



# **Digital Education Readiness in Maritime and Inland Navigation**

## ***REPORT ON QUESTIONNAIRE FOR STAKEHOLDERS***

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## Abbreviations

AR = Augmented Reality

E&T = education and training

ES-QIN 2019 = European Standard for Qualifications in Inland Navigation, Edition 2019

GDPR = General Data Protection Regulation

HMD = head-mounted display

IP = Internet Protocol

MR = Mixed Reality

STCW 2010 = International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, adopted on 7 July 1978 and majorly revised in 2010

VET = vocational education and training

VR = Virtual Reality

## Chapter 1. Overview

The use of virtual reality (VR) in maritime and inland navigation education is one of the revolutionizing strides in developing computer-assisted instruction.

Since the implementation of AR/VR technologies is still relatively new in maritime and inland navigation industry, there is not much empirical data on these topics. In order to gather data, the 6 partners involved in DERIN project: Faculty of Transport and Traffic Sciences – Croatia, Technical University of Varna – Bulgaria, STC Group – Netherlands, Latvian Maritime Academy – Latvia, Estonian Nautical School – Estonia and CERONAV – Romania designed a detailed online questionnaire to assess the impact of VR-based education and training in maritime and inland navigation (juxtaposed with the traditional method of teaching) and to analyse the need and growth of these technologies in the industry.

The detailed questionnaire was reviewed by all DERIN project partners to ensure questions are clear and not misleading.

The questionnaire was formulated to gather information about the adoption of AR/VR technologies in maritime and inland navigation education and training. Moreover, it investigated the opportunities for AR/VR technologies to improve stakeholders' communication and identify experts' predicted results.

The online questionnaire was hosted on:

<https://docs.google.com/forms/d/1HsKRKUMHA9klcpmAuHBPKHm5GaQiBIwkKuQBpeqiRZ8/edit?ts=613b171b>

The survey questions were divided into four sections: (1) general information, (2) AR/VR knowledge and experience, (3) visions for future of AR/VR and (4) risks and limitations.

The questionnaire responses were analysed to:

- (1) understand the current state and growth of AR/VR in inland navigation industry
- (2) identify opportunities of AR/VR development in improving education and training
- (3) understand the benefits, that are foreseen by trainers, experts, researchers, etc. of adopting AR/VR technologies.

**The first section** of the questionnaire aimed to identify general information about the respondents, such as nationality, occupation, and professional experience and organisation size in terms of employees/trainees per year.

**The second section** examined the respondents' familiarity, awareness and competency in AR/VR technology and applications.

**The third section** included questions about stakeholders' vision on the future integration of AR/VR technologies within the shipping industry, education and training.

**The fourth section** evaluated the organisations' main limitations, obstacles, concerns and challenges for integrating AR/VR in their activity.

The questionnaire was sent to over 100 stakeholders working in the maritime and inland navigation industry: education, crewing agencies, shipyard and port personnel, maintenance, research and consultancy organisations, various specialists in the industry. 62 responses were received from 10 countries: Netherlands (16), Croatia (12), Romania (12), Latvia (8), Bulgaria (6), Estonia (4), Sweden (1), Ukraine (1), Russia (1) and 1 respondent who did not state their nationality.

Most of the respondents were teachers/trainers (36%) and engineers (18%) with more than 10 years of experience in their organisation (over 48%), in the maritime industry (over 54%) and in inland navigation (almost 34%), followed by waterborne transport and port personnel (7%) and researchers (3%).

The answers received for section two demonstrated that more than 50% of the respondents were aware of the potential of AR/VR in the industry. As we expected, only 4 organisations are familiar with these technologies, 9 respondents are already using them and 22 stated that they never used them before. It is encouraging that all respondents revealed their interest in using them in everyday activities. Most of the organisations use AR/VR technology in the following sectors: Training/ familiarization, Sailing, Safety and public order, Maritime transport, Police training, Navigation, Ship remote support and assistance. Others are interested to use them, in the future, mainly for training, inspections and quality assurance, repair and maintenance.

Those stakeholders who use AR/VR tools answered that they are most *familiar with* VR glasses/headsets (approximately 20%), followed by Oculus/Oculus Quest/Oculus Quest 2 (10%), HTC/ HTC Vive (10%) and Microsoft HoloLens (10%), HMT-1/Realwear HMT-1 (8%), or Magic Leap, Varjo and VR cameras (2%). Others use innovative tools such as Velicus CPR+, Velicus Fire+, Microsoft Dynamics 365 Remote Assist, Microsoft Dynamics 365 Guides, Edumersive and Plusport, Unity, etc.

Also, when asked what *platforms they use with AR/VR devices*, their answers indicated Oculus Rift (14%) and Microsoft HoloLens (14%), HTC Vive (11%), Google ARCore (9%) and Oculus Go (9%), PlayStation VR, Samsung Gear VR, Google Cardboard, Apple ARKit, Magic Leap and ARVR 1 (2%). Furthermore, 13 respondents (30%) of the total of 62 analysed responses indicated that they use other platforms, such as: Wärtsilä Transas, Kongsberg, Kongsberg Norcontroll, Oculus quest 2, Varjo, Nautis, Realwear HMT-1, V-STEP simulator, MagicLeap, ARVR 1, PlayStation VR or other different customised simulation platforms for i.e. navigation, engine room or communication.

These *AR/VR tools and platforms are used to* create content Videos for simulation/360 training (27%), for upgrading workers' skills and competences (18%), for videos for assessment and evaluation (11%), to create content for Livestream (8%) or for news and visual stories (5%).

Next, organisations were asked to share their *opinion how AR/VR technologies can most effectively address challenges in safety training situations and/or safe working conditions*



*in their organisations.* Over 73% of the respondents considered that these tools provide a safe and repetitive environment for exercises, proper simulation scenarios, reducing injuries at work and preventing the occurrence of errors in real work (for example VR/AR for High Voltage breaker/ mooring operations for Navigational simulator/ lifting operations) and greatly improving the level of safety onboard a ship due to more realistic training.

The third section included questions about *stakeholders' vision on the future integration of AR/VR technologies within the shipping industry, education and training.* A wide range of sectors were identified: Port training, Logistics and training, Maritime education and safety management, Shipping; Medical sector, Inland water transport, Traffic in general, all modes of transport, Port operations, Criminal scene scenarios, Education and certification of the crew members, certification of boatmen and boatmasters for navigation on sectors with specific risks, Manufacturing, oil and gas, maritime and inland shipping education and education, transport & logistics, process industry & energy sector; Governmental units training (Police, Lifesavers, Firefighters) Maritime, Maritime engineering, shipbuilding, aviation; Healthcare, military, offshore & shipping; Shipbuilding, Data visualization, inspection, simulation, etc., for Research & Development and innovation (32%), upskilling employees by in-house specialized trainings (25%) or hiring people with AR/VR expertise (13%).

The *benefits of using AR/VR* in their organisations are/will be: Safety increase (23%), efficiency increase (21%), remote collaboration across locations to view same activity/project data (14%), productivity increase (13%), time saving (12%), cost reduction (9%) and complexity reduction (5%).

The last section asked stakeholders to identify the limitations, obstacles, concerns and challenges they may find in their organisations with reference to AR/VR usage.

In point of *limitations*, most of the organisations complained about Lack of budget (30%), others stated that one of the main limitations of using AR/VR is Lack of understanding of senior management about such technologies (21%), or that creating virtual reality models increases the time (16%), lack of knowledge of design teams of such technologies (13%), lack of communication among software and models are not realistic as limitations for AR/VR in the industry (6%).

The biggest *obstacles* organisations have to face are: financing and investment (24%), content offerings (e.g. lack of quality content, amount of content available) (21%), user experience (e.g. bulky hardware, technical glitches) (15%), consumer and business reluctance to embrace AR/VR and cost to consumers (11%), regulations and legal risks (10%), competition from start-ups with similar products (10%), or government oversight (3%).

The *top concern* of all respondents is the lack of an established market for technology when it comes to investing in immersive technology start-ups. Other concerns are: untested technology, slow adoption (39%), too much competition from start-ups with similar products (10%), Financial concerns, lack of awareness and knowing what it can

do for your organisation, as creating a good application is a process and it costs money if you want it done well (8%).

Analysing the answers to the questionnaire, one can see a significant increase in the level of concern about lack of experience/ expertise/ talent (23%), followed by uncertainty regarding the viability of the software (17%), platforms requiring exclusivity (14%), difficulty in negotiating licensing agreements and IP rights (11%), product liability risk (10%), Privacy and security concerns and uncertainty regarding the viability of the hardware (8%).

*We would like to thank all those who answered the questions and supported us with valuable insights on this matter. We hope that our findings will make the potential of VR and AR well understood and will be beneficial to the development of the maritime and inland navigation education and training system.*

## **Chapter 2. Scope of document**

In the current document an analysis was done to identify institutional capacities and multi-level transnational cooperation of VET institutes and key actors for educational attainment and recognition of skill level within and across national borders in order to ensure access to digital tools and technologies for every student/trainee, teacher/trainer.

Innovative multimedia tools and applications ranging from simulators, virtual and augmented reality applications, digital equipment and any other innovative teaching aids have the potential to increase the accessibility and efficiency of education and training process.

The COVID-19 situation created the opportunity to think about flexibilization of education by digital means. By developing and implementing innovative digital learning/training and assessment, on short term, we will be able to give learners the opportunity to learn independent of place and time and contribute to increasing the level of digital competence. On long term, we aim at adapting E&T institutions to the new learning and working conditions, by shifting learning modules to digital content, in our specific case by also taking into account the mandatory standards of competences approved by STCW 2010, Directive (EU) 2017/2397 on the recognition of professional qualifications in inland navigation and ES-QIN- Standards of competence adopted by the Delegated Directive (EU) 2020/12. At the same time, we will contribute to increasing the level of digital competence of maritime and inland navigation personnel and improving the level of their skills for employability.

In the last few years, E&T institutes have increased efforts to protect their trainees through new strategies for innovative courses development. However, the changes made in the way of studying and modernization and updating of education and training programmes have not sufficiently been accompanied by adequate changes in the way of learning and assessment. To be up to the task, the training staff must possess the knowledge and skills to allow them to effectively and efficiently use the range of new teaching tools available and the innovative ones that need to be used in the future.

Motivated by these identified needs, the DERIN project shall rely on the synergy between the consortium partners with the know-how and experience in the field in order to enhance professional competences and skills of training staff through capacity building in contemporary pedagogical approaches, methodologies and educational AR/VR technologies.

AR/VR technologies can potentially address most of the deficiencies and shortcomings and enhance inland navigation education and training in several aspects, such as real-time on-site communication. AR/VR can also improve communication among organisations and provide better visualization for trainers, engineers, designers, researchers and other stakeholders, enabling one-to-one fully immersive experience.

In this questionnaire, AR refers to a physical environment, whose elements are augmented with and supported by virtual input and VR refers to a simulated virtual environment, representing a physical environment.

The main objective of the present questionnaire is to understand the industry trends (growth pace) and limitations in adopting AR/VR technologies, as well as identifying new opportunities for using AR/VR to their maximum potential in the advantage of education, training and assessment of both seafarers and inland navigation crewmembers.

The questions were formulated to gather information about the stakeholders' interest in the adoption of Virtual Reality (VR)/Augmented Reality (AR) technologies in the past and in the future, to understand the current state and growth of AR/VR in inland navigation industry, to identify opportunities of AR/VR development in improving education and training and last but not least, to understand the benefits of adopting AR/VR technologies, as foreseen by trainers, experts, researchers, etc.

Through these questions, we wanted to evaluate the stakeholders' familiarity with and future needs of AR/VR tools and their organisations' efforts in integrating these technologies with on-going and future education and training activities.

The questions were designed to target a range of stakeholders in the maritime and inland navigation industry, such as VET schools, Maritime and Inland colleges and universities, research centres, port companies, crewing agencies, shipyards, ship owners, naval authorities, ministries of transport etc.

By understanding the potential and maturity of AR/VR technologies, industry stakeholders can better understand the potential use-case of these tools to better prepare our trainees for their future jobs and to adapt our education towards what the companies expect of their future employees.

In order to account for participant privacy in accordance with GDPR policy, the questionnaire did not ask for any personal information such as name, age, position in the company, etc. from the stakeholders.

## Chapter 3. Method

Since the implementation of AR/VR technologies is still relatively new in navigation industry, there is not much empirical data on these topics. In order to gather data, a detailed online questionnaire was designed, which was reviewed by all DERIN project partners to ensure questions are clear and not misleading and designed in such a way to be able to analyse the growth of these technologies.

Finally, by further analysis on the survey results, we were able to determine the industry trends and visions over AR/VR technologies.

The questionnaire is formulated to gather the information about the maritime and inland navigation industry's adoption of AR/VR technologies. Moreover, it investigated the opportunities for AR/VR technologies to improve stakeholders' communication and identify experts' need for such technology.

As stated before, the survey was hosted on the following link:

<https://docs.google.com/forms/d/1HsKRKUMHA9klcpmAuHBPKHm5GaQiBlwkKuQBpeqiRZ8/edit?ts=613b171b> that enabled keeping a record of the answers and entries from database for analysing survey results.

The questions were divided into four sections:

- (1) general information
- (2) AR/VR knowledge and experience
- (3) visions for future of AR/VR and
- (4) risks and limitations

**The first section** of the questionnaire aimed to identify general information about the respondents, such as nationality, occupation, and professional experience and organisation size in terms of employees/trainees per year.

**The second section** examined the respondents' familiarity, awareness and competency in AR/VR technology and applications; what types of AR/VR devices they have used and how many AR/VR experts they have in their companies as well as what the main sectors, areas and platforms where their organisations can use AR/VR and/or create content for AR/VR are.

Through these questions, we were able to evaluate the respondents' familiarity with AR/VR tools and their companies' effort in integrating these technologies with on-going and future education, training processes and projects.

