics is responsible to provide information when needed

Transparency

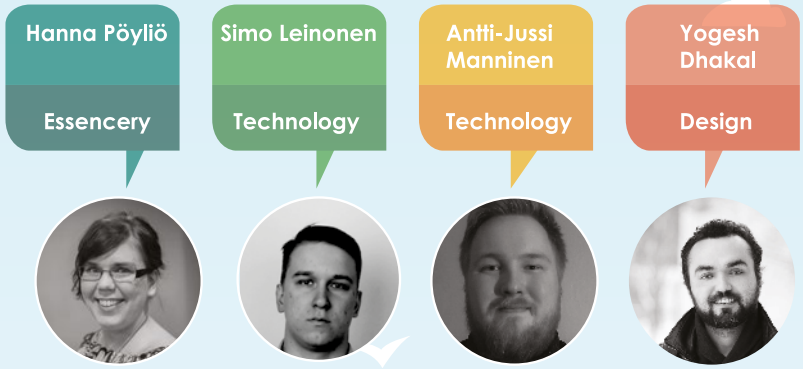
Who have access to data?

- Data is to make open to the stakeholders for the sake of transparency
- Developed system is a closed system, therefore no data is to be kept outside the stakeholders

PROJECT: AUTONOMOUS MARITIME ECOSYSTEM

Smart cARgo

THE CONCEPT INTRODUCTED IN THIS PRESENTATION HAS BEEN CREATED FOR UPM BY THE STUDENTS AT THE UNIVERSITY OF JYVÄSKYLÄ

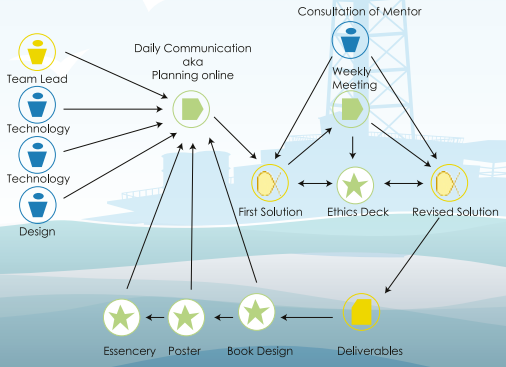


Description of Persona

Solution will be beneficial for UPM and its stakeholders, such as end users of UPM products and distributors of UPM products. It will also be beneficial for Finnish port`s operating cargo.

End users are UPM, Finnish forestry company and Finnish port`s operating cargo.

Week Two WOW



WAY OF WORKING (WOW)

The team worked intensively towards the solution. Daily communication online plus weekly meetings made it easy to work on the problem and comment on others ideas and suggestions. Clear roles were given to each member and the mentor was consulted on the solution in two phases. Ethics deck was used to help to formulate the solution.

JYVÄSKYLÄN YLIOPISTO

Team No-Code

Hanna Pöyliö
Simo Leinonen
Antti-Jussi Manninen
Yogesh Dhakal

UPM

PROJECT: AUTONOMOUS MARITIME ECOSYSTEM

Smart cARgo

THE CONCEPT INTRODUCTED IN THIS PRESENTATION HAS BEEN CREATED FOR UPM BY THE STUDENTS AT THE UNIVERSITY OF JYVÄSKYLÄ

Background

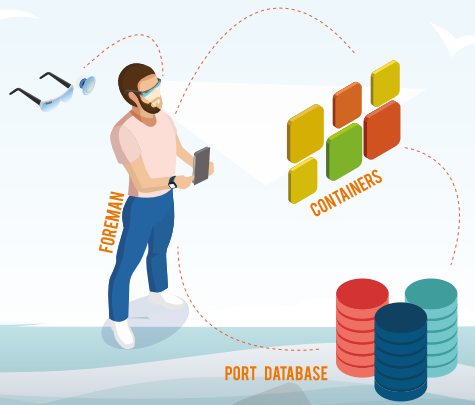
UPM is a global corporation specializing in manufacturing and refining various paper and forestry products with 10 billion € annual revenue (2017).

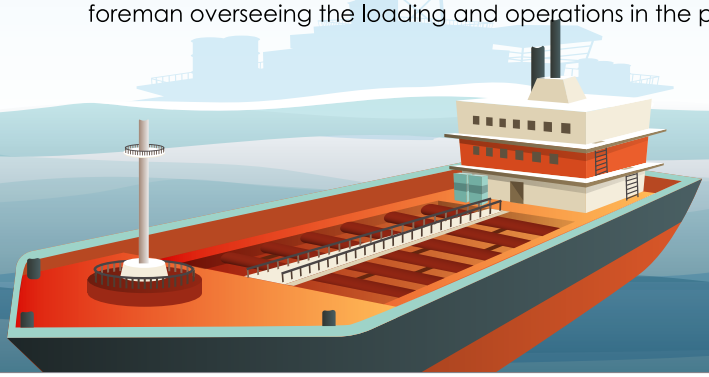
- UPM Logistics faces various operative challenges in it's port operations, that lead to cost and scheduling issues
- Core challenges for UPM Logistics include unsatisfactory operations effectiveness, lacking or faulty data, and operation delays, which in turn cause cost overruns to UPM Logistics

Solution

Checking and managing the container loading process using AR technology will both make the process faster and more efficient

- Place IoT enabled sensors onto the containers that transmit transport and content data about the cargo.
- The information of the containers is visible to the port foreman overseeing the loading and operations in the port.





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Antti-Jussi Manninen
Yogesh Dhakal
Mentor: Johannes Impiö

TJTSM54 Advanced Topics on Systems Development
Cyber-Physical System development, Gartner-development model, DevOps, BizOps and DevSecOps, Essence theory of software engineering, blockchain software engineering and continuous software engineering.

Startuplab JYU LabStartup

Teaching Team
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JYU UNIVERSITY OF JYVÄSKYLÄ

CHOSEN TECHNOLOGY

AUGMENTED REALITY

INTERNET OF THINGS

BACKGROUND

UPM Logistics faces various operative challenges in it's port operations, that lead to cost and scheduling issues.

Core challenges for UPM Logistics include unsatisfactory operations effectiveness, lacking or faulty data, and operation delays, which in turn cause cost overruns to UPM Logistics

PROBLEM DESCRIPTION

- The process of loading containers onto a ship could be conducted in a more efficient manner
  - Current method is that a foreman checks containers using paper paper or one-way technical documentation to make sure right cargo is being placed on the vessel
  - This process could be streamlined using technological concepts
- According to UPM, delays and insufficient data about the cargo are a cause for cost overruns
- Delays are commonplace and cause issues with port operation and dissatisfied customers
- This could be solved by implementing AR technology along with IoT into the port operations

JYVÄSKYLÄN YLIOPISTO

Team No-Code
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Simo Leinonen
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Yogesh Dhakal

UPM

SOLUTIONS

Checking and managing the container loading process using AR technology along with IoT will both make the process faster and more efficient

TECHNICAL DETAILS

Place IoT enabled sensors onto the containers that transmit transport and content data about the cargo

- Where is it going, what ship is it supposed to go on, weith and if the status of the container ok
- Data on humidity inside the cargo, tilt or movment of the cargo itself can also be monitored.

The information of the containers is visible to the port foreman overseeing the loading and operations in the port

- Using AR glasses or/and handheld devices, the status of the containers can be visually inspected instantly
- If a wrong container is being moved or the contents of the container have been damaged, the foreman can instantly tell and abort the loading process

BUSINESS DETAILS

Analytics and reporting based on the censor data enables better readiness for developing the processes further on. Problems that stand out can be traced easier and repaired more quickly. Company management will get precise information from reports based on the acquired data.

- Data can be used for better customer satisfaction, faster and safer delivery and process design

Information can be distributed to all units and information flow throughout the whole company will improve

- Knowledge management will be more efficient

ETHICAL CONCERNS

RESPONSIBILITY

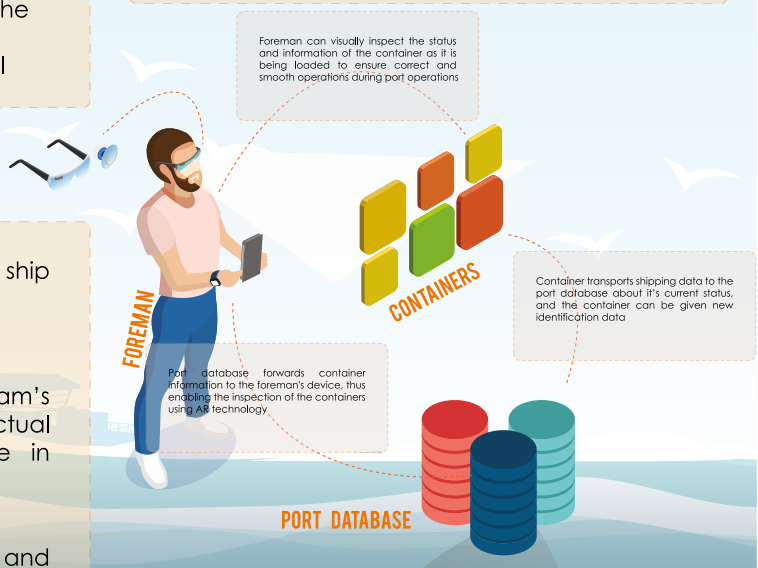
The goal is make the loading of the ship smoother - not trickier.

ACCOUNTABILITY

The demo was created based on the team's current knowledge of the subject. The actual product development should be done in cooperation with the end users.

TRANSPARENCY

EAD principles were used to formulate and evaluate the solution



JYVÄSKYLÄN YLIOPISTO

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Yogesh Dhakal

UPM

SUMMIT

JUSSI
WoW - leader

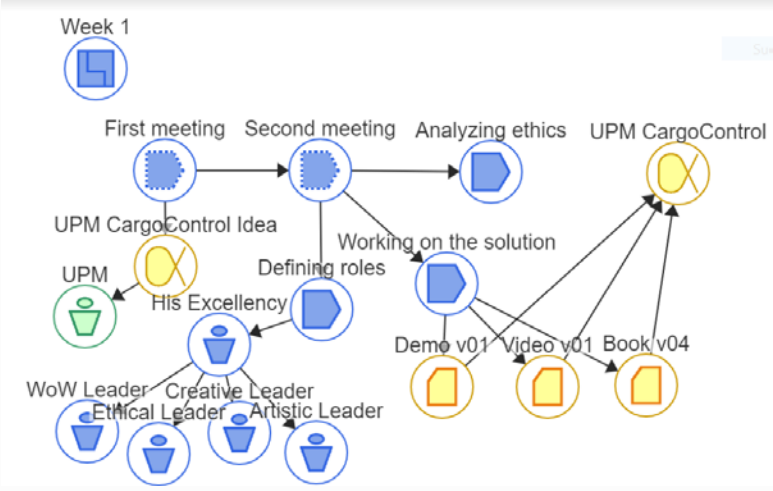
LASSI
Artistic leader

SAMI
His Excellency,
Respected Group Manager

TONI
Creative leader

ALEKSANTERI
Ethical leader

UPM



Way Of Working

IMPORTANCE OF RELIABLE LOGISTICS

EVERY YEAR GLOBALLY, THERE ARE INSURANCE APPLICATIONS WORTH OF 60 BILLION DOLLARS. 30% OF THESE ARE CAUSED BY BAD CONTAINERS. OUR AIM IS TO CUT THESE COSTS.