In **the third section**, the respondents were asked to answer a few questions about their vision on the future integration of AR/VR technologies within the shipping industry. The questions in this section were designed in a way that demonstrates AR/VR potentials for future developments. For example, the respondents were asked to identify the sectors (i.e. education and port training and operations) that have the

highest potential for the growth in AR/VR utilization. The last two questions evaluated how the respondents predicted the increase in end-users' satisfaction when AR/VR technology is used and their strategy for expanding AR/VR initiatives.

**The last section** evaluated the organisations main limitations for AR/VR in the industry, visions for cost and time saving through integrating AR/VR technologies in their activities and projects, what obstacles and concerns can hinder the adoption of these tools, as well as the challenges they might face when entering into deals with companies developing AR/VR solutions, or related to health and safety training situations.

By understanding the potential and maturity of AR/VR technologies, industry leaders can better understand the potential use-case of these tools. The identified industry trends can help industry leaders make better investment decisions on the usage of these technologies, mainly in education and training.

The questionnaire was distributed by project partners to their contacts in the stakeholder database directly via email within maritime and inland navigation industry. 62 responses were received from: Netherlands (16), Croatia (12), Romania (12), Latvia (8), Bulgaria (6), Estonia (4), Sweden (1), Ukraine (1), Russia (1) and 1 respondent who did not state their nationality.

Respondents represent maritime and inland navigation education and training institutions (37%), VET schools, research centres, port companies, naval architects and designers, general contractors, shipyard personnel, consultants etc.

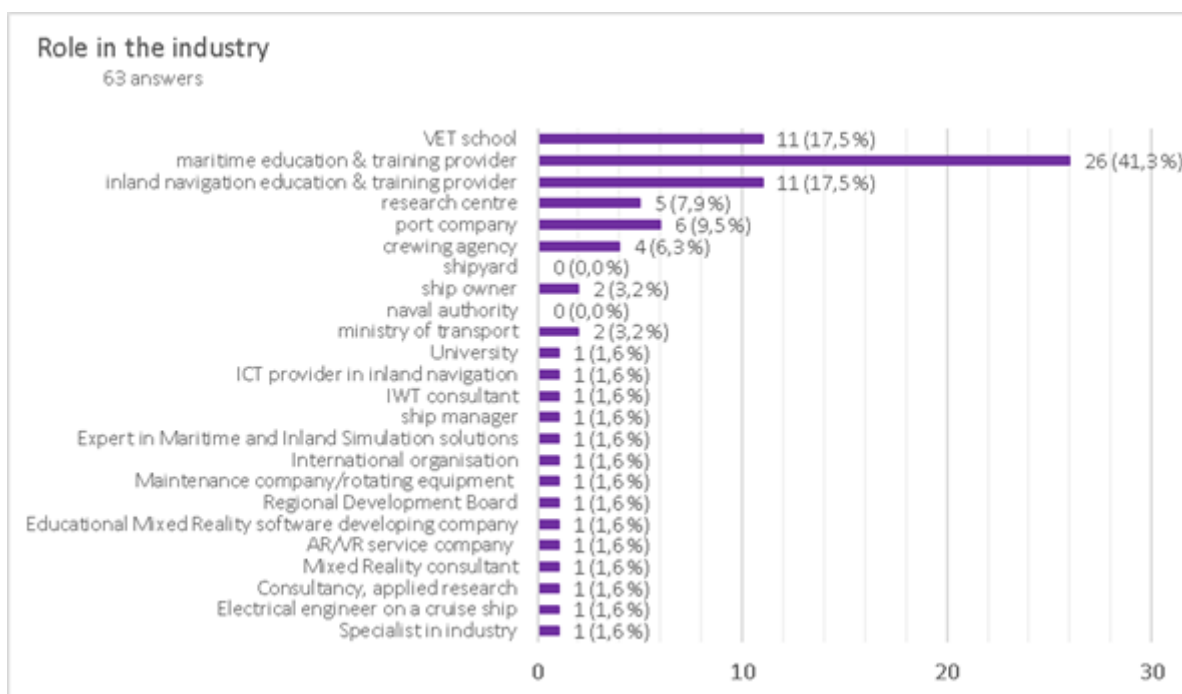


Figure 1. Role in the industry

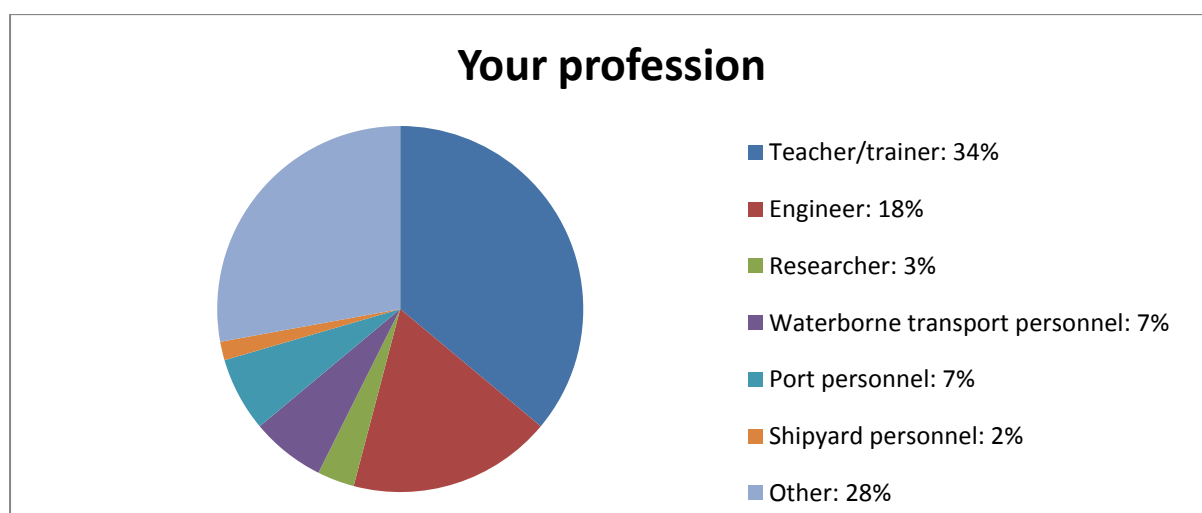
## Chapter 4. Survey findings and results

### Section 1. General information

The first section identified general information about the respondents, such as nationality, occupation and professional experience and organisation size in terms of both employees and trainees per year.

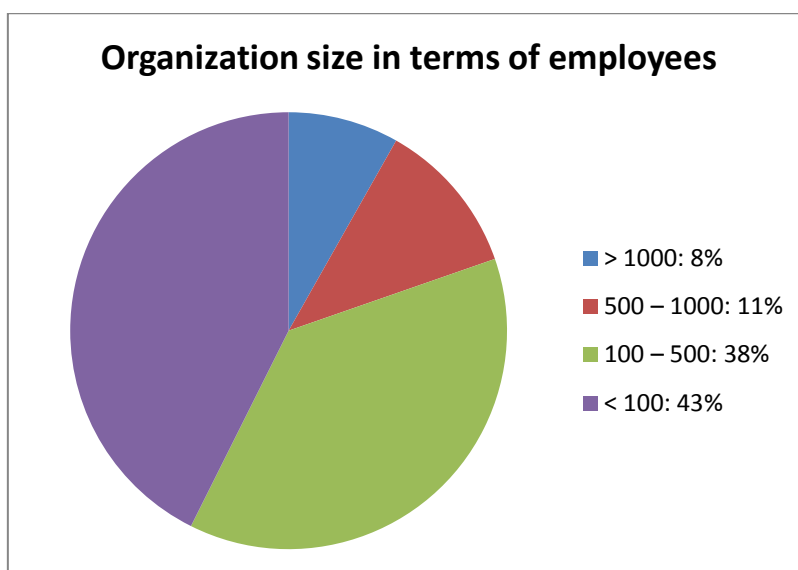
Professional experience is an important indicator of the expertise of the respondents. Out of the 61 respondents who stated their profession, most of them are teachers/trainers (34%) and engineers (18%), as per chart below.

Over 48% of them have more than 10 years of experience in their organisation in the maritime industry (over 54%) and in inland navigation (34%).



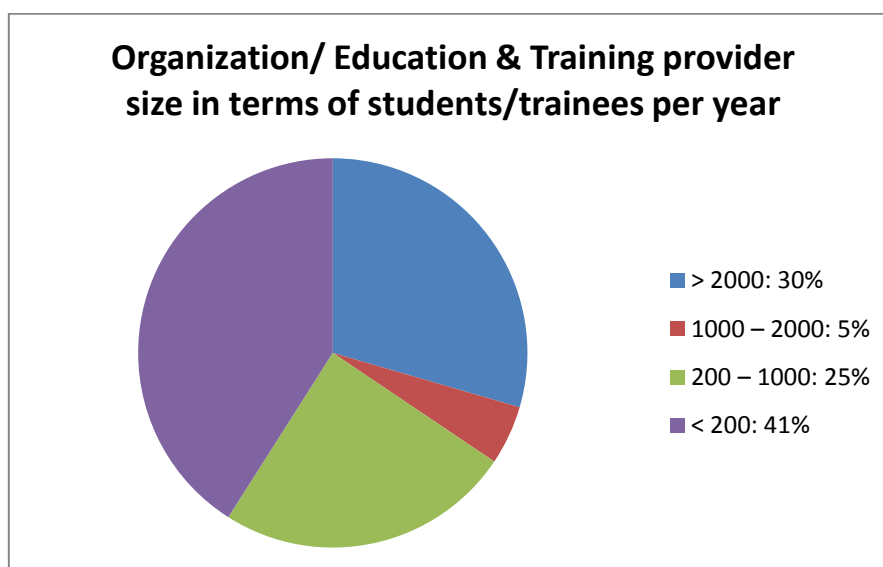
*Figure 2. Stakeholders' profession*

The other professions are listed as follows: software developer, captain, consultant, ship manager personnel, simulation expert, product manager, international organisation official, sales manager, project manager, creative technologist, company owner, training provider.



*Figure 3. Organization size in terms of employees*

The sizes of organisations the respondents are part of is also a factor to be considered. Most of the organisations (43%) are small, having no more than 100 employees. These are mainly the E&T providers; they are followed by organisations with 100-500 employees (38%). Only 11% of the organisations who answered the questionnaire have 500-1000 employees and a small percentage (8%) have more than 1000 employees.



*Figure 4. Organization/ Education & Training provider size in terms of students/trainees per year*

In terms of number of students/trainees per year, most of the E&T providers (41%) have a small number of trainees (up to 200). We were happy to notice that quite a large number of E&T providers have more than 2000 students/trainees per year – here

maritime and inland navigation universities and colleges are included. Next, 25% of the E&T providers have between 200 and 1000 trainees per year, and only 5% of E&T providers have a larger number of students/trainees, that is between 1000 and 2000.

## Section 2. AR/VR knowledge and experience

To assess AR/VR knowledge of the respondents, several questions related to AR/VR technologies were asked.

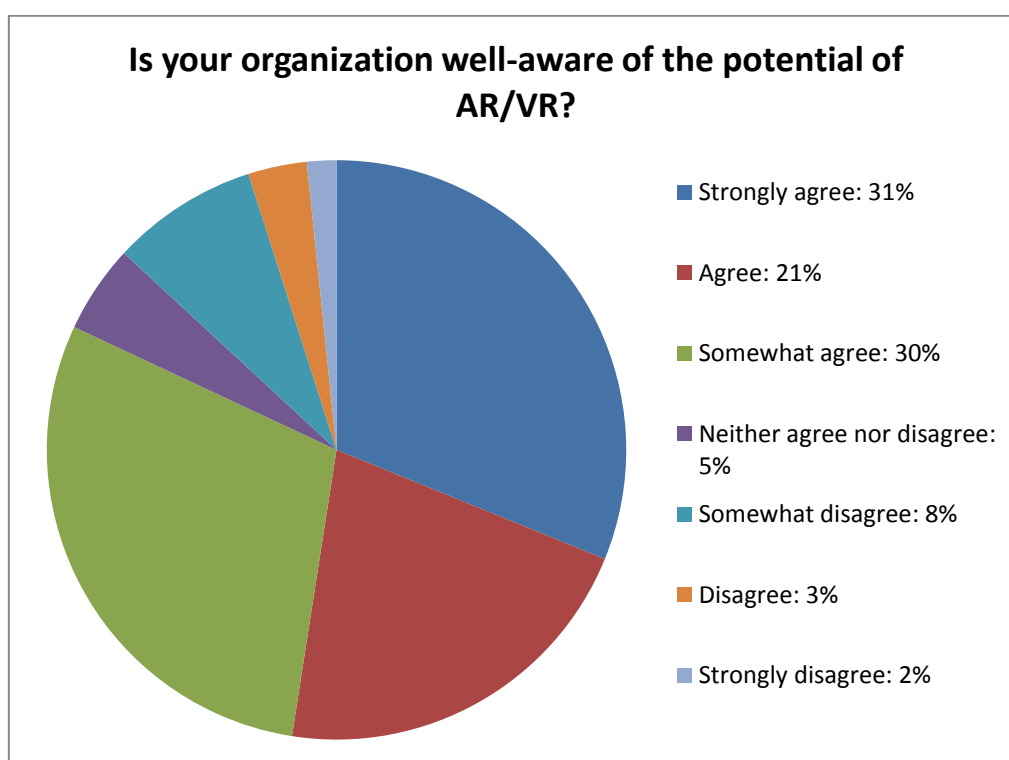
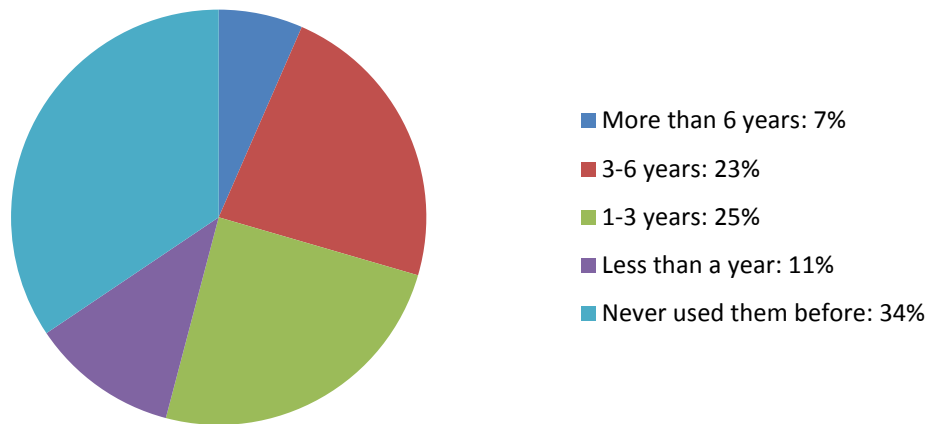


Figure 5. Awareness of potential of AR/VR

To the first question, whether the organisation was well-aware of the potential of AR/VR, over 50% of the respondents assessed that their organisations were aware while almost 30% were not quite sure.