SUMMIT

CUT DAMAGES, NOT PROFITS

CUTTING THE CARGO DAMAGES USING SMART SHIPPING CONTAINERS AND ARTIFICIAL INTELLIGENCE

SMART CONTAINERS, SMART RESULTS

Sami Olavuo, Jussi Kause, Lassi Lääveri, Toni Pekkarinen, Aleksanteri Rönkä

SOLUTION

Container as a Service

In case of damages, AI places a new order, thus eliminating delays in delivery

AI analyses the data collected from the containers and alarms about possibly damaged goods and also calculates risks of damages for different route options.

The cargo is loaded into the smart containers at the plant

The sensors collect data about the powers that act on the containers during the voyage

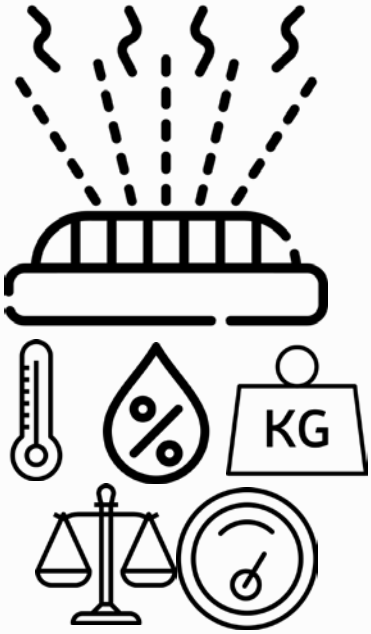
The containers with damaged goods are separated from the others at the dock, thus elimintating costs from shipping damaged goods for nothing

Time is money. Delays in delivery are not only frustrating, but also expensive.

Cargo damages account annually for tens of millions of dollars. Costs come from the damages as well as delays caused by damages.

Efficient deliveries and logistics = happy customers and good reputation.

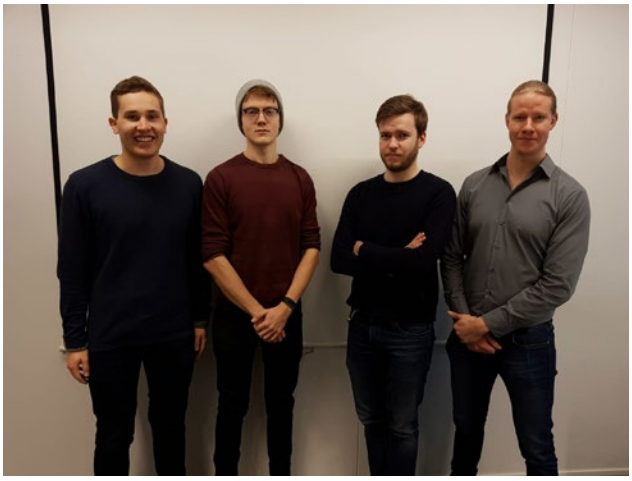
TECH



IoT devices are used to measure forces acting on the container. These forces could be for example:
- temperature inside the container
- humidity inside the container
- stability of the container and cargo
- shocks and impacts absorbed by the container or an item in the cargo
- pressure under which the container is

- AI analyses the data from the sensors and learns what kind of forces cause damages.
- According to the data AI calculates probabilities of damaged cargo based on the type of content and forces, and when a certain value is exceeded, makes automatic replacement orders
- Learns circumstances in which damages are caused, such as location and weather. Makes adjustments on routes based on previous experiences and weather conditions to avoid damages

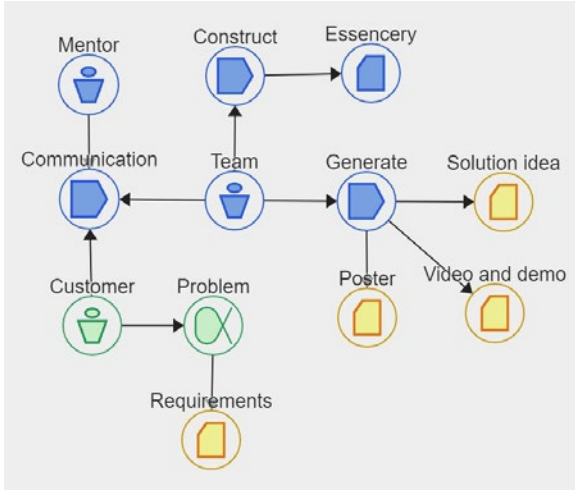
DigiboiZ



Sami Simsiö - Project leader
Juuso Siivonen - Project worker
Iiro Räsänen - Project worker
Samuli Romo - Project worker

UPM
- Smart Harbour

Intelligent inventory solution
for optimized cargo handling



Project: Sea4Value

Team name: DigiboyZ **Team members:** Sami Simsiö, Juuso Siivonen, Iiro Räsänen & Samuli Romo

UPM Smart Harbour

Intelligent cargo inventory solution

UPM BIOFORE BEYOND FOSSILS

Maritime and port network administers.
Global **logistics producer** and **logistics service buyer**

Problem

Old practices cannot respond to **modern requirements**

Solution

Computer vision based system **automates data collection** without the need for several individual sensors.
Automated **cargo tracking** drives **optimization of operations**

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JYU UNIVERSITY OF JYVÄSKYLÄ

Background

UPM Logistics administers the maritime and port networks and manages the logistic suppliers in order to secure customer satisfaction and synergies of UPM Group. UPM Logistics acts as a global logistics producer and logistics service buyer.

- *UPM wants to be the forerunner in smart ports and maritime ecosystem development.*

Sea4Value

UPM Logistics is part of Sea4Value program, which mission is to drive digitalization, service innovation and information flow in maritime transport, ultimately leading to autonomous operations and navigation.

Traditional operations cannot respond to demands of modern customer requirements. Information flow related to cargo handling need to be improved. The technology that is required to solve this problem is computer vision.

The amount of information flowing through a port is enormous. However, a lot of that data is being left unexploited as manual labour and filing cannot extract as much as is possible.

Computer vision based cargo handling system could drive the automatization of data collection and optimized utilization.

Solution

Computer vision based system gathers data directly from a video or picture feed without the need for a complex network of several individual sensors.

Instance segmentation is a computer vision technology which is capable of identifying and labeling objects from an image or a video. Methods such as OSVOS: One-Shot Video Object Segmentation are capable of tracking objects from a video-input. These methods can be trained to detect and collect contextual data from essential objects in a harbour environment, for example containers and container handlers.

Material used by the computer vision technology is collected by multiple cameras that are located around the container terminal area. There could be even camera drones used for this purpose.

Based on the collected data, containers will be organized autonomously in the container terminal. This container terminal will operate fully without human contribution. As a result, containers are in optimal order for ship loading, which leads to **reduced port lead time.**

Key ethical concerns:

- Cameras & privacy
  - Presence of cameras used by the autonomous system could lead to problems related to privacy concerns of the harbour workers. However, we aim to provide such a solution where humans are not directly operating with the visual material produced by these cameras.
- Misuse of data
  - Due the fact that gathering data is in central role in our solution, there is a possibility that data will be misused or lost in some part of the information flow process. We tackle this ethical concern by proposing a solution that is strictly authorized and controlled.

CUSTOMERS

Our customers are any companies in charge of delivering cargo over the seas. For the personnel in charge of keeping the deliveries on time, our system provides efficient planning and a comprehensive monitoring tool.

WAY OF WORKING

Our design process revolves around the course requirements. Tangible work products are those deliverables required by the course. Our actions, even though outlined by the course requirements, aim to innovation of new smart container environment. Skills needed are innovative, design, testing and development skills. With emphasize on innovation and design, since schedule and programming competence are limited.

Project: Autonomous Maritime Ecosystem

CARGO PROCESS FLOW

Backlog Boys: Jani Kuhno, Joel Kataja, Miiro Korhonen, Joonas Kiiveri

WHAT?

An autonomous system that gathers data from smart containers, makes decisions based on the data and plans efficient routes for the containers.

DETAILS

Sensors of the smart containers collects data such as: temperature, humidity, g-force and location. System can detect if container gets damaged or get lost. The system informs customers about possible delays

DATA FLOW

Data flow in maritime logistics isn't efficient yet. People use papers and emails to communicate with each other. There is no system which helps to find reasons of damages and losses. Autonomous Maritime Ecosystem gives tool to communicate faster, cheaper and more efficient way.

TIME

Competitive advantage by less idle time of the ships. System plans routes days ahead. Advanced monitoring cuts the delay of information from items breaking during transport to end-users.

MONEY

Current way of work costs lots of money. Primary cost increase for example overtime and demurrage costs. Autonomous Maritime Ecosystem saves money in many areas.

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JYU UNIVERSITY OF JYVÄSKYLÄ

BACKGROUND

Maritime industry and logistics have old habits and traditions when it comes to information flow and collecting data. Harbour and maritime industry is also very old and traditional business with millions of euros turnover. The whole supply chain employs a vast amount of people but the state of automatization and digitalization hasn't been able to keep up with the growth in the industry. The digitalization and the advancement in information transmission can be the answer to many problems in maritime and harbour industry.

TECHNOLOGIES

Our solution uses cloud based computing for calculations and planning, so hardware can be rented or own datacenter can be used. Containers will be equipped with cost-efficient sensors and long-life batteries. 5G technologies are implemented for adjustable and uninterrupted connections. Centralized system can be built with any scalable tools. Planning is done with any cutting-edge technology, but interfaces are done with popular tools for possible future integrations.

PROBLEMS

The current state of maritime and harbour business haven't been able to capitalize fully on the benefits of modern technology and digitalization. Majority of the planning and organization work is still done by humans, which means that human errors will occur.
The amount of information that is gathered through the shipping process, is far from the level that it could be, since the weight, size and loading order of the containers are the only attributes monitored now.

TECHNICAL DETAILS

The system consists of three main components: the containers (equipped with sensors, network connection and longlife battery), the data processing system or the software and the people using the system. The data processing system naturally resides in the cloud, enabling seamless global integration of data. With modern computing capacity, global situation map can be provided containing information of every container and their status. This can be used for efficient planning, since the computer does not get overwhelmed by the amount of data and can take every piece of information into account.

The containers have different kind of sensors for measuring key values. The system also keeps track of different values pointing to unique containers. These values are size, weight, temperature, humidity, acceleration, location, contents, route status and service status. Contents are described accurately, item by item. Temperature, humidity and acceleration are monitored for the purpose of alerting damages and making adjustments from repetitive patterns.

With upcoming 5G network technologies, location can be recorded very accurately regarding container position in the harbor and in the ship.

KEY ETHICAL CONCERNS

Ethical concerns revolve around system development and usage. When developing the system, developers should make sure no major disasters strike when using the system. Clear neglections in system safety in source code or design are on the development team. Unexpected system failures and unclear cases of harm, the company running the system should take responsibility over the situation. Supervisory personnel should always be on charge of the system safety.

Intentional system misuse is an ethical concern when implementing the system. Cases of piracy and smuggling can be be eased by misusing the system while in supervisory position. If a system gives an alarm of container situation, the supervisor can deliberately ignore the alarm.

Project: Autonomous Maritime Ecosystem

TracKING

Team Best: Jenna Kela, Suvi Kuusela, Elena Veijalainen, Sirja Virolainen

Who are we?

Jenna Kela: Essence Consultant.
Jenna makes sure that the Essence practice will be followed. She is also head of the software engineering team.

Suvi Kuusela: Team Manager.
Suvi is the leader of the team and Suvi's responsibility is to make sure everything will be done on time. Suvi manages the relationships with the stakeholders.

Elena Veijalainen: Requirement Engineer.
Elena's area of responsibility is to contact the customers and create the value for them. She also makes sure that the requirements are acquired.

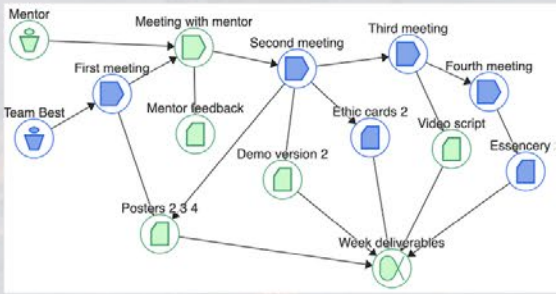
Sirja Virolainen: Graphic Designer.
Sirja's responsibility is to take care of the user interface and she is head of the graphic team.

Who will benefit?

UPM

UPM, transportation, port, employees and clients of UPM will benefit from our solution. TracKING will make it less complicated to deal with the orders from the very beginning to the very end of the ordering process. With our solution customers life will be easier and no more money, time or resource will be wasted.

How we do it?



Our WOW: The project was started by discussing possible solutions for the cases. After that we met with our mentor to clarify our goals. Next we shared the roles and responsibilities for each team member. Even though everyone has their own tasks, we work as a team and help each other with challenging situations.

Sea4Value

UPM

Team Best

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JYU UNIVERSITY OF JYVÄSKYLÄ

Project: Autonomous Maritime Ecosystem

TracKING

Team Best: Jenna Kela, Suvi Kuusela, Elena Veijalainen, Sirja Virolainen

Benefits

Our solution is environmental friendly (green IT). It helps people in delivery chain to save time and money. It will help workers of delivery chain by providing accurate necessary information easily.

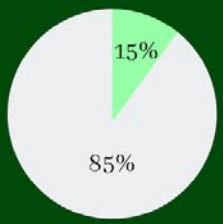
Latest technology

We are using the cutting edge technology to support IoT and automatization of port processes to help it become forerunner of the world. The most important technologies are Bluetooth Low Energy and Beacons.

Problems solved

- No more order delays
- No more last minute changes
- No more missing orders

Reduces extra costs up to 85%



Easy to use

With the application it is possible make orders, modify orders and track orders

Cost efficient and reusable

Estimote stickers have 4 year battery life and they are affordable

Sea4Value

UPM

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Project: Autonomous Maritime Ecosystem

TracKING

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What?

The purpose of Sea4value project is to create smart harbor by increasing the level of automation of the harbor and its processes. UPM is a partner of Sea4value and UPM has a need for smart harbor services.

Why?

Our client has a problem with their order processing; they do not track their deliveries and their clients can not follow the ordering process. There are delays and sudden last minute changes in orders. This creates difficulties for our client but also for their clients.

How?

These are the innovative technologies we are using to solve the problem.

Sea4Value

UPM

Team Best

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Project: Autonomous Maritime Ecosystem

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Team Best: Jenna Kela, Suvi Kuusela, Elena Veijalainen, Sirja Virolainen

Beacon and Estimote Stickers

A beacon is a small RFID-like transmitter using BLE (Bluetooth Low Energy). It repeatedly transmits a single signal that other devices can see. A Bluetooth-equipped devices can "see" a beacon once it's in range. The Beacons act with up to 100 meters range. It's transmitting a unique ID number that tells which beacon it's next to. With BLE and long range, Beacons are the prime candidates for standard of the IoT revolution.

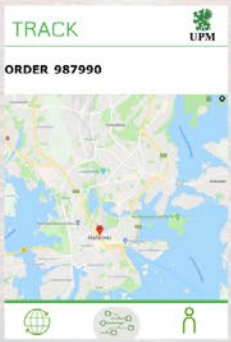
Estimote stickers are just small beacons. They are tiny inexpensive computers that are powered by a battery which can last more than 4 years. They are small sensors that can be placed anywhere. Any information can be included to Estimotes.

Solution

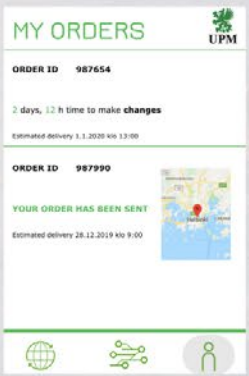
We are attaching Estimote stickers to containers and developing an application that displays the data from Estimote stickers. Any additional reader won't be needed (like for example for RFID), you only need a device with Bluetooth connection. The application will be common to everyone in the delivery chain (UPM, customers, transportation workers and storage workers.) The information read from Estimote stickers will include at least location and order information. And the stickers will be read when cargo is leaving the warehouse, when the cargo is loaded to vessel and from vessel to truck and from truck to the customer. This way both parties are assured of the location of the order. Also cargo won't get missing so easily and delays can be anticipated better.

Application

The application will read the ID of Estimote stickers and display and store the information. There won't be a need for a separate reader but only a device with Bluetooth.



With the application people in delivery chain can see the latest location of the orders.



The application allows everyone concerned to check the status of orders.
One of the most important features is that customers can see how much time is remaining to modify their order. This way sudden last minute changes and harm caused because of them can be avoided.

Ethical aspects

The key ethical concern was about the location information and who can see the orders if we are using Bluetooth. These privacy issues were tackled by limiting who can read the information from Estimotes. Only people concerned to certain delivery chain are allowed to read the Estimote data. Also the application only works in work stations and devices, so private individuals can't use the application nor the Estimote data.

Sea4Value

UPM

Team Best

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Cyber-Physical System development, Gartner-development model, DevOps, BizOps and DevSecOps, Essence theory of software engineering, blockchain software engineering and continuous software engineering.

Startuplab JYU LabStartup

Teaching Team
Pekka **Abrahamsson**, Sami **Kollanus**, Ville **Vakkuri**, Juhani **Risku**, Kaj-Kristian **Kemell**,
Mentors: Johannes **Impiö**, Joni **Kultanen**, Joonas **Himmanen**.

JYU UNIVERSITY OF JYVÄSKYLÄ

Smart fairway navigation

AUTONOMOUS PILOTAGE

The Luotsi Team: Teemu Reponen, Jenny Elo (team leader), Samu Rinne, Anssi Sorvisto

GOAL

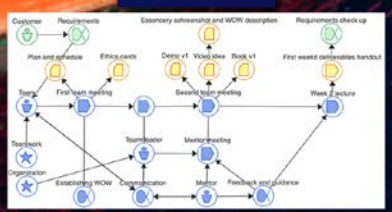
The goal of our product is to make the piloting of ships more efficient and safe. We will take in consideration multiple scenarios that include different types of ships.The customers will benefit from our product regardless of how much they are prepared to invest in new technology.

PERSONA

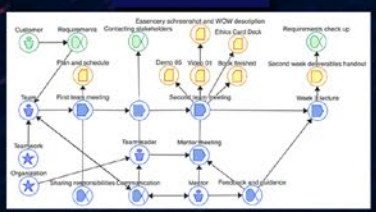
Our personas are all captains of ships arriving or departing through our smart fairway. In the current situation, the captains are forced to wait for the pilot to come on board to guide in the steering of the ship through the fairway. The main requirements for the pilotage system from the captains point of view is safe and efficient passage.

WAY OF WORKING

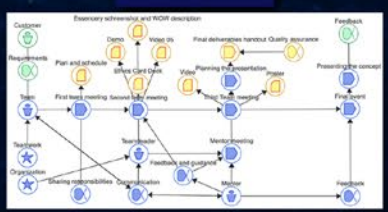
WEEK1



WEEK2



WEEK3



LUOTSI

Project: Autonomous Maritime Ecosystem

Smart fairway navigation

AUTONOMOUS PILOTAGE

The Luotsi Team: Teemu Reponen, Jenny Elo (team leader), Samu Rinne, Anssi Sorvisto

STEP 1
The ship sends a request for autonomous pilotage

STEP 2
Vessel Traffic Service receives the request
AI enabled system processes real time data of marine traffic and surrounding conditions

STEP 3
Automatic pilotage system sends optimal route information and pilotage guidance to the ship

PROBLEMS

Efficiency
Vessels often have to wait for pilotage which leads to time being wasted

Safety
Pilots have to climb aboard the vessel

Reliability
Quality of the service may differ based on the pilot's experience

Sustainability
Waiting time leads to higher fuel consumption

SOLUTION

Autonomous pilotage to reduce human error and inefficiency.
Vessel traffic service collects data and AI determines optimal routes for all ships.

Less bottlenecks!
Better safety!
Higher reliability!
Sustainable option!

LUOTSI

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Smart fairway navigation

AUTONOMOUS PILOTAGE

The Luotsi Team: Teemu Reponen, Jenny Elo (team leader), Samu Rinne, Anssi Sorvisto

One sea project to create autonomous maritime industry by 2025

BACKGROUND

Fairway navigation is a key problem for autonomous ships as the fairways are often shallow and narrow. There is need for local knowledge of the area. In the current situation vessels are forced to wait at sea for pilotage services and the pilots have to climb aboard the ships. This is both inefficient and unsafe.

On their road towards autonomous maritime industry the project client DIMECC has remote pilotage in a testing phase. However, that still includes human participation prone to human error. That is why we believe that the next step towards autonomy is autonomous pilotage. To build the best possible concept for this idea, we have contacted representatives at DIMECC as well as at the Pilot Union in Finland. The latter has raised concerns about the fully autonomous pilotage offering the same quality as the other options. These concerns have been taken into account when designing the solution and we are confident that autonomous pilotage will be a focal part of fairway navigation in the future.

AIS + Electronic charts
Artificial intelligence

LUOTSI

Smart fairway navigation

AUTONOMOUS PILOTAGE

The Luotsi Team: Teemu Reponen, Jenny Elo (team leader), Samu Rinne, Anssi Sorvisto

SOLUTION

Automatic identification system (AIS) + Electronic charts + Artificial intelligence (AI)

Autonomous pilotage to reduce human error and inefficiency. Vessel traffic service collects data and AI determines optimal routes for all ships.

Vessel traffic services (VTS) all over the world already monitor marine traffic and can gather detailed data transmitted by the automatic identification systems (AIS) of the ships in the area. AIS is already required aboard international ships with 300 or more gross tonnage. This data along with nautical charts and knowledge on the weather conditions can be utilized by artificial intelligence provided by the VTS to generate optimal routes and timetables for vessels arriving or departing. The vessel's autopilot uses the calculations made by the AI. Fully automated pilotage will remove the possibility of human error, thus enabling a smarter and more efficient fairway. We believe that optimized fairway navigation will also benefit vessels lacking the technology needed for automated pilotage.