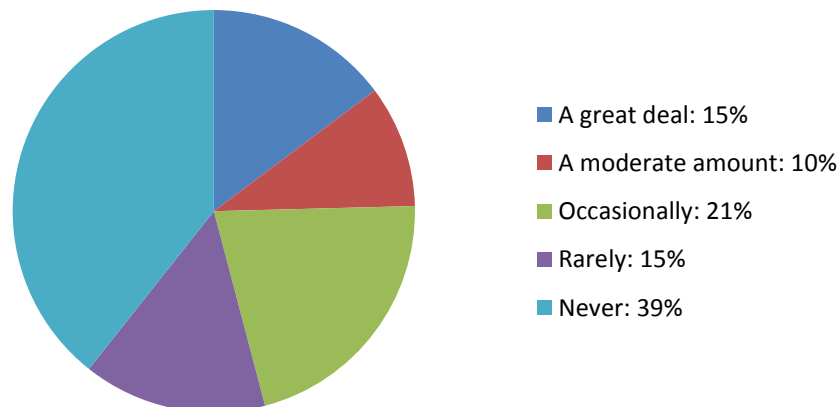
**Is your organization familiar with AR/VR tools based on experience?**



*Figure 6. Familiarity with AR/VR tools*

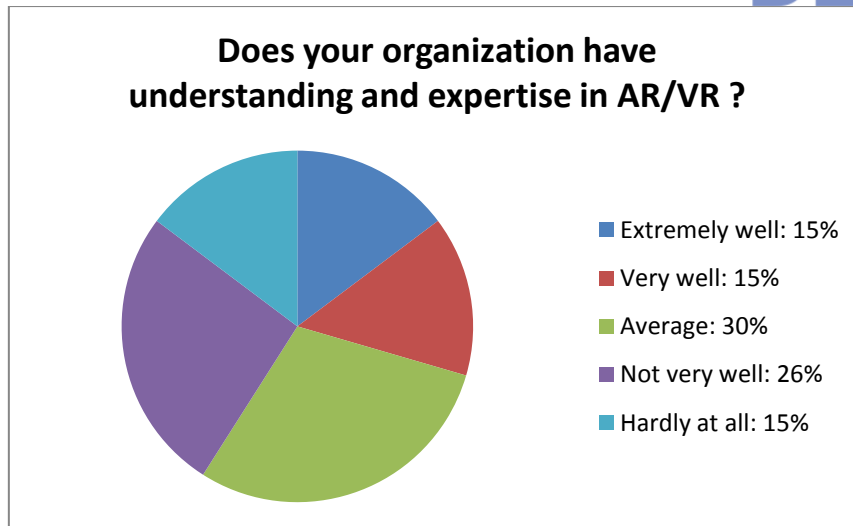
The second question in this section was about the organisations' familiarity with AR/VR tools based on experience. Only 4 respondents said that their organisations are familiar with these technologies for more than 6 years and 22 stated that they never used them before.

**Is your organization making use of AR/VR devices and applications in general?**



*Figure 7. Usage of AR/VR devices and applications*

As a consequence, the answers received for the third question, about usage of AR/VR devices and applications in their organisations are similar to the ones in the previous question: 9 respondents use these tools, but 25 respondents (over 40%) out of 62 are not using such tools. 21% of the respondents, meaning representatives of 13 organisations, indicated that they occasionally use AR/VR tools.

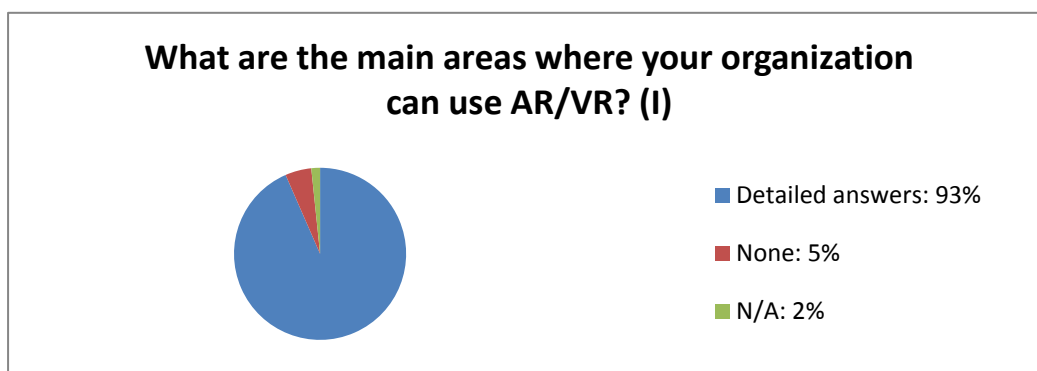


*Figure 8. Understanding of and expertise in AR/VR*

It's useful to understand AR and VR technologies that are out there under the umbrella of mixed reality. One way to do that is by discussing the technical differences between product offerings. However, by understanding the three main characteristics that distinguish the experience enabled by these technologies, stakeholders can better understand and describe the fundamental distinctions between products and how these new technologies can be successfully used in their activity.

In this respect, 30% of the respondents stated that they have an average understanding and expertise in AR/VR, 15% of them can understand and work very well and extremely well with these innovative technologies, 26% of the respondents still need to better understand how AR/VR tools work and again 15% of respondents have no understanding or expertise in AR/VR.

Despite the fact that virtual and augmented reality are relatively new technologies, the next question regarding the main areas where organisations can use AR/VR tools revealed their interest in using them in everyday practice, as we can see in the graph below.

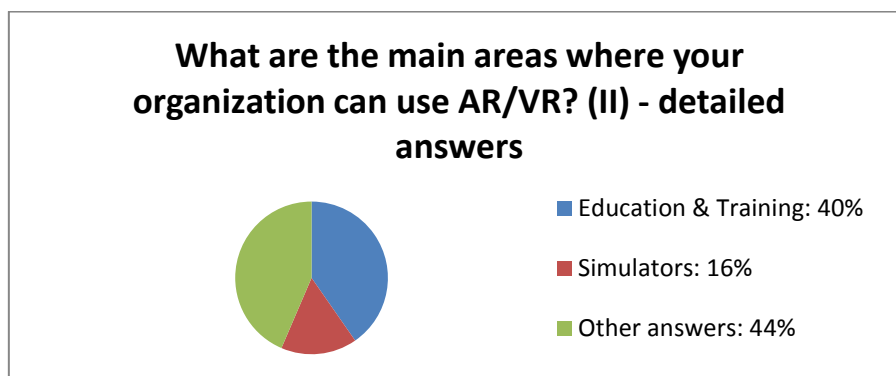


*Figure 9. Main areas organisations can use AR/VR*

Out of 61 analysed answers:

- 57 respondents, representing 93% of the total, gave detailed answers;
- Only 3 respondents, representing 5% stated that their organisations cannot use, or are not interested in using AR/VR and
- 1 respondent gave no definite answer

Next, respondents were asked about the main areas where their organisations can use AR/VR devices.



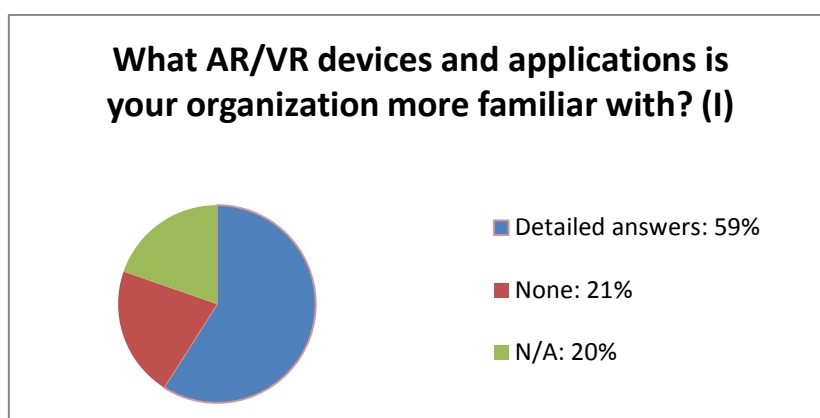
*Figure 10. Main areas organisations can use AR/VR*

The 57 detailed answers were analysed and the results of the survey indicate that 40% of the respondents are most likely to use these innovative devices in Education and Training, 16% will make use of Simulators.

27 respondents, representing 44% of the total number of 61, gave detailed answers as follows:

- Familiarization with Safety Equipment and procedure (fire extinguisher, breathing apparatus, radio beacons (EPIRB))
- Safety controls and navigation supervision, Training/assessment, Scenario blended training
- Remote instruction and support
- Port logistics
- Selecting personnel
- Preparing crews for the vitality of the ship (extinguishing fires, plugging water holes) and providing first aid in case of injuries, burns, drowning; Marine engineering; Navigation; Maintenance; remote familiarization; Training on maritime engineering structures; Deck operations
- Live Remote audits and assistance, Quality inspections, Problem analysis, New employee training, Annotation taking, Document sharing, Knowledge transfer, Assisting the trainer on site, Port worker training
- Remote technical inspections,
- On site Jobs with mechanics

The terms Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR) are getting thrown around a lot these days. There is a plethora of devices: Oculus Rift, HTC Vive, Samsung Gear VR, Google Glass, Microsoft HoloLens, ODG R-8, Epson Moverio and the list goes on.



*Figure 11. Organisations familiar with AR/VR devices and applications*

59% of the 61 respondents provided detailed answers and 41% gave no answer, meaning that they are not familiar with AR/VR tools yet.

Respondents were asked about which AR/VR devices they are more familiar with (figure 12).

For the 36 respondents who gave detailed answers, the results of the survey indicate that respondents are most familiar with VR glasses/headsets (approximately 20%), followed by Oculus/Oculus Quest/Oculus Quest 2 (10%), HTC/ HTC Vive (10%) and Microsoft HoloLens (10%), HMT-1/Realwear HMT-1 (8%). Only 2% of the respondents are familiar with Magic Leap, Varjo and VR cameras.

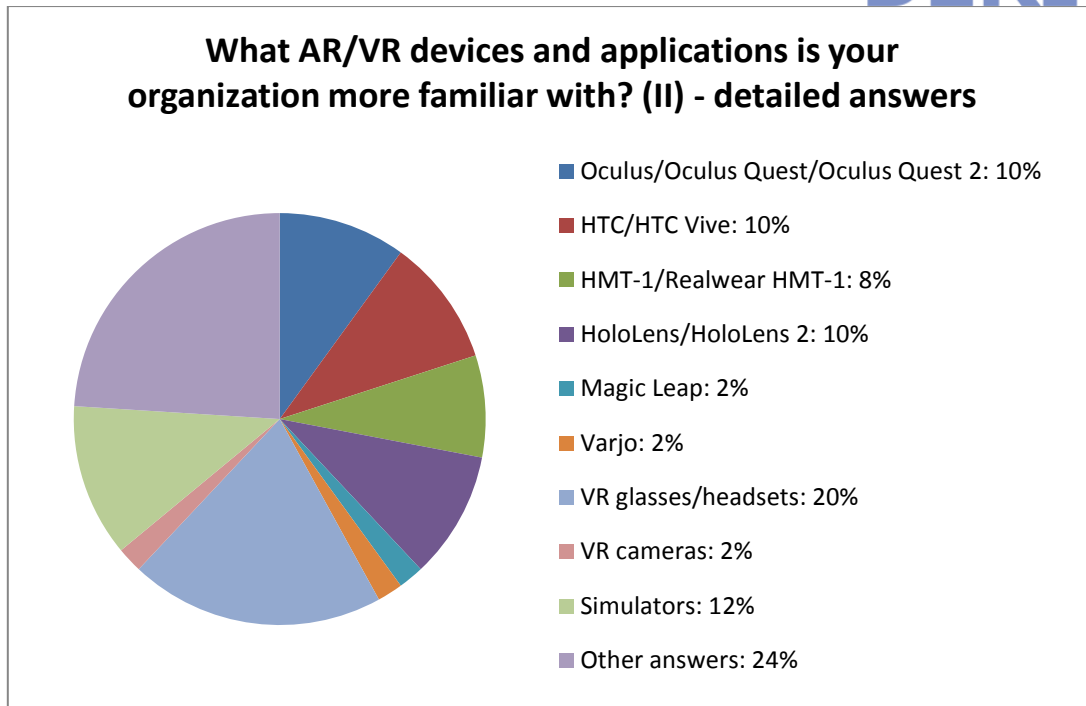


Figure 12. Familiarity with AR/VR devices and applications

Next, respondents were asked about what AR/VR devices and applications are used by their organisations.