KEY ETHICAL CONCERNS

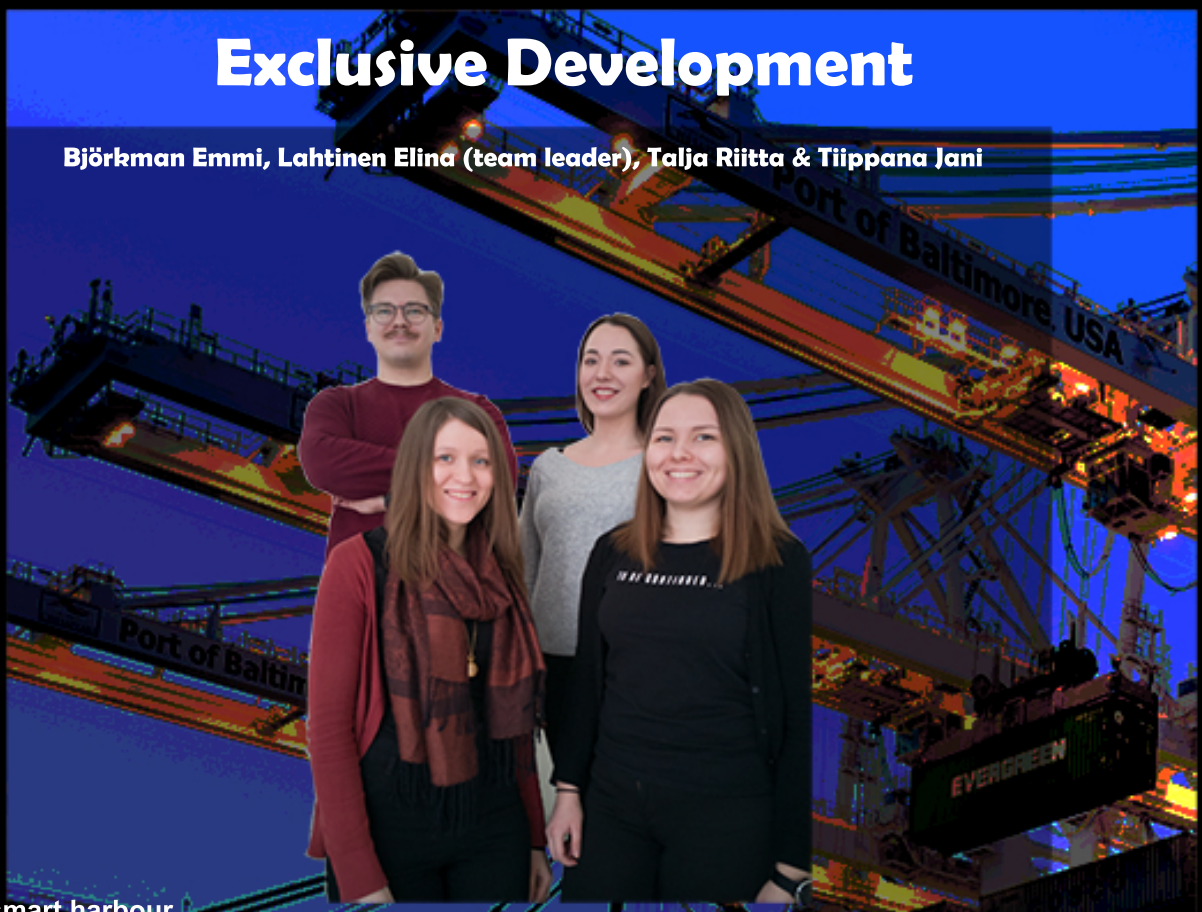
Ethical concerns have been estimated during the project using Essence Ethics Card Deck. In addition, the team has consulted the Pilot Union for their opinion. They are sceptical about the fully autonomous pilotage offering the same quality. Other concerns identified regarding the solution:

Potential loss of jobs for pilots or changes in job description
Accountability in case of accidents and issues related to AI making decisions

LUOTSI

Exclusive Development

Björkman Emmi, Lahtinen Elina (team leader), Talja Riitta & Tiippana Jani



Case smart harbour

With our Smart Harbor Assistance System (SHAS), you can optimize the operations and logistics at harbors. SHAS enables an effective supply chain leading to cost savings, better understanding of operations and decreases overall hassle. Real-time data obtained from the system provides our customers with valuable information, allowing them to streamline their processes.

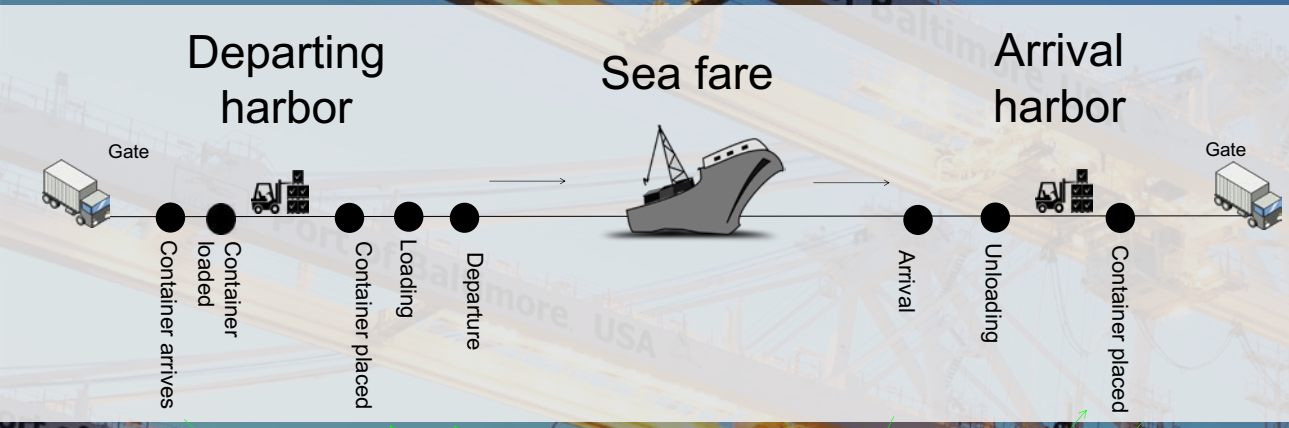
WOW week 2

Week 2 the members of the team have been in touch trough communication channels such as Whatsapp and also we have had 2 meetings. During the week our idea and the book pages have gotten a finishing touch and the idea and technologies used in the system were refined. Essencery and ethics cards have been in use to benefit the project.

Project: Autonomous Maritime Ecosystem

Exclusive Development

Björkman Emmi, Lahtinen Elina, Talja Riitta & Tiippana Jani



Solution

Smart Harbor Assistance System enables the optimization of logistics and operations at harbors. SHAS results in cost savings and better overall mangement of harbor logistics.

Technology

SHAS utilizes several technologies
Machine learning to make better use of the data collected
GPS to communicate the location of smart containers throughout their journey
AR to help forklift drivers at the harbor

Problem

Companies lose over 100 M€ annually due to the poor logistics of transportation.
A lack of communication and data is largely responsible for these losses.

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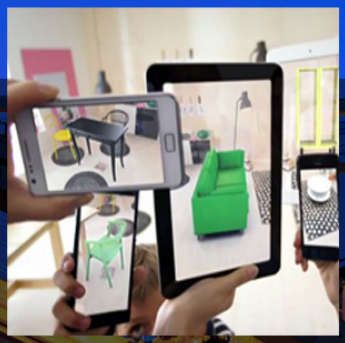
Background

Chosen technologies



AR, Augmented Reality
AR, technology designed to assist the forklift driver. It helps to organize cargo containers in the harbor. A head-up display, HUD, will help to make driving even more easier and safer in the near future.

Machine Learning
Machine learning enables us to handle logistic issues in the harbor. In the future, our system can be implemented to communicate with the autonomous forklifts and cranes.

GPS, Global Positioning System
Technology behind Automatic Identification System (AIS) which is implemented to work with our system is GPS. AIS, Automatic Identification System, helps to locate the ship where the container is. It keeps our system up-to-date the time of arrival to the harbor.

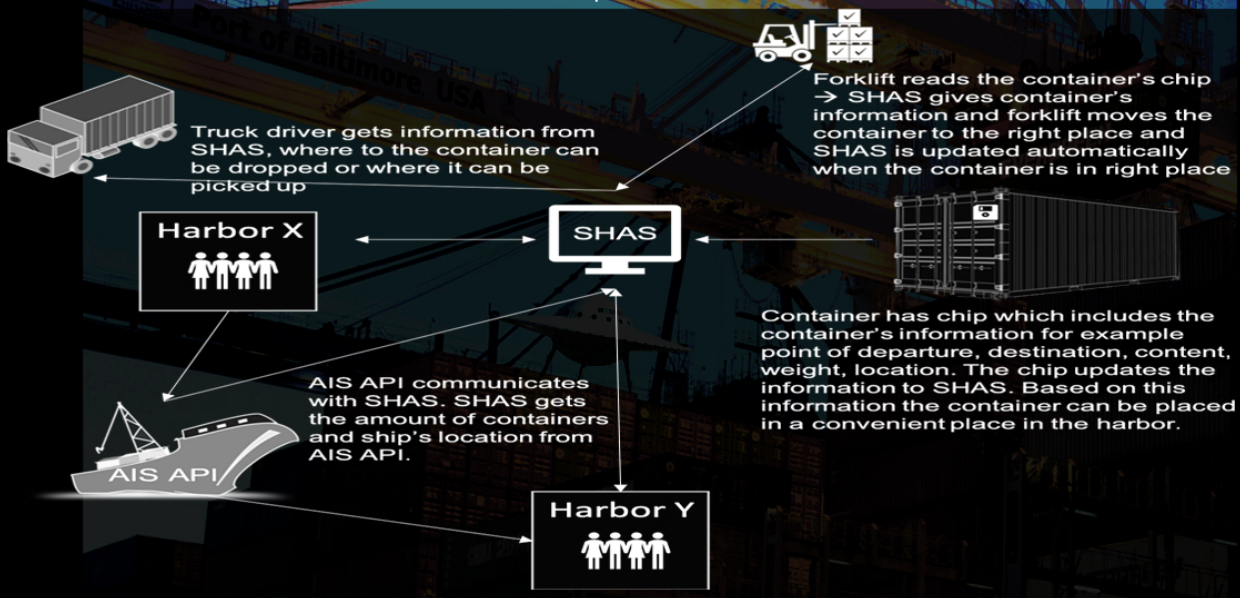
SHAS

Problem description

In the harbor, there is no unified system where you can see ships and containers at the same time. Companies lose hundreds of millions of euros a year due to poor logistics. The biggest obstacle is to overcome the issue with the communication and data accessibility of cargo transportation chain the which is described as chinese whisper. (Pisto, 2017) Logistics is difficult in harbors during peak times.
According to Ojala, Solakivi, Kiiski, Laari & Österlund, 2019 Finnish harbors lack in maritime expertise in order to guarantee security of supply in unusual circumstances.

Solution

SHAS is a Smart Harbor Assistance System which main principle is to enable the optimization of logistics and operations at harbors and thus help employees of the shipping industry all over the world. The system utilizes various technologies such as machine learning for better data collection, GPS for monitoring the containers' location throughout their journey and AR for guiding forklift drivers at harbors. SHAS gets the containers' data directly from them since the containers used are smart containers that can provide data such as location, content, weight, origin, destination and status of the container. When the container is filled the employee responsible of the filling will update the container's information to SHAS and from this moment onwards the container itself will keep SHAS updated. It will update its location through GPS technology to SHAS and at the harbor the system will inform the harbor's employees where the containers should be placed based on the container's information about where it is going and what the container contains. In the harbor forklifts will utilize AR technology for placing the containers. The driver will see the container's route through the forklift's windshield.
During voyage the container won't send any data instead the AIS API will keep SHAS updated about the containers location. Once the container is at harbor, the container will start up dating SHAS on its own again.