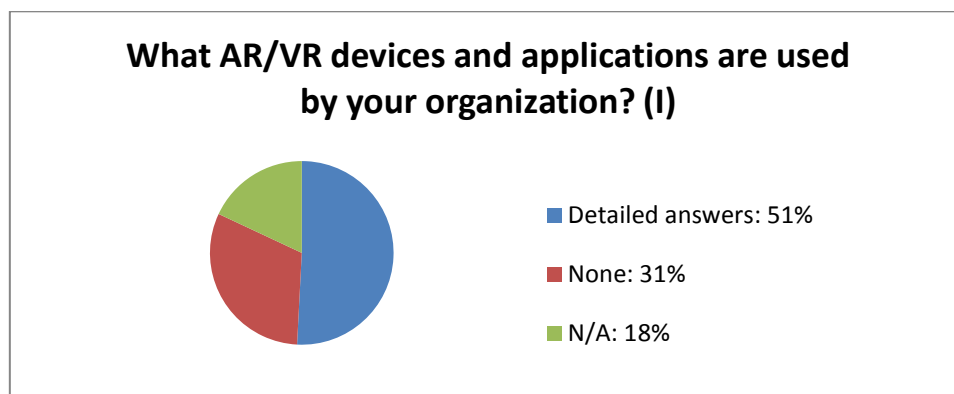
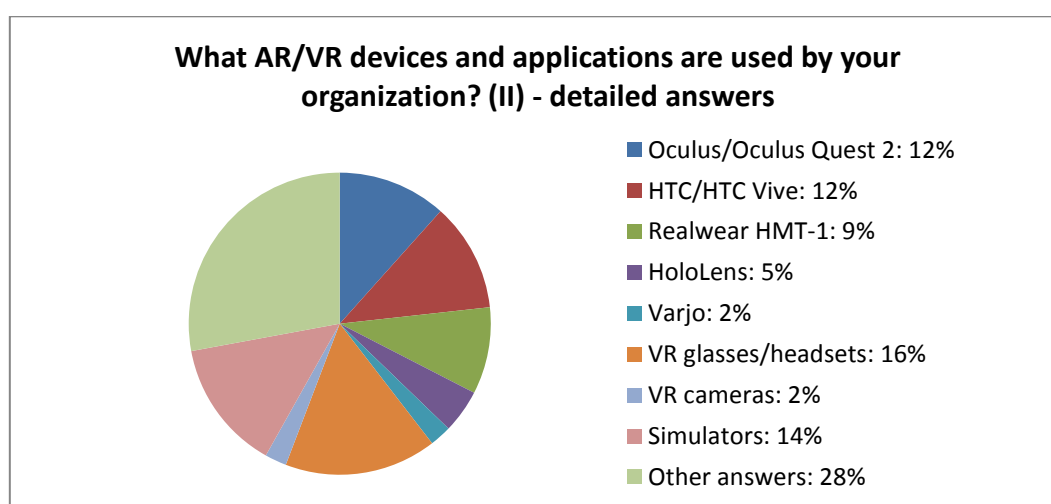


Figure 13. Organisations using AR/VR devices and applications

The results of the questionnaire indicate that over 51% of the respondents use these devices and 49% responded that they do not use them.



*Figure 14. Types AR/VR devices and applications used*

The answers of the 51% respondents who offered details were analysed separately and the results of this questionnaire indicate that some of those respondents use VR glasses/headsets (16%), followed by simulators (14%), Oculus/Oculus Quest/Oculus Quest 2 and HTC Vive (12%), Realwear HMT-1 (9%), Microsoft HoloLens (5%). Only 2% of the respondents are familiar with Varjo and VR cameras.

28% of the respondents gave other answers. They stated their organisations used other innovative tools, such as:

- Game engines Unreal, Unity, Google VR, Computers/Microsoft Teams
- Special devices for security and surveillance
- E navigation, new technology related to autonomous ships
- Proprietary software, Knowledge Insights software for digital workflow
- Remote Assist, Guides, Velicus apps (their own applications), Mesh, etc.
- Velicus CPR+, Velicus Fire+, Microsoft Dynamics 365 Remote Assist, Microsoft Dynamics 365 Guides, Edumersive and Plusport, Unity
- Science hub system, SteamVR

The next question: *What is the number of AR/VR experts in your organization?* Received the following answers showing that in almost 60% of cases a smaller or bigger number of experts exist within the organisations.

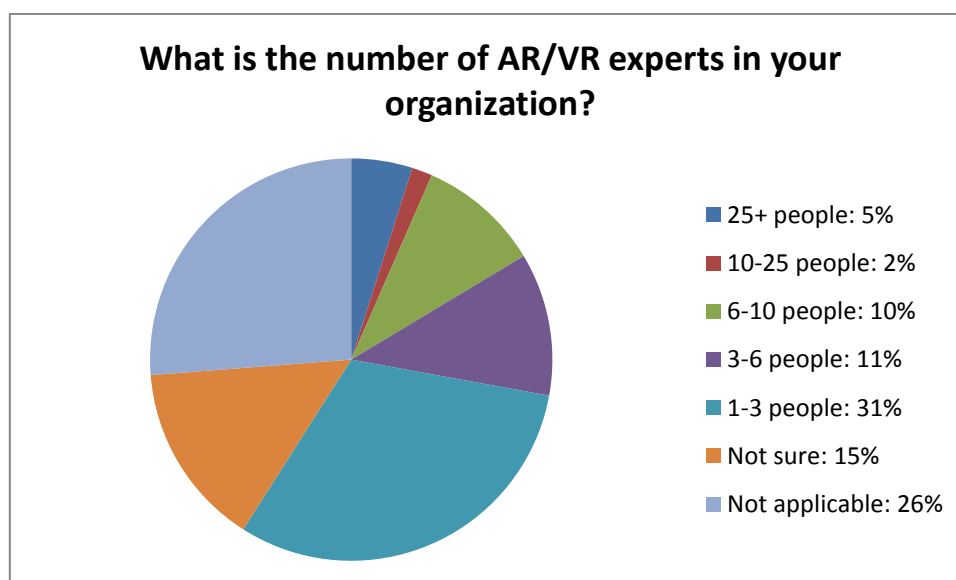


Figure 15. Number of AR/VR experts in stakeholder organisations

It is important to note that more than 25 AR/VR experts work in 5% of the organisations questioned, followed by those organisations, representing 2% of the total number of respondents, where 10-25 people have expertise in using AR/VR tools. Although 26% of respondents stated that they do not have experts in AR/VR, we are fully confident that soon, some of these organisations will have such experts.

Due to the importance and expectations for continuous training in maritime and inland navigation sector, there are many training academies and centres offering all types of training courses with all teaching methods and techniques. From the traditional classroom teaching, to off-line digital teaching, to on-line interactive e-learning platforms, up to modern Virtual Reality environments, this sector will become a fast and unstoppable market.

The unexpected incidents create a need for a different point of view on safety, outside the traditional thinking and practices. Today, safety within a safety culture and safety climate is a priority for inland navigation companies.

**How do you believe AR/VR/ technologies can most effectively address challenges in safety training situations/safe working conditions?**



*Figure 16. Usage of AR/VR technologies for safety training situations/safe working conditions*

In this respect, respondents were asked to share their opinion how AR/VR technologies can most effectively address challenges in safety training situations and/or safe working conditions in their organisations. 72% of the respondents gave detailed answers, 11% consider these new technologies are significant and very good while 16% of the total of 61 respondents gave no answer.

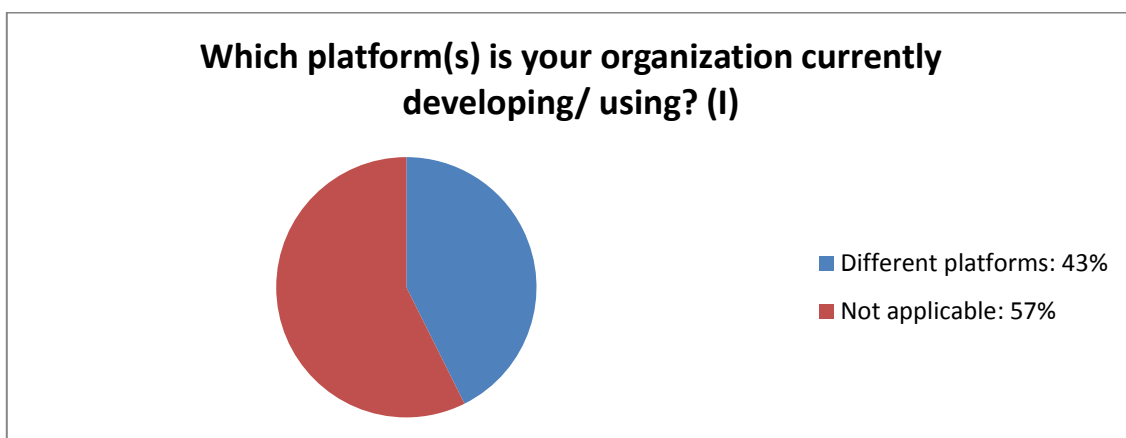
Here are the detailed answers received from the majority of the respondents. They consider the usage of AR/VR technologies is important in:

- reducing physical presence, new training opportunities, more realistic practical training, allowing immersion in a specific environment without the risk of physical involvement
- providing a safe and repetitive environment for exercises, proper simulation scenarios
- training and education, practical unsafe situation awareness
- improving maritime education and safety training, allowing AR/VR drills
- providing real-life situations, thus reducing injuries at work and preventing the occurrence of errors in real work (for example VR/AR for High Voltage breaker/ mooring operations for Navigational simulator/ lifting operations).
- improving safety training creating different real-life scenarios and environment in which risky events can occur or could be triggered
- enabling practice and create different situation the worker may face, upgrading workers' skills and competences
- familiarizing the staff with the technical means used in emergency situations and with the variants of their use
- implementation of VR enables coaching and hands-on training using digital workflows to be executed by students step-by-step and measuring improving of performance (duration of execution, failures, etc.)



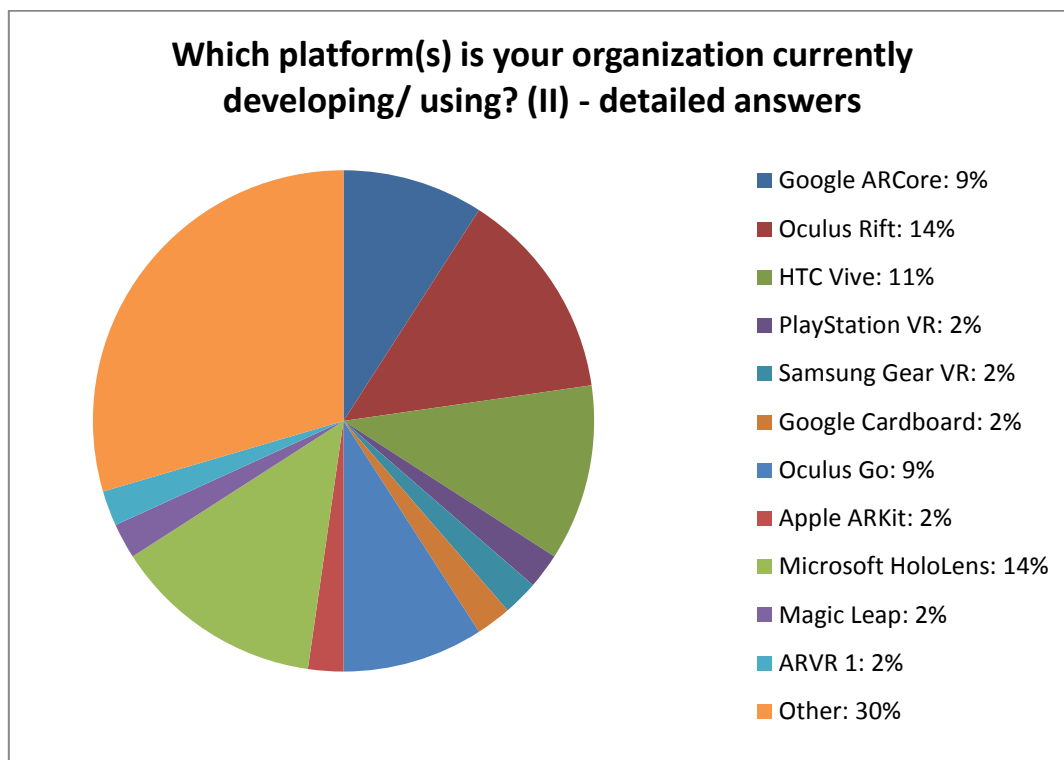
- making it possible to train when, wherever and how often you want and being able to simulate emergency situations in the real surroundings.
- "XR (extended reality is the umbrella term for MR/VR/AR/PR) can be utilised to really enable someone to make new skills their own, offering a way to practice what they've learned and utilise the power of reinforcement. It can create immersive experiences either in a fully digital environment or a in their own environment that is enriched with digital 3D objects. Data can be collected, analysed and applied to improve the experience or teaching methods
- By creating an interface between simulator and AR/VR, inland navigation nautical and safety crew can train together how to prepare for calamities (e.g. fire, collisions, environmental issues like spills, leaking of batteries etc.). Furthermore, the energy transition will introduce renewable energy sources and more electrification on board on vessels. For educational institutes investing in actual installations is more expensive than AR/VR solutions, so virtual applications can really contribute as well as AR if connection with vessels equipped with new technologies can be made (e.g. guest lecture bunkering hydrogen by means of AR connection, real time is a different experience than a pre-recorded movie). Also, remote control in inland shipping has a future due to lack of inflow of new professionals / students. AR/VR combined with simulation can guarantee a license to operate in the future.
- AR/VR has a great potential and believe soon they will be wildly used in maritime education.
- greatly improving the level of safety onboard a ship due to more realistic training
- Learning by doing is still one of the most powerful ways to learn (new) skills, habits and techniques. AR and VR technologies can provide a safe and efficient 'digital place' where new skills can be obtained.

Next, respondents were asked to indicate the platform(s) their organisations use for AR/VR devices and applications.



*Figure 17. AR/VR platforms developed/used by organisations*

The results of the questionnaire indicate that 43% of the respondents use different platforms, but more than a half, namely 57%, do not.



*Figure 18. Types of AR/VR platforms developed/used by organisations*

Out of those 43% who offered detailed answers, the respondents use Oculus Rift (14%) and Microsoft HoloLens (14%), 5 respondents use HTC Vive (11%), followed by those using Google ARCore (9%) and Oculus Go (9%).

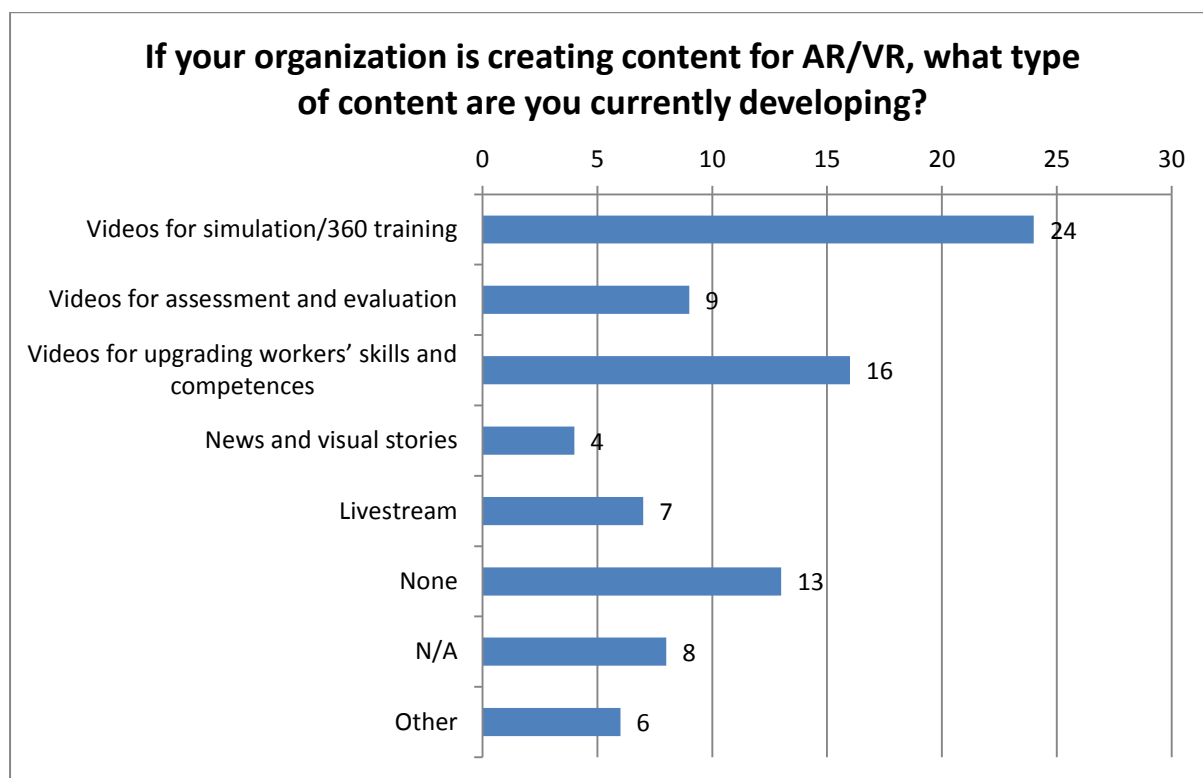
2% of the respondents indicated that their organisations use PlayStation VR, Samsung Gear VR, Google Cardboard, Apple ARKit, Magic Leap and ARVR 1. No responses were received for the usage of Google Daydream, Windows MR Headsets and Google Tango.

30% of those who indicated the platform they develop/use gave answers such as: Wärtsilä Transas, Kongsberg, Kongsberg Norcontroll, Oculus quest 2, Varjo, Nautis, Realwear HMT-1, V-STEP simulator, MagicLeap, ARVR 1, PlayStation VR or other different customised simulation platforms for i.e. navigation, engine room or communication.

Content for AR/VR can be developed in-house or outsourced. The main differences are saving time and having access to expert experience. If an organisation is building an in-house team, they will need a developer, a programmer and a 3D artist at minimum. When the content for AR/VR is outsourced, organisations can access more experienced professionals, but may have to pay a higher price. Whether organisations create a

program in-house or outsource, it is important to develop an AR/VR program that aligns with their custom learning and training goals.

In this respect, respondents were asked to indicate if their organisations create content for AR/VR education and training and if they do, what type of content they are currently developing.



*Figure 19. Types of AR/VR content developed by organisations*

The results of the questionnaire indicate that 24 respondents create content Videos for simulation/360 training, 16 respondents create Videos for upgrading workers' skills and competences, 9 respondents create content for Videos for assessment and evaluation, 7 respondents create content for Livestream and only about 4 do them for news and visual stories.

The questionnaire also revealed that 8 respondents do not create content for AR/VR yet and 6 respondents create other types of content, as follows:

- VR/AR simulation training modules
- Educational software for safety and healthcare training (CPR / First Aid / Firefighting)
- 3D content
- Mixed Reality applications to enable and facilitate learning health and/or safety training
- Simulations and scenarios

- 3D content and simulation for VR training

Last question in this section was about the sector of activity organisations use AR/VR technology.

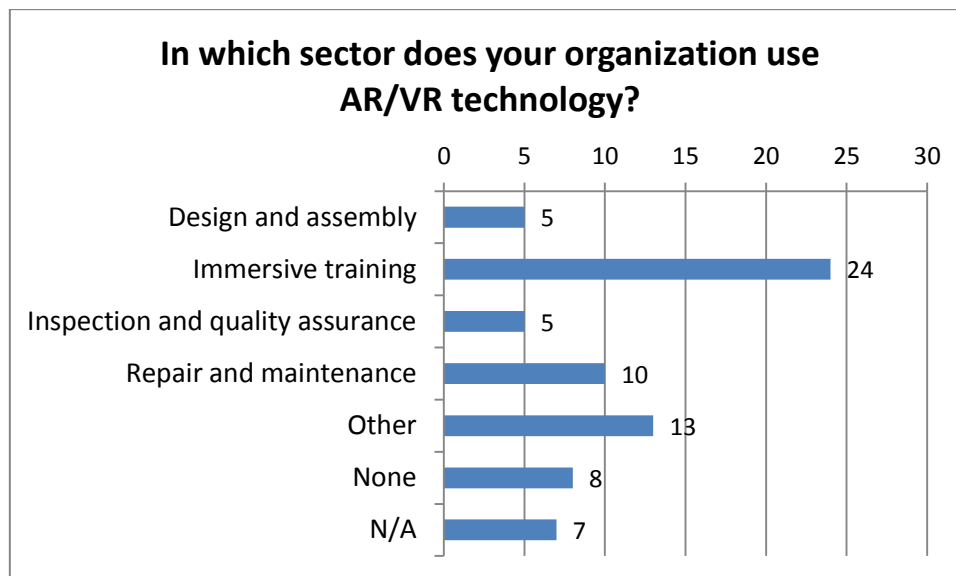


Figure 20. Sectors where AR/VR is used

The results of the questionnaire indicate that 24 the respondents use AR/VR devices for Immersive training, 10 organisations use this innovative technology for Repair and maintenance, 5 stakeholders for Design and assembly and other 5 stakeholders for Inspection and quality assurance, as per chart above.

13 respondents gave other detailed answers. They indicated that their organisations use AR/VR technology in the following sectors: Training/ familiarization, Sailing, Safety and public order, Maritime transport, Police training, Navigation, Ship remote support and assistance.

15 respondents answered that they do not use this type of technology, while some of the respondents/organisations stated that they are not using AR/VR technology yet, but they are deeply interested in using it in the future, mainly for training, inspections and quality assurance, repair and maintenance.

### Section 3. Visions for the future of AR/VR

When the respondents were asked to predict whether AR/VR will be used on all or majority of the activities within the next 5 to 10 years, the 62 answers analysed showed a majority of positive answers:

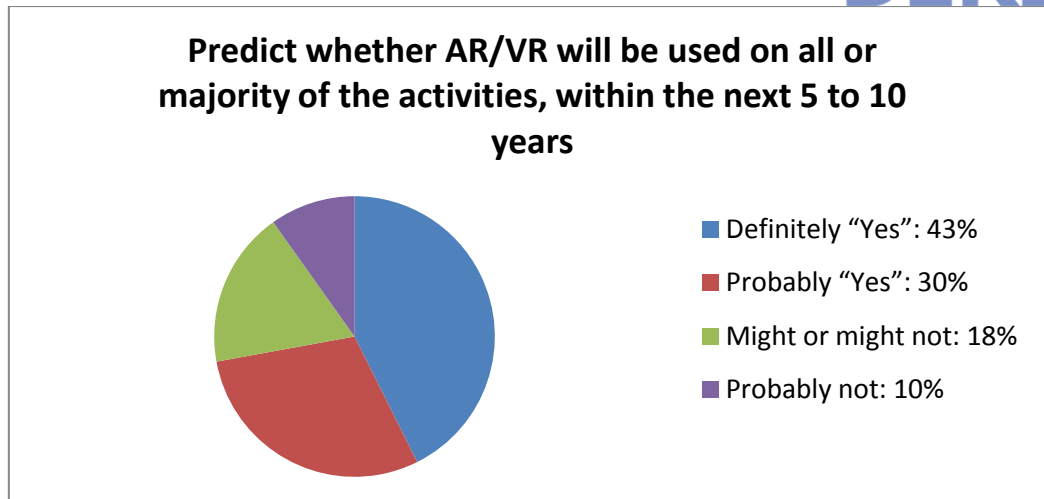


Figure 21. Prediction on AR/VR usage

Next, respondents were asked to identify the local sectors in their region that have the highest potential for the growth in AR/VR utilization.

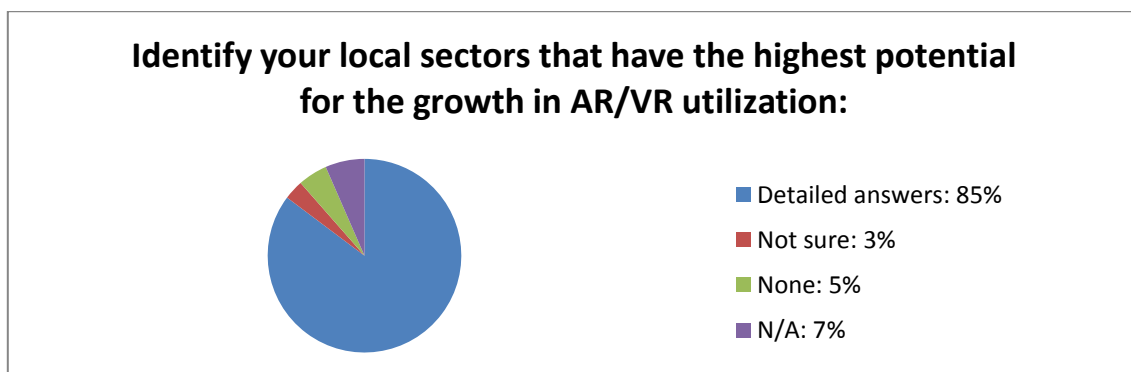


Figure 22. Local sectors where AR/VR have high potential to be used

52 respondents (85%) gave detailed answers to this question in the survey.

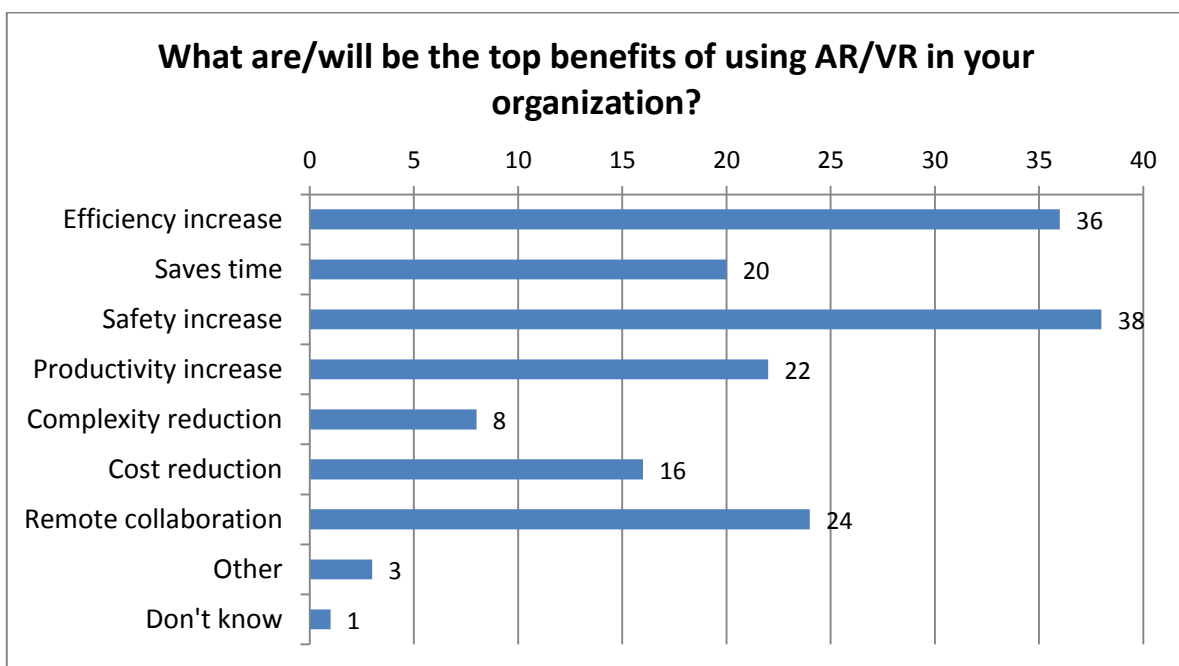
Out of them, 13% indicated Education & Training as the main sector having the highest potential for the growth in AR/VR utilization. The other sectors identified are: Port training, Logistics and training, Maritime education and safety management, Shipping, Medical sector, Inland water transport, Traffic in general, all modes of transport, Port operations, Criminal scene scenarios, Companies involved in the naval sector: CNAPDM /ICEPRONAV, Remote auditing, training and inspecting, Education and certification of the crew members, certification of boatmen and boatmasters for navigation on sectors with specific risks, Manufacturing, oil and gas, education, maritime and inland shipping education and education, transport & logistics, process industry & energy sector, Governmental units training (Police, Lifesavers, Firefighters) Maritime, Maritime engineering, shipbuilding, aviation; Healthcare, safety education, military, offshore & shipping, Shipbuilding, Data visualization, inspection, simulation, etc.