Key ethical conserns

SHAS doesn't have many ethical problems but have identified some regarding the development of the system, criminalization and usage rights of the system. Since the system will use technologies like machine learning and AR, it has to well tested before use and when used testing and careful monitoring should be included to basic upkeep processes. Also the accountability issues should be considered when making the system and contracts should be made in a way that they show who accountable and for what.Criminalization should also be considered since data about containers contents is centralized and it can be used for criminal intentions. This can be prevented by checking the employees backgrounds and monitoring the usage rights of the system. Usage rights should also be easy to monitor and modified.

SHIPWRECK TECHNOLOGIES

"Make Shipping Great Again!"

PROJECT TEAM

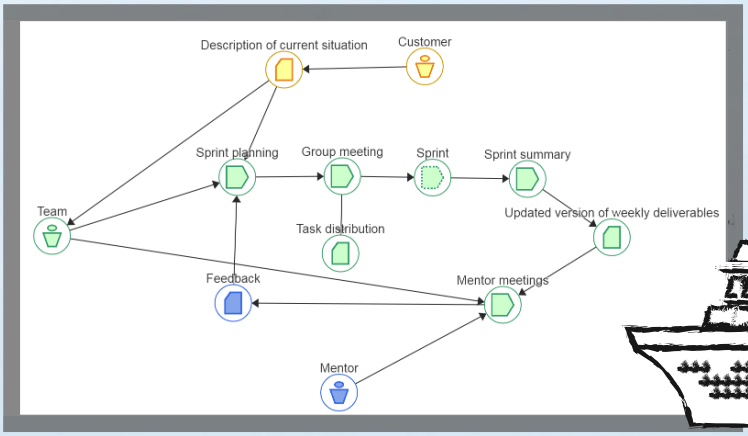
Tommi Kari	*Project leader*
Ilari Ojansuu	*Developer*
Vladimir Keda	*Developer*
Ján Baláž	*Developer*

PERSONA

"We want our data capture and cargo- loading to be more efficient and reliable"
- Ben, harbor worker

"It will be really helpful for us to know exact date and time when our cargo is arriving to the harbor"
- Chris, head of construction

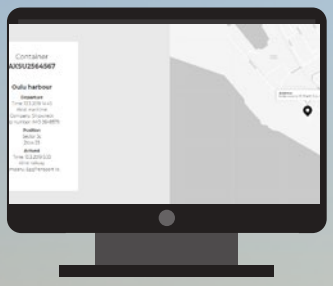
WAY OF WORKING



Shipwreck Technologies. Helping you in creating a better future.

SHIPWRECK TECHNOLOGIES

"Autonomous container tracking- system"



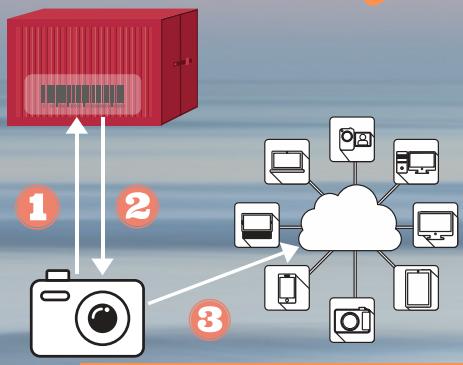
TODAY

FUTURE

Containerizing → Losing data → Crane with camera → Data saved and collected

WHY?

- Increasing efficiency
- Saves time and money
- Real-time data
- Tracking more specific

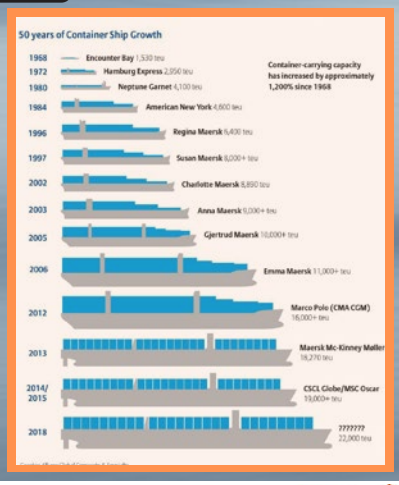


HOW?

- Using text-recognition camera
- Camera will capture unique bar code (located in every container)
- After capturing it, the code will automatically be saved in to database

TECHNOLOGY

- Text-recognition camera
- Shared database



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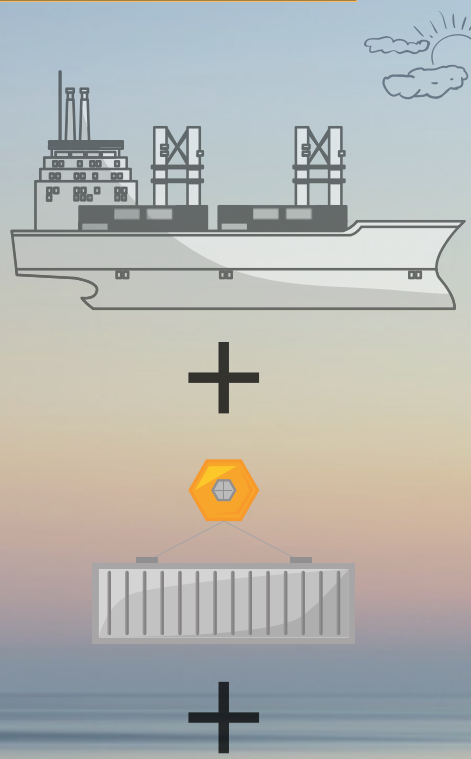
SHIPWRECK TECHNOLOGIES

BACKGROUND

Harbors are struggling with the increasing traffic of containers and suffer significant losses as the processes are not crafted for the modern needs. Digitalization could help improve the logistics environment to better track and administrate the whole process at harbors. Our team, Shipwreck Technologies focused on the data management and customer experience aspects. The mission for us is to help harbors gain more specific data of the containers handled and the data collected could be used by harbor itself and could be easily enhanced to provide customers useful information of their orders/shipments. Our solution is realistic and relatively cheap to implement and it could help improve the whole process in many ways.



TECHNOLOGY

The technology used in the solution is a Text-recognition camera using artificial intelligence to read the container number as it is brought to the harbor or as the container is being loaded to a ship. Text-recognition is already used in organizations solutions and artificial intelligence is doing quite well in those tasks. The technology can be easily implemented to existing systems and therefore does not require expensive adjustments to the existing systems used by the harbor. The camera is linked to the database and simple robotics / automation can be used so it can automatically fill in and manage the information in the system.

SHIPWRECK TECHNOLOGIES

PROS AND CONS

- Relatively inexpensive compared to the potential
- More specific and real-time data
- Data can be used to create value in many aspects (customer service, logistics)
- Easy to scale based on the needs of each harbor
- Can be implemented to existing systems
- Scales to the future as other processes are enhanced as well

- Weather conditions (readability of the container IDs)
- Containers in poor condition (ID not readable)
- The whole potential could be realized only if all (or most) of the harbors in the world would use same kind of system (possible regulations, this way the container conditions could also be supervised to prevent problems better).

OUR SOLUTION

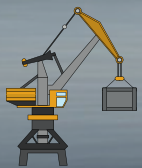
The unique container number can be used to manage the containers on the harbor and help track the container location specifically. This information linked to the existing information can be used to better handle logistics in the harbor, plan the loading and unloading of the ships as the container positions can be tracked precisely. The information can also be used so customers making orders that are being transported via containers to track their shipments and get better estimations on the time of arrival for their shipments. This creates increased value for the whole service as nowadays real-time information is looked after in modern services regardless of the industry.

Customers

Shipping companies

All stakeholders connected together

Suppliers



Harbors

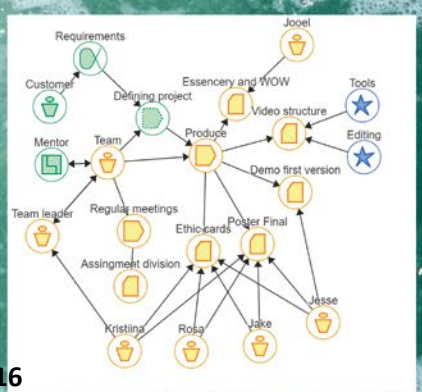
LIGHTS OFF

UPM Logistics- Smart Harbour

Kinnunen Rosa, Team member
Kronholm Kristiina, Team leader
Tuomisto Jakke, Team member
Saranen Jesse, Team member
Tulisalo Jooel, Team member

Who benefits & stakeholders?

- Cargo owner (producer)
- Transport service providers
- Port operators / stevedoring companies
- Shipping companies
- Authorities(ports, custom etc)
- Customer (End user)



WOW

The team consists of 5 team members and one of the member is also the team leader. In first place the team decided to communicate via Whatsapp and Google Docs. Whatsapp works as daily level communication way and on the Google Docs appears the to-do-list and deliverables. As other tools we are using Canva for posters, and Vegas Studio for video editing.

Project: Autonomous Maritime Ecosystem

UPM Logistics - Smart Harbour

Utilizing Drones

LIGHTS OFF: Kristiina Kronholm, Rosa Kinnunen, Jesse Saranen, Jooel Tulisalo & Jakke Tuomisto

In the Nutshell

- Drones create IoT-network which collects various data from the port
- There are different sensors in drones to collect various data
- Data is evaluated by automation and Artificial Intelligence

Case: Oil Leak

- Oil in water is found by sensors in drones or by sensor pods in water
- Collected data is evaluated by automation and oil leak is found
- Drones (flying or swimming ones) are sent to lay down oil booms

Oil leak is found

Drone flies to SAVE THE DAY

Oil boom is laid down

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Background

- How to utilize digitalization and technology at the harbour to improve the logistics environment?
- How to make the operations at the harbour more effective?
- How to get more real time data of the ships and cargo?

Problems

- Rush hours
- Cargo Damages Shipwrecks &
- Environment
- Cyber Security

The Technology

- Utilizing drones
- IoT- Network
- Sensors and responders to the ships
- Secure Databases

Our Solution

The usage of drones:

- Supervise the area
- Supervise the ships and their routes
- Inspect the ships for possible damages
- In case of oil spills, drones can be used to secure the spillage area

Possible concerns:

- Data collection
- Protecting the identities of marine workers
- Possibility of the drones getting hijacked

Possible solutions:

- Making the system as secure as possible
- Encrypting the data
- Tracking the drones

Automated Cargo Handling

Customer

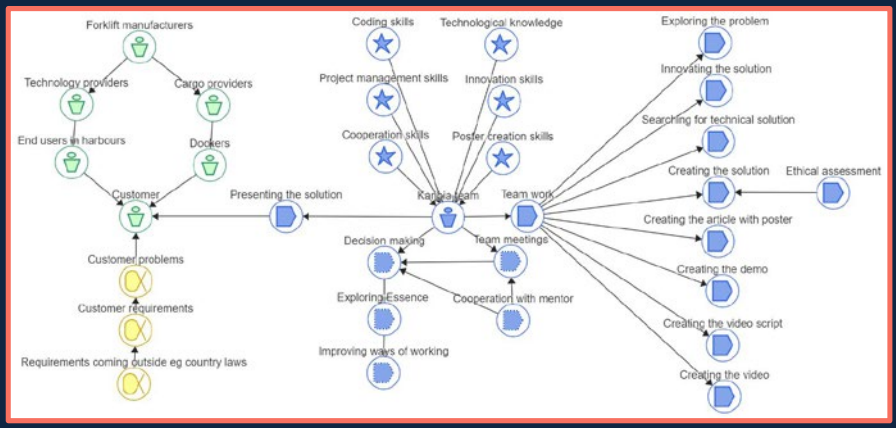
UPM Logistics is a subsidiary company of UPM Kymmene which is a Finnish forest-based bioindustry corporation. UPM Logistics is focusing on maritime transportation and is facing technical challenges and problems with cargo quality.