2 respondents (3%) are not sure whether local sectors in their regions have any potential for the growth in AR/VR utilization and 7 respondents (12%) consider that the local sectors in their regions have no potential for the growth in AR/VR utilization.

The benefits of AR/VR in inland navigation education and training are embraced by many educators, but some are still reluctant to use it in their classrooms. Reasons range from high costs to push back from school administrators. Others see the value of both VR and AR as entertainment, but not as effective teaching tools in the classroom.

Bringing AR and VR tools into the classroom does not have to be expensive. Available resources, ranging from low-priced viewers like Google Cardboard to cost-effective equipment that can connect to smartphones, can be acquired with less significant financial effort.

In addition to providing students with immersive learning experiences, other benefits of virtual reality in inland navigation education and training include the ability to inspire students' creativity and spark their imaginations. And this can motivate them to explore new academic interests. AR and VR in education and training also helps students struggling to understand difficult academic concepts.



*Figure 23. Benefits of using AR/VR*

In this respect, stakeholders were asked to indicate what the top benefits of using AR/VR in their organisations are/will be.

Here are the answers received:

- **Safety increase:** 38 answers
- **Efficiency increase:** 36 answers
- **Remote collaboration** across locations to view same activity/project data: 24 answers
- **Productivity increase:** 22 answers
- **Saves time:** 20 answers
- **Cost reduction:** 16 answers
- **Complexity reduction:** 8 answers

The following benefits were also indicated (one answer each):

- The power of muscle memory, ensuring that people will feel confident in what they've learned and practiced
- Developing software
- Costs increase

Only one respondent chose to answer: "I don't know"

Next, respondents were asked to indicate their organisation's strategy for expanding AR/VR initiatives.



Figure 24. Organisations' strategies to expand usage of AR/VR

As the questionnaire indicates, 32 respondents stated that there are initiatives to use AR/VR in Partnerships with other institutions/organizations, 25 respondents will use AR/VR in Research & Development teams/ Innovation Centre, 20 organisations in Upskilling employees by in-house specialized trainings, 13 respondents/organisations will use AR/VR technologies for Hiring people with AR/VR expertise, 3 respondents indicated using AR/VR for Organizing innovation platform and community to boost partnership of education and industry in innovation and Creating awareness of the possibilities of MR and the HoloLens 2.

Only 2 stakeholders are not sure whether they will have a strategy in this respect as they are actually hiring people in short term to get more experience in-house, but they are definitely teaming up with experts in the field to assist with development of in-house applications.

And 2 respondents stated that their organisations have no strategy for expanding AR/VR initiatives, as they are not using these devices at the moment.

When asked if their organization believe that there will be an increase in end-users satisfaction rate by integrating AR/VR, the respondents were quite convinced according to the answers in the chart below.

**Does your organization believe that there will be an increase in end-users satisfaction rate by integrating AR/VR?**

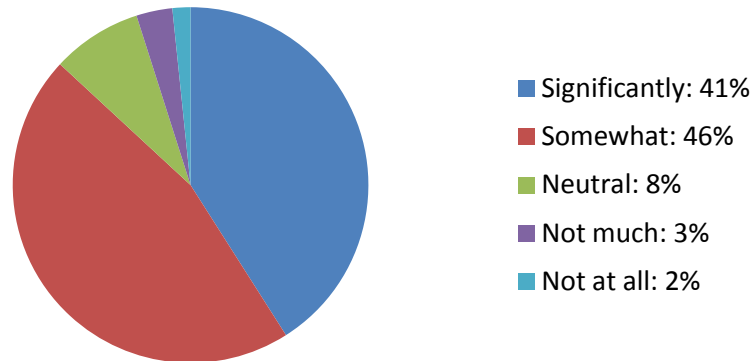


Figure 25. Increase in end-users satisfaction rate by integrating AR/VR

#### Section 4. Risks and limitations

Technology is endlessly evolving, and the introduction of brand-new devices sometimes acts as a touchstone to the arrival of a completely new technological paradigm. Every technology has some limitations and AR/VR is no exception. Even though mobile devices have many uses in their present form, there are several issues that should be addressed before the technology becomes fully commercialized and goes mainstream. In this respect, stakeholders were asked to identify the limitations they may find in their organisations with reference to AR/VR usage.

**Which does your organization consider being the main limitations for AR/VR in the industry?**

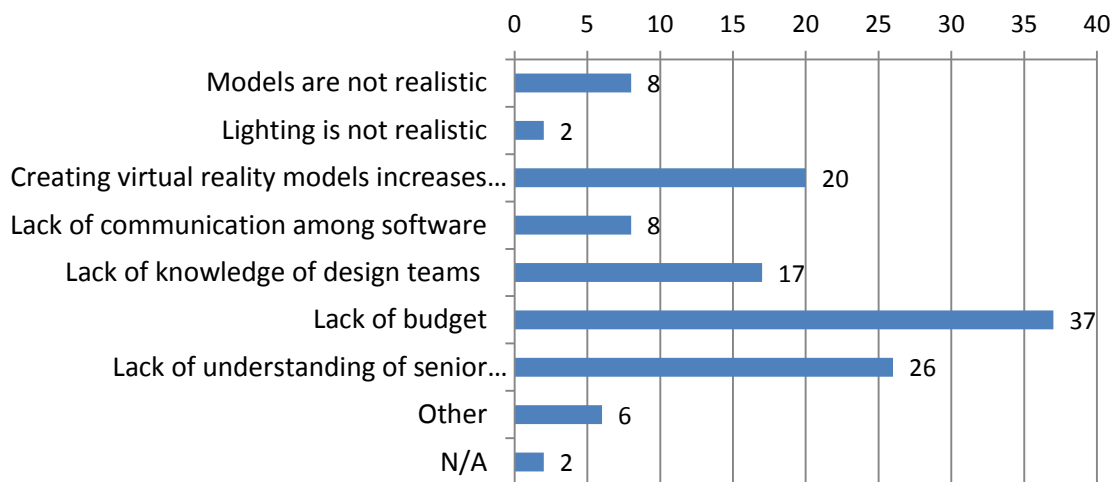


Figure 26. AR/VR limitations

Respondents/ organisations complained about Lack of budget – 37 answers (almost 60%), 26 respondents (42%) stated that one of the main limitations of using AR/VR is Lack of understanding of senior management about such technologies, 20 respondents (32%) consider that Creating virtual reality models increases the time, while another important limitation is Lack of knowledge of design teams of such technologies, identified by 17 respondents (27%). 8 respondents (almost 13%) consider Lack of communication among software and Models are not realistic as limitations for AR/VR in the industry and 3% had to deal with the following limitation: Lighting is not realistic.

Only 6 respondents indicated other limitations for AR/VR in their organisations, as follows:

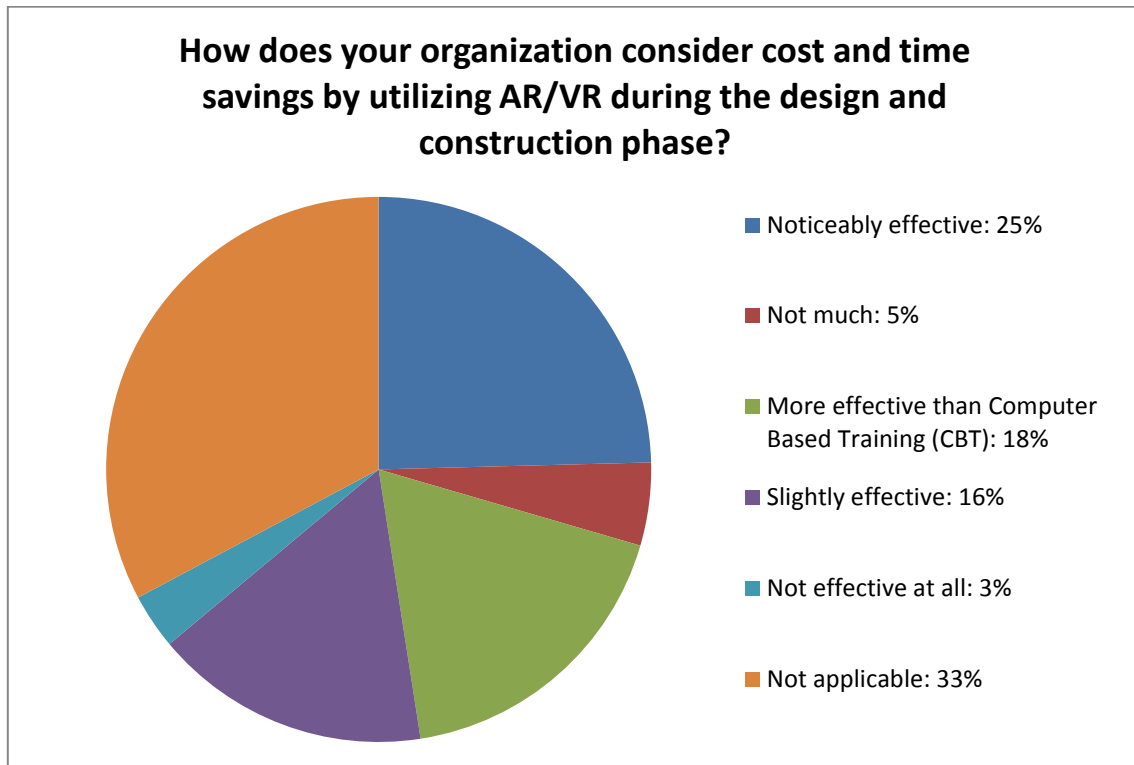
- Inertia of employees including senior management
- VET schools in certain countries (e.g. Estonia) are governmental organisations and they may not have a fleet under the flag, so organisations in these countries are allocated small budget for education and training activities.
- The lack of awareness and lack of focus on adoption and change management. Utilising XR means you're going into a space where nothing existed before. It's completely new for people so it's key to ensure a good change management process. Which means investing in your people and listening to them.
- Lack of understanding from the part of the teachers
- Creating realistic VR models TAKES time. And it must be realistic in order to be of added value in our activities, also in relation to customer satisfaction levels.

During this COVID-19 pandemic, there has been an acceleration of integrating technology-driven programs into education and training institutions curricula. With access to technology, there are more ways to teach, learn and train.

Unfortunately, over the last couple of years, many educators really want to start integrating AR/VR in their schools and institutions but have found it difficult. Often this is due to management and school leaders vetoing project proposals.

There are several key barriers to AR/VR integration in education & training institutions. There are walls that are usually built from misconception, lack of understanding or fear of the unknown. Reasons for these barriers are people who don't understand what virtual reality actually is nor what it can do or tight budgets.

When thinking of creating an innovative AR/VR app for the business, any stakeholder's top concern is how much AR/VR costs during the design and construction phase.



*Figure 27. Cost and time saving by utilizing AR/VR during the design and construction phase*

As the chart above indicates, 25% of respondents consider cost and time savings of AR/VR in design and construction phase as noticeably effective; 18% of organisations consider cost and time savings by utilizing AR/VR more effective than CBT design and construction, 16% of respondents consider this aspect slightly effective. Only 3% of respondents are not quite satisfied with cost and savings by utilizing AR/VR tools in the design and construction phase, whereas 33% of stakeholders consider this aspect not effective at all.

Another area where cost savings can be made is AR/VR education/training/ research/ assessment. Not only is it more accessible and often delivered to a consistently higher standard, AR/VR training has been shown to have higher retention rates than traditional classroom training, which can reduce training time.

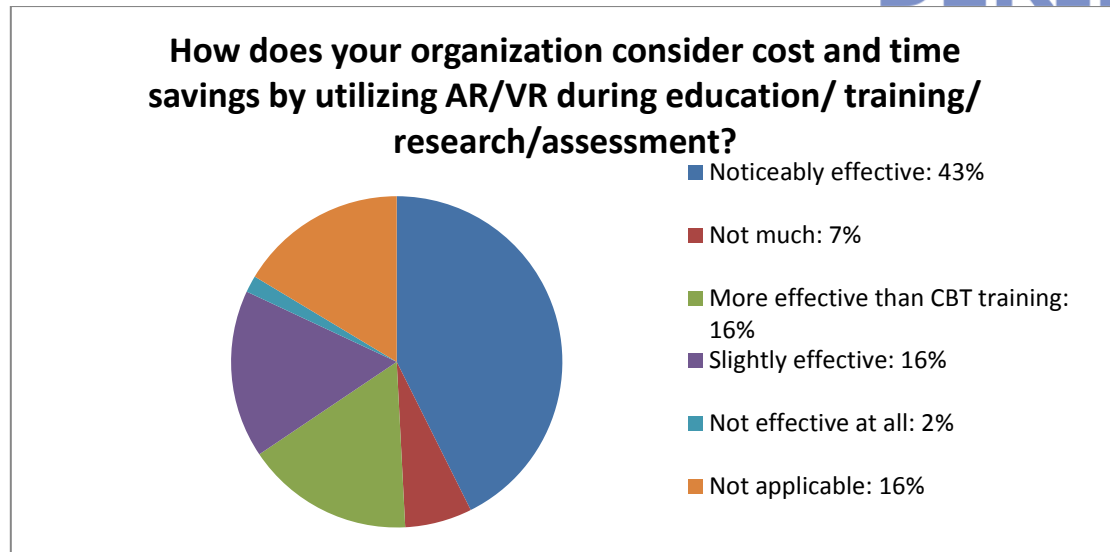


Figure 28. Cost and time saving by utilizing AR/VR in education/training/research/assessment

As the chart above indicates, 43% of respondents consider the usage of AR/VR in education, training, research and/or assessment as noticeably effective; 16% of organisations consider their usage more effective than CBT training, other 16% of respondents consider the introduction of AR/VR tools slightly effective. Only 7% of respondents are not quite satisfied with the introduction of AR/VR tools in their activity, whereas 2% of stakeholders consider AR/VR tools not effective at all.

Virtual reality (VR) and augmented reality (AR), bring many benefits to E&T providers, shipping companies and other stakeholders as consumers, and to the industries that adopt them. But we can't ignore the fact that there are many personal and societal obstacles, risks that come with these tools, particularly at the more immersive end of the spectrum.

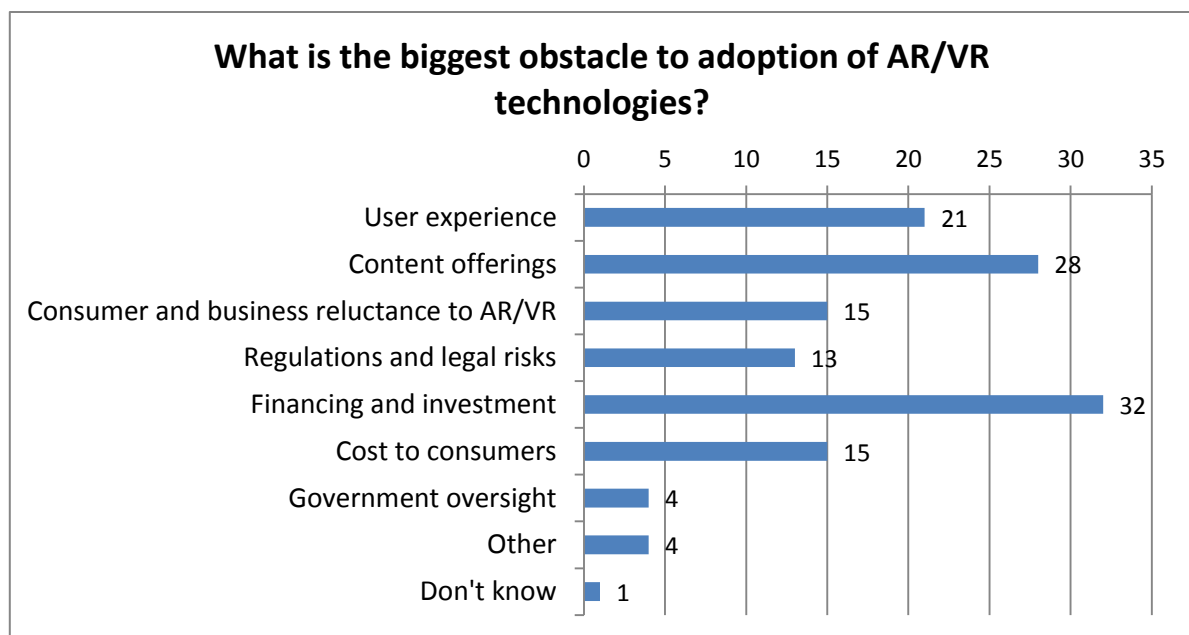


Figure 29. Obstacles in adoption of AR/VR technologies

In this respect, 62 respondents were asked to indicate the biggest obstacle to adoption of AR/VR technologies. The following answers were received:

- 32 = Financing and investment (51,6%)
- 28 = Content offerings (e.g. lack of quality content, amount of content available (45%)
- 21 = User experience (e.g. bulky hardware, technical glitches) - (34%)
- 15 = Consumer and business reluctance to embrace AR/VR and Cost to consumers (24%)
- 13 = Regulations and legal risks (21%)
- 4 = Government oversight (6,5%)

4 respondents indicated other barriers, as follows:

- Tailor made application is necessary for specific training requirements
- Lack of awareness. If you don't know it exists and what it can do for you, how are you going to embrace it? Again, this is where adoption and change management plays an extremely important role.
- Scaling
- Government oversight and regulations risks go hand in hand. In order to formally adopt AR/VR technologies in assessment and certification in the sectors we are active, there is still a lot of ground to cover. That is okay, but convincing conservative sectors takes time, and therefore it is a risk (especially from the investment perspective).

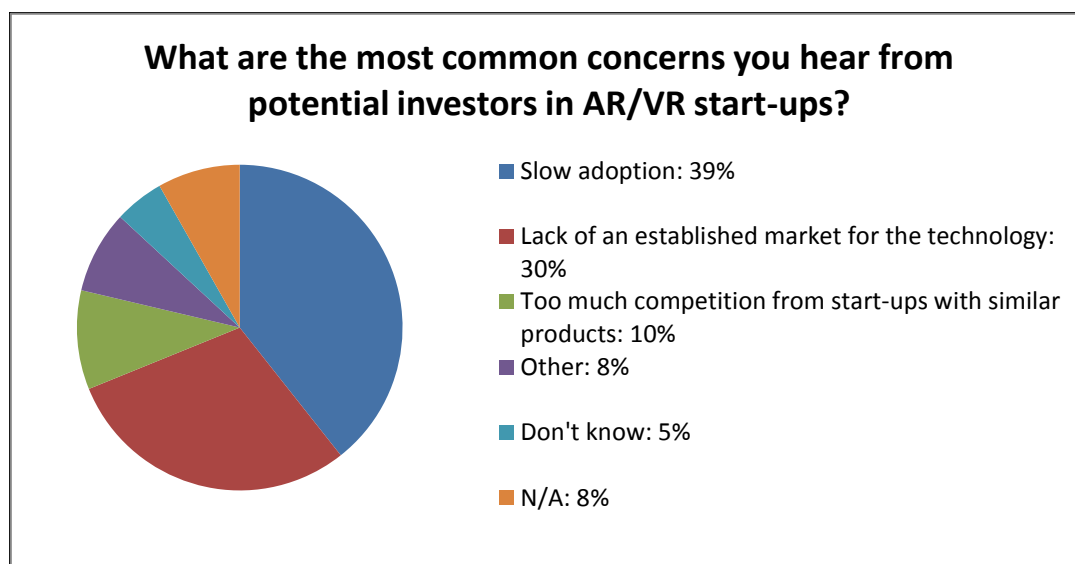


Figure 30. Concerns in AR/VR start-ups

The lack of an established market for technology is the main concern potential investors have when it comes to investing in immersive technology start-ups.

30 percent of respondents from this survey had this concern. Untested technology, slow adoption (39), too much competition from start-ups with similar products (10%),

Financial concerns, lack of awareness and knowing what it can do for your organisation, as creating a good application is a process and it costs money if you want it done well (8%) are other top concerns for investors in this space, as the graph above indicates.

Augmented reality (AR) and virtual reality (VR) are showing clear signs of a growing industry—with increased investment, exciting new content (and types of content) and technological advancements. But with growth come new obstacles, including heightened legal concerns.

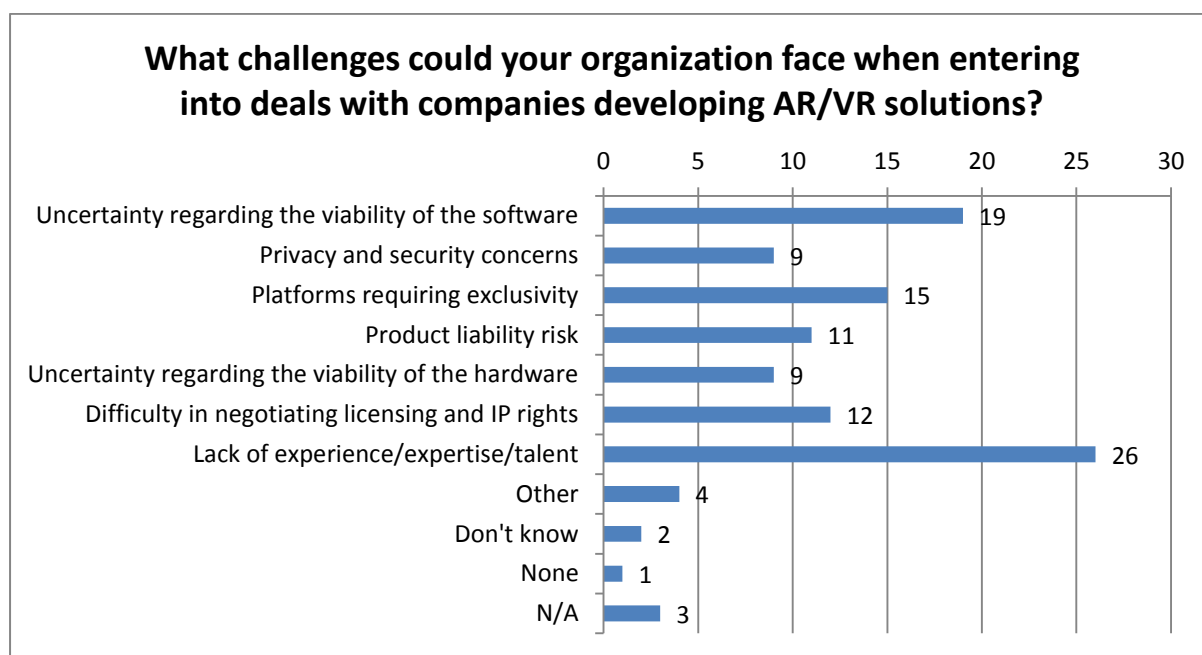


Figure 31. Challenges in AR/VR start-ups

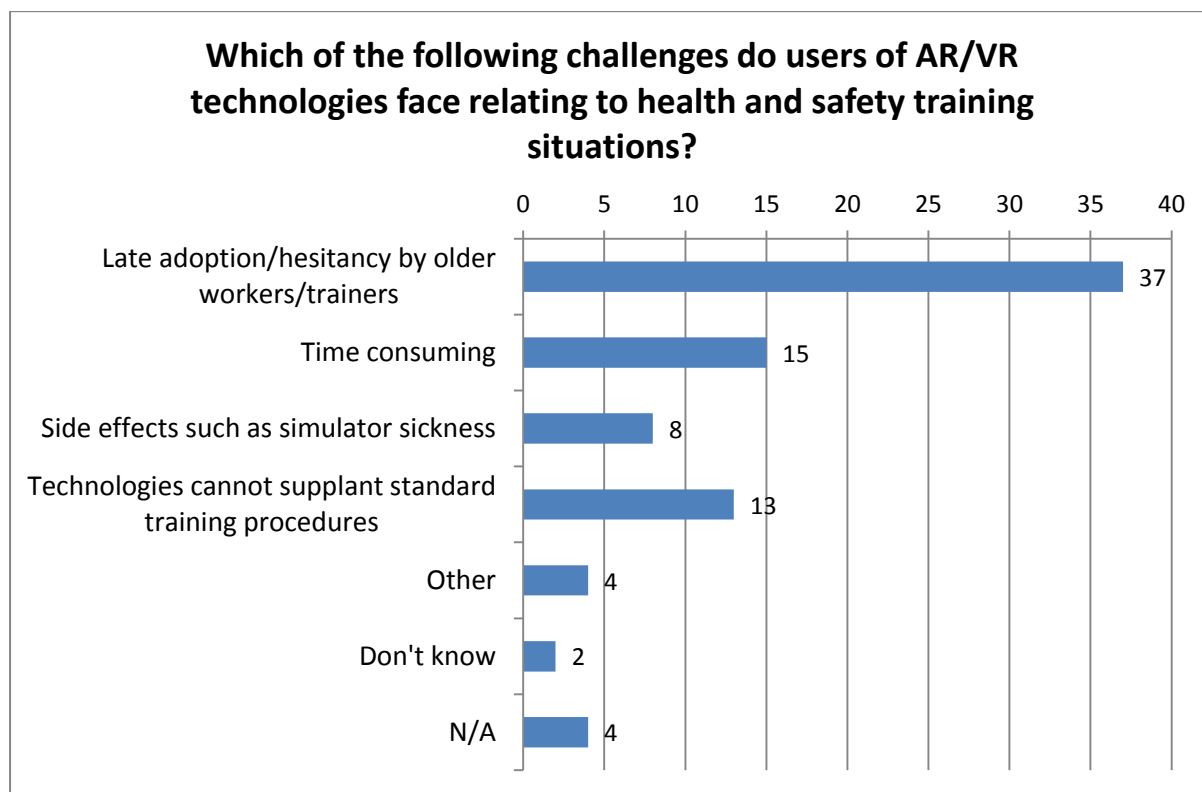
The questionnaire sees a significant increase in the level of concern about lack of experience/expertise/talent (26 answers), followed by uncertainty regarding the viability of the software (19 answers), platforms requiring exclusivity (15 answers), difficulty in negotiating licensing agreements and IP rights (12 answers), product liability risk (11 answers), Privacy and security concerns (9 answers) and uncertainty regarding the viability of the hardware (9 answers)

Other challenges depicted in the survey are:

- Lack of interest
- As developer, there's a big knowledge gap. Not every headset is the same and the differences between MR/AR/VR aren't widely known. Many organisations also look to the technology first and then consider how they can use this to solve something. It should be the other way around, what's the challenge, what are you trying to solve? Then, which technology can facilitate the solution?
- non-profit organisations we would rather develop with their own students
- Lack of experience is linked to the software (e.g. designing a proof of concept among design experts is one thing, making this proof of concept applicable to a real situation that provides added value is a challenge). However, this is needed

to convince management, investors and clients to adopt and continue with AR/VR solutions.