> "We aim to provide a solution that will solve the harbours' operational and the cargo safety problems as well."

The Team

- Aleksi Lokka (technology lead)
- Joonas Hellsten (technical advisor)
- Teemu Vitikainen (marketing director)
- Minna Manninen (project manager)

Karibia Ways of Working, based on Essencery



Project: Autonomous Maritime Ecosystem

Automated Cargo Handling

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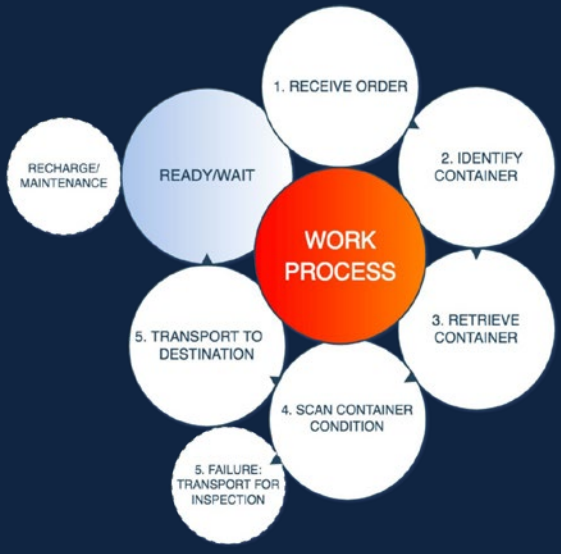
Karibia team provides a safe solution for UPM Logistics to efficiently and environmentally sustainably automate the work in harbours when handling the cargo and containers.

Automated truck lifts and handlers check, secure, load and unload the vessel to transport the cargo and containers.

Autonomous container process cycle



Automated truck lifts

Technology of a robot truck lift
- Autonomous, self-driving truck lifts and handlers
- Image recognition for checking the right container
- Ultraviolet light scanning for checking the impairments of the cargo and container

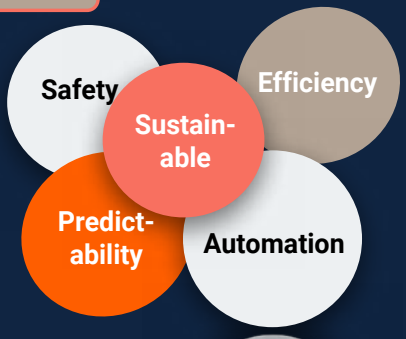
Technology between the forklifts
- AI agent technology to support the communication and cooperation
- Control system to operate and monitor the truck lifts working in restricted area

Technology already available
- Robot truck lifts with Conexbird sensoring
- Kalmar empty cargo handling
- Semantic web -agent technology
- Electromagnetic acoustic transducer EMAT
- Light Detection and Ranging LiDAR

Karibia Team

Aleksi Lokka, Joonas Hellsten, Teemu Vitikainen, Minna Manninen

Benefits



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JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

Automated Cargo Handling

Challenges

- Harbour system is a complex combination of humans and technology
- Human factor creates 75-90% of errors occuring in harbours and maritime transportation, up to 10 million lost cost of UPM Logistics
- In the harbours the forklift operators must manage on all conditions
  - Bad weather limits visibility
  - Long work hours cause fatigue
  - Fickle timetables create stress
- Moments of lost human concentration can create massive damage
- Data needed for predictions varies and is insufficient

Scope

- Aim is to provide autonomous machine which can replace yard cranes, terminal tractors and reach stackers into one unit
- Dynamic machine could be used in different kinds of harbours. Automatization of the container handling would not need grand renovations to the harbour
- This solution reduces the human made errors greatly
- Automated cargo handling creates detailed situational view and enhances data collecting

Technologies

Computer vision

Truck lift uses the computer vision to create a view of its surroundings. The computer vision has essential part on lifting the container, since it needs to perceive the dimensions of the container. Combined cameras, lasers and operating software provide the essential data to the truck lift. The text recognition is needed for reading register numbers from the containers in order to identify them.

AI Agent technology

Supports the communication of a heterogenous team of distributed forklifts and handlers. The teams share knowledge about the working environment, sensor and task states, diagnosed failures and also communicate to redistribute the tasks e.g. when a forklift becomes inoperable. Humans monitor these teams via IT system.

Soundwaves & neural network

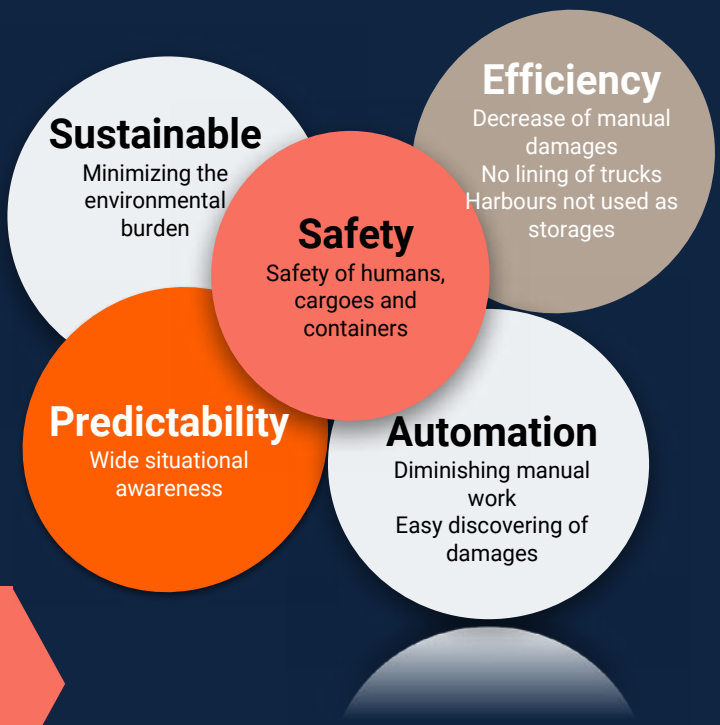
Impairments in the containers are difficult to discover because they are usually invisible for human eyes. They can be spotted with a combination of soundwaves and neural networks. Neural network is trained to notice what kind of soundwaves impairments in containers produce.

Automated Cargo Handling

Ethical issues

- How will the autonomous cargo handling affect the work of dockers -> What might be the problems the dockers see in their work?
- How do different country law's react to the autonomous truck lifts?
- How many percentage are the cargo problems of the yearly income of the companies? What is the real need for the change?

Benefits of automated cargo handling



Risks of autonomous cargo handling

01	Autonomous truck lifts not connecting to the web	• Problems in communication between other truck lifts and the controlling system • Cargo handling will stop without internet connection
02	Long electricity power cuts	• Power cuts prevent the charging of the truck lifts • The truck lifts will continue working until their battery is dead • The truck lifts are not able to communicate between each others or with the controlling system without a generator
03	Unexpected incident in the restricted autonomous area	• Something unexpected may happen while the truck lifts are loading or unloading the vessel, eg. an animal appears in the area
04	Complex and expensive solution to build and maintain in the beginning	• Have to have extra truck lifts because of the charging • Continuous training for the autonomous truck lifts and their maintenance needed until they are robust

Project: *Autonomous Maritime Ecosystem*

SmaCo

The Smart Container

Persona

Harry the Harbor Man

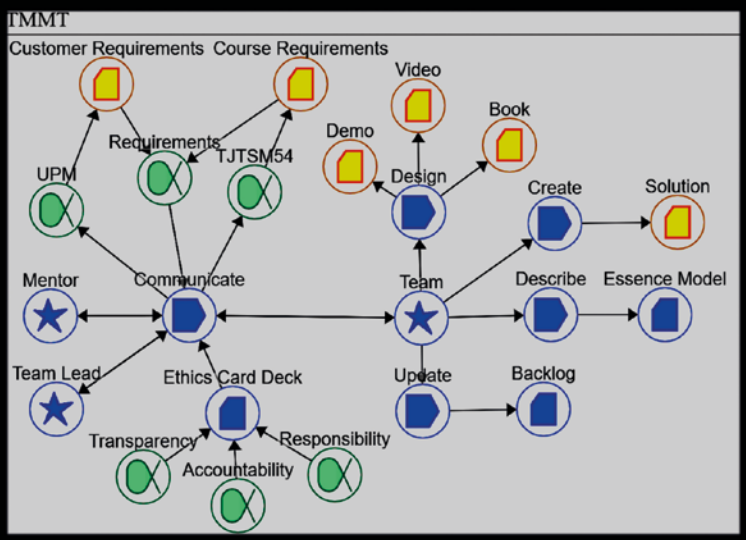
Harry is a 51 years old long term harbor worker. Harry is otherwise quite conventional, but occasionally enjoys playing Angry Birds™ with his phone, so Harry is comfortable with the latest mobile technology.

As a harbor worker, Harry would like to be able to utilize the latest technology in his work, which includes a lot of manual checking of containers.

"Checking all the containers manually and keeping track of damages with pencil and paper is not a favorable way to do the work" -Harry.

-Harry the Harbor Man

Team's Way of Working



Team TMMT

Tuomas Tervo
Team Leader

Merja Leppänen
Essence Master

Juuso Eskelinen
Graphics Designer, Video Editor

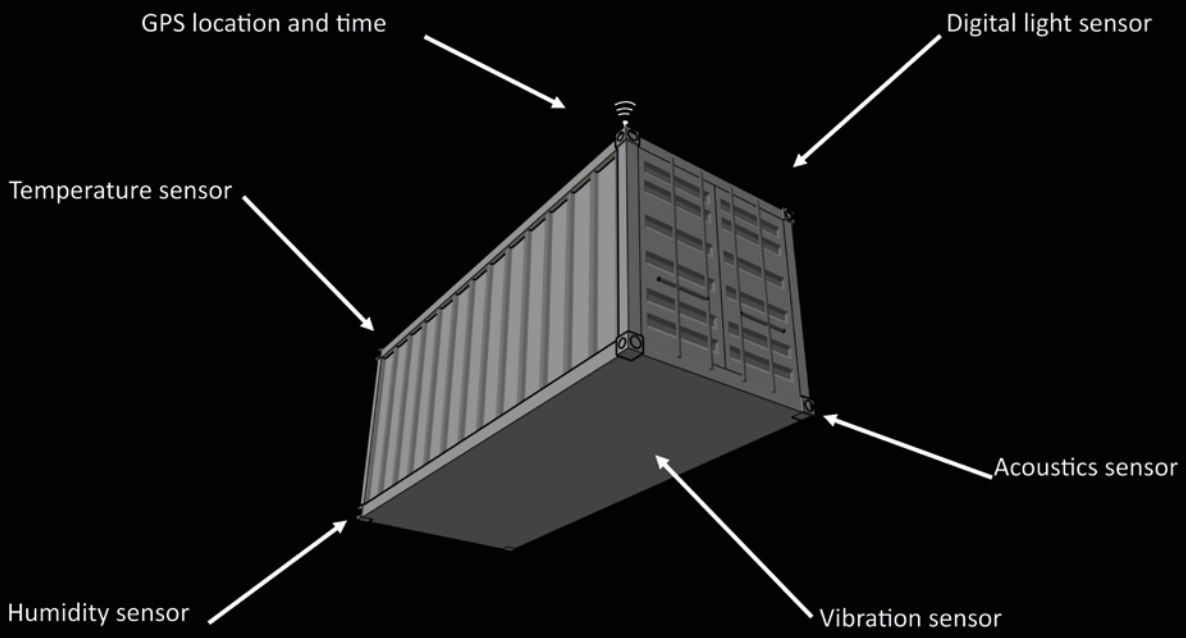
Tommi Pulkka
UI Designer, Developer

Mikko Toitturi
Technology Research Specialist, IoT Specialist

Project: *Autonomous Maritime Ecosystem*

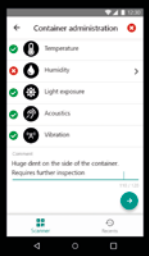
SmaCo

The Smart Container



The SmaCo product family

SmaCo Mobile

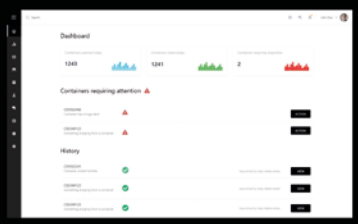


The user scans a QR code on the side of the container. The QR code contains the data required (container ID) for the mobile application to form a connection between itself and the sensor device.

In the container administration view, the user can check the warnings and add a comment of the inspection.

Icons provided by: FontAwesome

SmaCo Analysis tool



SmaCo solutions offers an analysis dashboard for the system administrators. The analysis tool can be used to analyze what causes the conditions of shipping containers to worsen.

Why SmaCo?

- Track environmental data (such as humidity and temperature) from containers with IoT-sensors.
- Receive warnings on the condition of containers prior to manual inspection.
- Keep track of your containers easily in one system.
- Fast data inputs directly to the system instead of pen and paper.
- Plug-and-play system allows retrofitting old containers with cutting-edge technology.
- Service flexibility - the containers can be added to the system and their data can be accessed with a QR code even if the container is not “smart” (does not have sensors).

Cyber-Physical System development, Gartner-development model, DevOps, BizOps and DevSecOps, Essence theory of software engineering, blockchain software engineering and continuous software engineering.

Pekka **Abrahamsson**, Sami **Kollanus**, Ville **Vakkuri**, Juhani **Risku**, Kaj-Kristian **Kemell**,
Mentors: Johannes **Impiö**, Joni **Kultanen**, Joonas **Himmanen**.

SmaCo

The Smart Container

Chosen technologies

⇒ **A variety of military-grade IoT-sensors**	Gathers data about the condition of a container
⇒ **GPS**	Tracks location and provides time service
⇒ **Small computers**	On site analytics and data distribution
⇒ **AWS**	Scaling cloud services to store the sensor data
⇒ **Mobile UI**	On site inspection and reporting of containers
⇒ **Desktop UI**	More advanced analytic tools for the sensor data

The problem

⇒ A lot of materials are lost during shipping due to damaged containers. The damage is caused by manual handling, weather etc., though their cause and date aren't always clear.

⇒ Manual surveillance of container integrity requires a lot of resources and isn't always accurate.

⇒ Cargo worth of tens of millions of euros is lost each year.

⇒ Missing/corrupted information cause operational delays.

⇒ Loss of reputation (and potential customers) because of damaged cargo.

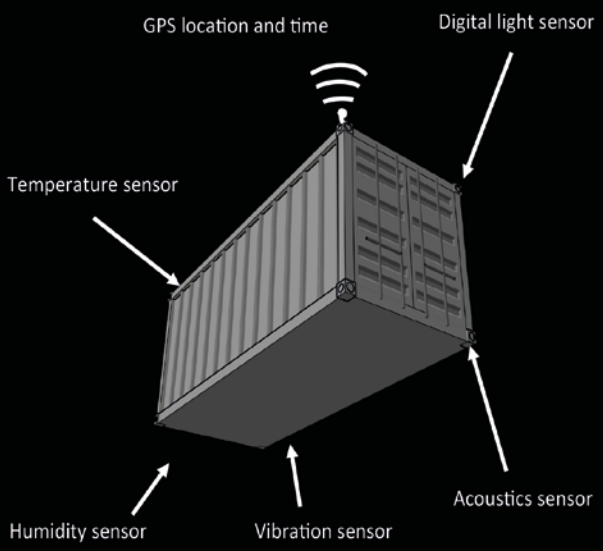
Tehcnology stack

Project: *Autonomous Maritime Ecosystem*

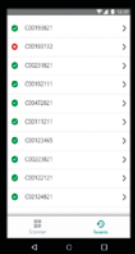
SmaCo

The Smart Container

The smart container equipped with sensors



Smaco Mobile and Analytics tools



SmaCo Mobile allows the harbor workers to easily check and report container condition.

SmaCo Analysis tool is used to analyze the issues causing the condition of containers to worsen and to act before a defective container causes business losses.

The solution

⇒ A variety of military-grade all-weather tested IoT-sensors collecting relevant information about the condition of the cargo container (for example humidity, light, and acoustics). Engineers and industrial designers will be the best people to consult on the optimal placement of these monitors.

⇒ Small computers (one per container for example RaspberryPi) that can collect, process and transfer the data collected by the IoT-sensors.

⇒ Self-powered sensors. Power generated from "small amounts of indoor light, subtle temperature differences, and modest vibration". Complemented with a power reserving battery that can also be manually charged (the system will also indicate the power-level).

⇒ AWS (or similar cloud technology) for supporting the centralized service (including the database for collecting and logging the sensor data).

⇒ Mobile UI for the harbor workers to review the data collected by the sensors and make their own observations and data inputs to the system.

⇒ Desktop UI for the managers.

Key ethical concerns

⇒ Usage and storage of the sensor data

The system is designed with clear ethical principles in mind and from our side we make sure that the data uploaded to the system is not used for anything else than it was designed for (we will not for example sell this data to our partners). The sensor data is neutral in a way that it's based on factual metrics. The sensors only measure specific conditions within the container which are not dependent on what is being shipped or who owns the cargo. Therefore, it is impossible to misuse the data collected to link the data to a specific person or corporation (corporate espionage).

⇒ Effects on employment

We discussed the effect that the improved efficiency might have on employment but this does not seem likely as this is only a tool for the users to perform their work better. This is a very common issue and the effects on employment from a larger perspective are rarely permanent.

⇒ Misuse of the system

Misuse of the system is tackled with providing detailed documentation, manual and training to minimize the risk of unintentional misuse. Intentional misuse is tackled as the system is designed to be secure with sufficient encryption and limited manual access to container data (The crypted QR code can only be scanned with our application by an authorized user and the code only contains reference ID to a specific container, and therefore cannot be misused in any other contexts). We only collect data that is needed for the system to work and the data is only stored as long as it is necessary.

About the Project

Crew Members

Veli-Pekka
Leader

Niki
Marketing

Michael
Programming

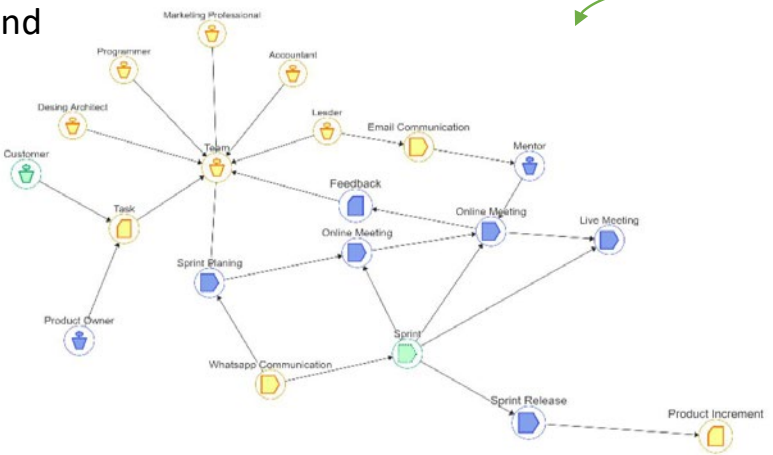
Aleksi
Accountant

Viljami
Design

SanDtrack – Efficient schedule and damage tracking!

- ✓ Group Mämmi provides UPM and its respectful customers an extremely modern platform which is powered up with the latest technology.
- ✓ With the SanDtrack -project UPM is able to reduce costs by tracking down damaged cargo and get up-to-date data from transports and conditions.
- ✓ Customers of UPM get an efficient platform to communicate with UPM and get on-demand information about their shipment. It also has all the necessary documents in one place.

So, how do we do it?



Project: Autonomous Maritime Ecosystem

SanDtrack

Efficient schedule & damage tracking

Group Mämmi: Michael Laukka, Niki Neejärvi, Viljami Paananen, Veli-Pekka Pajula, Aleksi Pölkki

Problem?

We have focused on two main problem domains: damage control issues & communication flow interruption.

Damage control issues alone cost up to 5M€ annually. They also cause reputation loss and customer dissatisfaction.

Solution?

Our solution is to reduce these costs, reputational loss and increase customer satisfaction with the combination of artificial intelligence and sensor technology.

We provide a customer portal that enables fluent communication flow between UPM and its customers.

Customer experience

Our customer platform offers:

- Company-specific accounts
- On-demand shipment tracking
- Examination of shipment condition and related paperwork
- Examination of schedule estimations and possible delays
- Quick and efficient communication with UPM

Our baseline is to offer efficient, highly usable and satisfying customer experience.

Technology

Our solution uses up-to-date AI, 3G/4G networking- & sensor technology and cloud services.

Sensors measure G-force, humidity, air pressure temperature and location data.

System is fully backed up with a physical hard drive.

UPM

Benefits

For UPM:

- Offers data for internal business process improvement → reduced damage-related costs
- Preventing the delivery of damaged cargo
- Increased customer satisfaction and reputational benefits

For UPM's customer:

- Real-time shipment data → efficient business planning
- All relevant data on the same platform

TJTSM54 Advanced Topics on Systems Development
Cyber-Physical System development, Gartner-development model, DevOps, BizOps and DevSecOps, Essence theory of software engineering, blockchain software engineering and continuous software engineering.

SanDtrack

Startuplab JYU LabStartup

Teaching Team
Pekka **Abrahamsson**, Sami **Kollanus**, Ville **Vakkuri**, Juhani **Risku**, Kaj-Kristian **Kemell**, **Mentors:** Johannes **Impiö**, Joni **Kultanen**, Joonas **Himmanen**.

JYU UNIVERSITY OF JYVÄSKYLÄ

Background for the solution

SanDtrack – Efficient schedule and damage tracking!

So, what's the problem?