In recent years, the development of AR/VR has progressed significantly. AR/VR, due to its ability to design a standard, reproducible, and controllable environment, has been increasingly used from simple graphical application to advanced usages in the automobile industry, architecture, maritime, inland navigation, aviation and medicine as well as the production, the visualization of science, engineering, and training.



*Figure 32. Concerns involving AR/VR technologies related to health and safety issues*

Despite the benefits of using AR/VR in inland navigation education and training, some challenges and limitations result in the uselessness or misuse of this technology. Therefore, recognizing potential challenges related to AR/VR might be helpful in the strategic decision-making process to implement and develop this technology in inland navigation sector. The main challenges of developing and using AR/VR with educational and instructional objectives are categorized as general and specific. General challenges include reduced face-to-face communications, education, cost challenges, users' attitudes, and specific challenges such as designing, safety considerations, AR/VR side effects, evaluation, and validation of AR/VR applications. Challenges related to AR/VR will have different effects, thus identifying each of them helps to determine the solutions for each challenge. Also, it is suggested to develop and update laws, standards, and protocols, which play an important role in increasing the effective application of AR/VR at the national and international level.

The respondents delivered a variety of answers, but the main challenge/concern is Late adoption/hesitancy by older workers/trainers, indicated by 37 respondents. 15 respondents suggested as a main challenge Time consuming as mock training sessions

need to be conducted by technicians and concerned staff to avoid any equipment damage or other issues during real training sessions. These are followed by Technologies cannot supplant standard training procedures: 13 respondents and Side effects such as simulator sickness: 8 answers.

4 respondents suggested other challenges for users of AR/VR technologies relating to health and safety training situations, as follows:

- There is a big difference between VR and AR
- Lack of expectation management
- Lack of awareness. Introducing new tech and app right off the bat is a lot for an end-user to take in. In an ideal situation they wouldn't be getting a training until they have been made aware, learn about what it can mean for them and then they are ready to absorb the knowledge. (ADKAR methodology)

As with any disruptive technology, AR/VR has the potential to create a host of new legal issues and challenges. The overwhelming success of Pokémon GO highlighted a number of these issues, from the use of copyrighted images and trademarks in virtual worlds and the collection, use and sharing of users' personal information, to injury to people and property from users immersed in the technology. Future disputes will likely include arguments about the ownership of AR/VR rights under pre-existing contracts entered into long before AR/VR became realistic platforms that don't address these "new media" rights (akin to the arguments that have pervaded the entertainment industry for at least 100 years as new technologies developed – silent films to talkies, films to videocassettes and discs, broadcast television to cable and satellite and various forms of video on demand).

As AR/VR technology becomes pervasive in our daily lives, there will be unintended legal consequences and liability issues of which companies, brands and AR/VR content creators must be aware of.

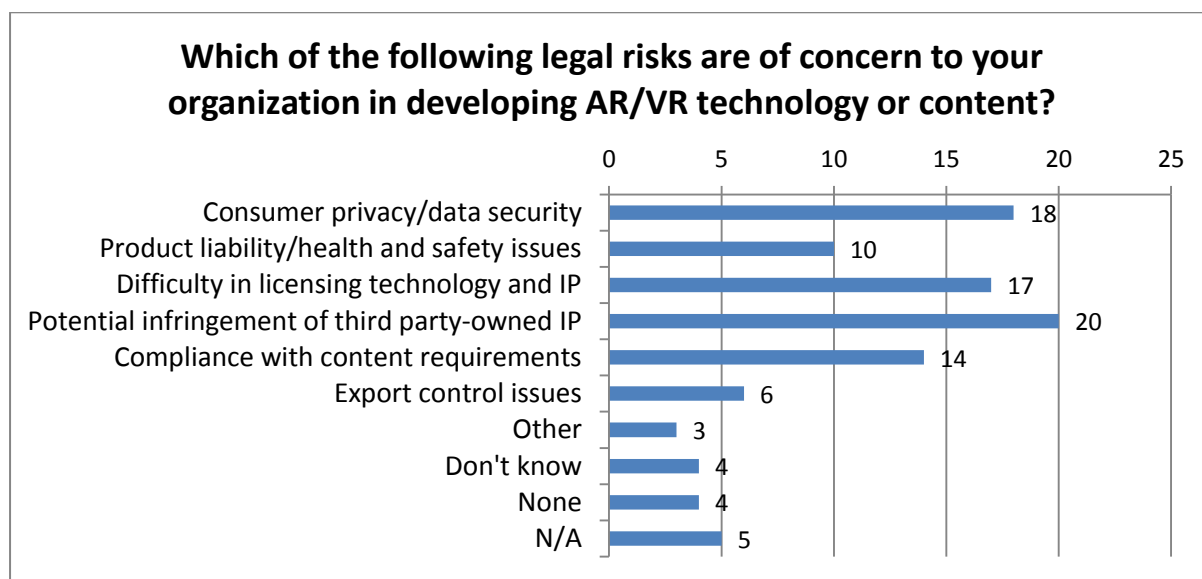


Figure 33. Legal risks in developing AR/VR technology or content

According to the questionnaire, the main concerns of the respondents regarding legal risks in developing AR/VR technology or content are:

- Potential infringement of third party-owned IP (patents, trademarks, copyrights): 20 respondents (32%)
- Consumer privacy/data security: 18 respondents (29%)
- Difficulty in licensing technology and IP: 17 respondents (27%)
- Compliance with platform requirements in publishing content: 14 respondents (22%)
- Product liability/health and safety issues: 10 respondents (16%)
- Export control issues: 6 respondents (over 9%)

4 answers indicated other concerns regarding legal risks in developing AR/VR technology or content, as follows:

- Compliance with international standards for Maritime Trainings
- We use the HoloLens and therefore Microsoft platform. This offers a wide range of security advantages as the device fully integrates with their security platform.
- Changes in requirements to certain standards by government bodies
- Language barriers

The increasingly rapid pace of technological advancement presents continual opportunities — and challenges — for the research and education communities. Most recently, advances in head-mounted displays (HMDs) for both virtual reality (VR) and augmented reality (AR) have made dramatic improvements in the devices' efficacy and affordability.

Today, new HMDs can provide these high-quality immersive experiences at consumer price points, reducing costs by almost two orders of magnitude. Because of this paradigm shift, VR and AR will become an integral part of the education and training technology environment; on some campuses, this is already the case.

These applications are used in the classroom and thus entail potential sensitivities around student data, which must be secured. Further, if students bring their own VR/AR devices to the classroom, the complexity around security increases because the devices' security aspects and integrations may be unknown. User authentication is also important to determine participant identities and thus avoid potentially serious problems such as students attending classes without registering or anonymously harassing each other in the VR/AR classroom where an institution could identify harassers from the authentication records. Such authentication can also protect against having someone copy an avatar to impersonate the instructor.

If an organisation is collaborating on something with complex and extensive security requirements, such as research or medical cases, safety or security measures on board the ship or at the place of work, organisations need to implement strong security controls to protect the data. Collaborations in VR and AR may even be integrated into existing campus collaboration tools. In that case, they must ensure that someone in a VR/AR environment could not use someone else's access into a collaboration tool.



Figure 34. Privacy and data security with AR/VR technologies

Considering these aspects, the organisations involved in the present survey, indicated the following four steps to address privacy and data security concerns with AR/VR technologies:

- Training employees on cyber security risks and information security (28%)
- Updating privacy policies and disclosures regarding consumer data (21%)
- Strengthening data security measures to mitigate the risk of breaches or hacks (20%)
- Limiting the amount of collected, shared and used personal information from users (19%)
- Usage of Microsoft platform which means data/security is taken care off for the most part. See Microsoft Trust Centre (2%).

As AR/VR technologies continue to evolve quickly, they have led to the development of considerable intellectual property and other assorted legal issues in the AR/VR space. Disputes over who holds the copyright to VR software will be an important source of liability in the future.

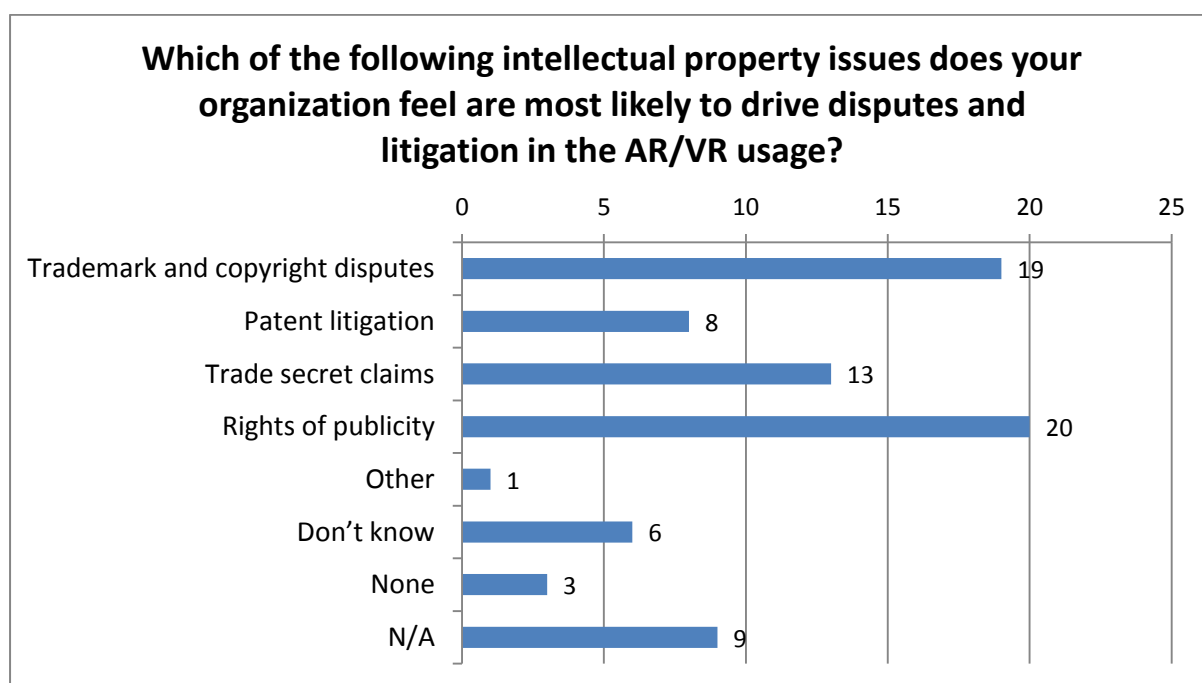
Trademarks may be a combination of words, sounds or designs used to distinguish the goods of one creator from those of another – and last fifteen years. However, and particularly notable in the relatively new VR industry, expensive legal battles can arise when a company must prove the authenticity of their non-registered trademark.

A significant recent increase in patent applications in respect of AR/VR technologies reveals companies' desires to maintain a competitive advantage and protect their

inventions. As the field grows more crowded, it will become necessary for companies to protect their IP through patents.

Like trademark claims, the idea of personality rights will inevitably arise in the virtual world. If an individual can prove that their name, voice, or likeness was used in VR content without their consent, they may have a potential claim.

In part due to the nature of VR products, there will inevitably be claims made by users against VR companies. Since most VR technologies require the use of a headset and other equipment, the potential for personal injury is great. Without being able to see the environment one is in, falls, trips, hits and other injuries are likely – especially if the VR technology requires physical movement. Nausea and motion sickness are also likely, mostly when a user’s body movement does not align with the visual stimulus because of subtle delays in screen responsiveness. Finally, privacy issues may arise where users are asked for personal information, or data storing.



*Figure 35. Intellectual property issues regarding AR/VR usage*

Considering the above-mentioned aspects, the respondents identified the following four main intellectual property issues:

- Rights of publicity (e.g. laws protecting the economic interest of brands/people portrayed in a virtual experience)
- Trademark and copyright disputes (e.g. use of copyrighted images/text or trademarked products/services in a virtual world)
- Trade secret claims (e.g. confidential business information acquired by a competitor or third party by a former employee or other improper means)
- Patent litigation (e.g. infringement lawsuits over AR/VR-related)

## Chapter 5. Conclusions and Future Vision

Although maritime and mostly inland navigation industry is far behind other industries such as healthcare and retail in adopting AR/VR technologies, the results of this questionnaire showed that inland navigation industry is willing to change its previous path towards utilizing these technologies.

The results were analysed to assess the current state, growth, and saving opportunities for AR/VR technologies in inland navigation industry. The results of the surveys show that the industry experts foresee a strong growth in the use of AR/VR technologies over the next 5 to 10 years. Furthermore, the results show a significant increase of interest in the AR/VR utilization in the education and training system in the industry over the past year and potential opportunities.

The broad feeling of optimism when it comes to the technologies listed above (more commonly referred to as AR, VR) shows the enormous potential of immersive technology as we enter the third decade of the 21st century. However, there are concerns about the quality of user experience and available content offerings, along with the pace of adoption.

The results of the questionnaire demonstrated that most of respondents are confident about the future of AR/VR technologies and they see more benefits in utilization of such technologies; and the industry is growing significantly in adoption of these technologies.

The questionnaire shows some inherent limitations in adopting new AR/VR technologies such as the “lack of budget,” “senior management’s lack of understanding of these technologies,” and “lack of knowledge.” One major limiting factor that prevents the maritime and inland navigation industry from adopting AR/VR technologies is the lack of availability of cost/benefit analysis. Organisations are not willing to invest their money without knowing the true costs and benefits (i.e., time and cost savings).

However, with recent advancements in mobile augmented reality and machine learning, it is expected that AR head-mounted displays provide a better assistant to project teams during the construction phase (e.g., real-time safety feedback, progress monitoring) or facility managers during the operation phase (e.g., sensor data visualization, energy simulations) in comparison to VR tools. Moreover, connecting several VR headsets to enable a group meeting in a virtual space can enhance and improve communications among stakeholders. These problems have to be solved in order to convince the maritime and inland navigation industry to spend more money on the development and adoption in this area.