- ✓ According to UPM Logistics damage control issues alone cost ~5M€ annually. They also cause reputation loss and customer dissatisfaction.
- ✓ Damage control takes too much time and effort when executed completely manually.
- ✓ Customers may not have up-to-date information of their deliveries.
- ✓ Communication between UPM and it's customers can be challenging without a shared platform.
- ✓ Essential documents can be divided in different systems or can be only in paper form.

Chosen technologies

- ✓ A complex sensor will measure G-force, humidity, air pressure, temperature and location data.
- ✓ Works in 3/4G network, backed up on a physical hard drive.

- ✓ Artificial intelligence will gather, analyze, modify and transfer data gained from the sensor towards quality control.

Solution details

SanDtrack – Efficient schedule and damage tracking!

Container sensor

- ✓ The sensor for the containers will measure G-force, humidity, air pressure, temperature and location data.
- ✓ It works via a 3/4G network to transfer the collected data to the servers in real time.
- ✓ If network isn't available the data is stored to a physical hard drive and sent forward when connection enables it.

Customer portal

- ✓ The customer portal will provide the end-user to get information of their deliveries in real time.
- ✓ Artificial intelligence will gather, analyze, modify and transfer data gained from the sensor towards UPM's quality control which will inform the customer if necessary using the customer portal.
- ✓ AI will count and estimate delivery times for the customer based on weather forecast, past delivery times and other relevant data.

Ethical concerns

- ✓ The new efficient schedule and damage tracking – system doesn't threaten anyone's job but mainly speeds up and simplifies the operation process.
- ✓ The portal is being developed based on customer feedback to always provide the best possible customer experience.

"We protect our customers' privacy and always strive for a high level of data protection. Our data handling measures provide that we are compliant to the new data protection regulation GDPR."

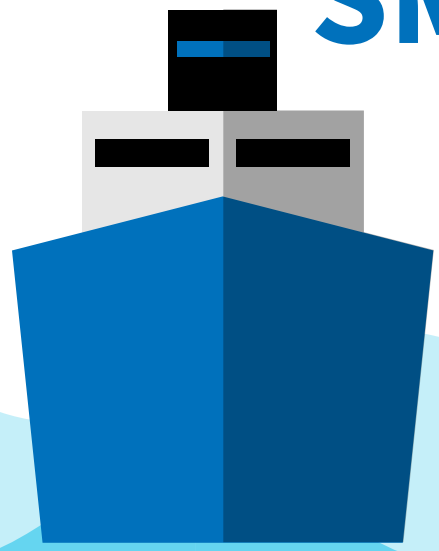
TUOMAS KOKKO, PROJECT MANAGER

SATU HILTUNEN, TESTER

PIRJO HELANDER, DESIGNER

HANNA SAARIVIRTA, DEVELOPPER

SMART FLOOR

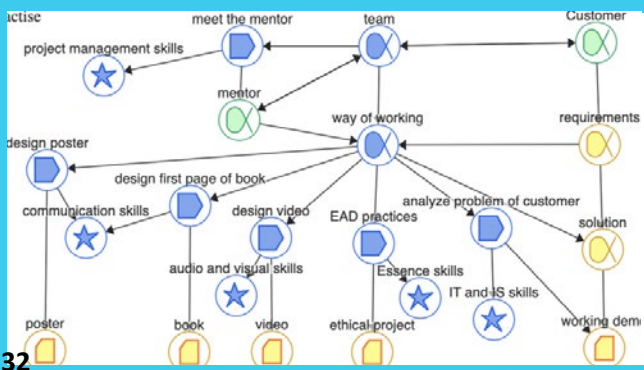


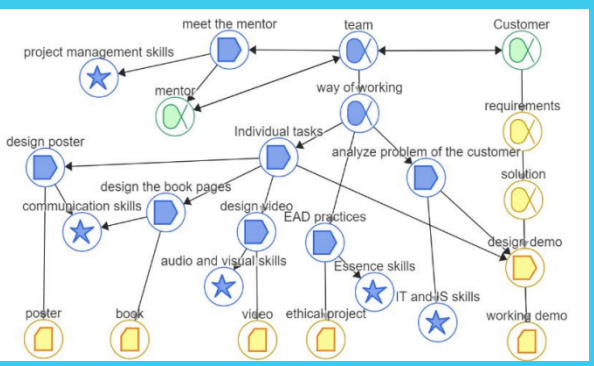
TEAM

THREE DIMES

TO HELP HARBOUR WORKERS LOAD PAPER ROLLS INTO CONTAINERS WITHOUT DAMAGES

TO MAINTAIN FLAWLESS PAPER ROLL QUALITY FOR PAPER ROLL OWNERS





TEAM
THREE
DIMES

SMART FLOOR

34 % of UPM's cargo is shipped in containers, and very recently quality of shipped goods has been compromised:
-During cargo loading process forklifts and containers inflict damages to goods
-Customers have low tolerance regarding damaged goods, which have an impact on costs and revenue

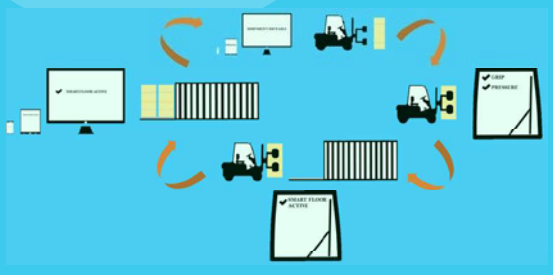
PROBLEM

How can UPM prevent paper roll cargo damages?

SOLUTION

SMART FLOOR is based on embedded system of IoT, augmented reality and AI:

-It is fully integraded cloud based system
-Forklifts and container's floor contain specialized sensors
-Container's loading process is fully automatized
-System is designed to increase workers' well-being by decreasing work based stress
-System increases overall loading efficiency and reduces costs
-Regard of international laws the system is ready for global expansion



TEAM THREE DIMES

Johannes Impiö (mentor), Tuomas Kokko, Pirjo Helander, Satu Hiltunen, Hanna Saarivirta

TJTSM54 Advanced Topics on Systems Development
Cyber-Physical System development, Gartner-development model, DevOps, BizOps and DevSecOps, Essence theory of software engineering, blockchain software engineering and continuous software engineering.

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JYU UNIVERSITY OF JYVÄSKYLÄ

TEAM
THREE
DIMES

BACKROUND

UPM SMART HARBOR

As forefront of global sea traffic service provider UPM offers innovative leading sea traffic solutions to customers.

Customers' requirements are getting tighter which leads to low damage tolerance.

Problem is paper cargo damages caused by contact to cargo unit walls/floor and manual forklift handling.

Cargo damages lead to increased damage costs and customer complaints.

TECHNOLOGY CHOSEN

IoT

IoT enables connection, interaction and exchange of data

Artificial intelligence

AI implemented in the container's floor and forklifts

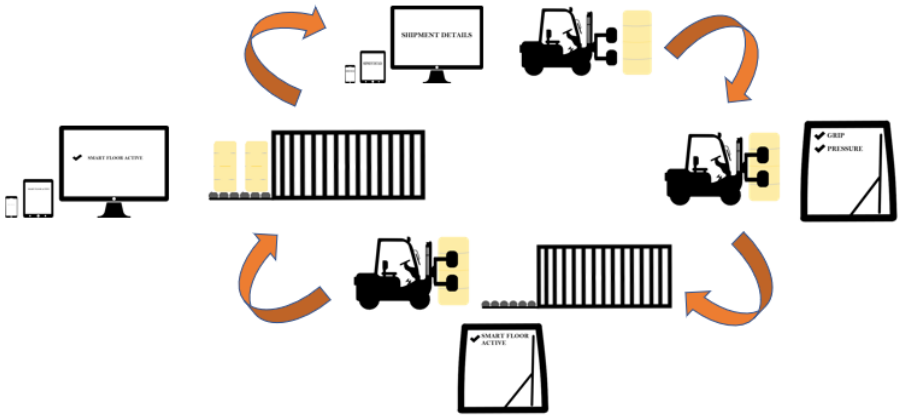
Augmented reality

AR enhanced user interface in forklifts

AI and IoT implemented in container and forklifts are the key solving quality challenges with paper cargo. AI and IoT combined with AR enhanced user interface minimizes quality damages and ensures loading process efficiency.

TEAM
THREE
DIMES

SOLUTION: SMART FLOOR



AI, IoT and Sensor Technology

The interior of our Smart Container has dozens of intelligent sensors that have the ability to see (photonic technology), feel (physical measurements), smell (electronic noses) and move (sensors integrated with actuators). The sensors effectively suspend any movement that could damage the cargo during loading.

To prevent damages even more, the forklifts do not drive into the Smart Containers at all. The forklift operators make paper stacks at the doorway of the Smart Container, and the Smart Container itself then moves the paper stacks deeper into the container and locks them into right places with the help of Sensors and Smart Floor Technology. In addition to the Smart Container sensors, the forklifts are equipped with damage preventing sensors as well.

No damage to the cargo during forklift loading of the Smart Container could be a central factor in terms of cargo quality and positive customer experience. As a result, also job satisfaction of the forklift operators increases because of the decreased stress of worrying about damaging the valuable cargo. With less stress the operators will remain more alert enabling them to focus on work speed. This in turn will create efficiency and cost savings to UPM. Although the focus of the solution is on the loading phase of the Smart Container, the sensor technology suspending any movement that could damage the cargo will certainly help protect the cargo also during voyage.

With sensor technology, GDPR in the EU areas, and other laws, regulations and possible universal standards, too, have to be taken into account - along with possible cyber security issues. It is assumed that UPM has a topnotch cyber security policy, processes and systems in use. But since every country has its own culture and governance, country specific laws and regulations regarding sensor technology must be checked and taken into account.

Augmented Reality

A user-friendly Graphic User interface of the Smart Container is implemented on the windscreen of a forklift using Augmented Reality Technology. Forklift operators turn the AR user interface manually on when approaching the container loading area. In the future GPS technology can be used to help turn the AR user interface automatically on in loading areas.

The cloud-based management system of the Smart Container provides via the user interface the forklift operator and other UPM staff real-time, comprehensive information about the container interior and the loading process. Detailed information about the container during loading and, in the future, also during voyage keeps UPM up to date about matters supporting profitable operations. All needed data is transferred automatically from the Smart Container to UPM without the forklift operator or anyone else having to send files during or after loading. In addition to the AR Graphic User interface on the forklift windscreen, there also are more traditional, but still user-friendly Graphic User interfaces for smartphones, tablets and computers. Thus, UPM staff can monitor and guide the daily Smart Container related operations of the company on a smartphone, tablet or computer, regardless of location.

The Smart Container solution has been developed ethically using Essence. Widely accepted ITIL (IT Infrastructure Library) processes have been concidered, as well. It is assumed that when the solution is in operation, UPM uses some widely accepted framework, such as ITIL, in its IT Service management practices. Thus, the processes of Smart Container solution can easily be integrated into UPM's as is IT Service Management processes (e.g. service strategy, service design, service transition, service operation, and continual service improvement).

Digital concepts and business cases

Students engaged as co-researchers in a master's level course titled TJTSM54 Advanced Topics on System Development in University of Jyväskylä to conceptualize, design and demonstrate a solution that solves some of key the problems of the Autonomous Maritime Industry. In this unique book there are close to 30 concepts for the Maritime Industry to benefit.

JYU 2019