

# Assessing the need for changes in the pre-departure safety briefings onboard cruise ships for the prevention of the spread of infectious diseases

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Master thesis

Aalborg University Esbjerg

Master of Science in Risk and Safety Management

4<sup>th</sup> semester

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## TITLE PAGE

<u>Theme:</u>	Master thesis
<u>Project title:</u>	Assessing the need for changes in the pre-departure safety briefings onboard cruise ships to prevent the spread of diseases
<u>Educational institution:</u>	Aalborg University Esbjerg, Denmark
<u>Education:</u>	Master of Science in Risk and Safety Management
<u>Semester:</u>	4 <sup>th</sup> semester
<u>Supervision:</u>	Anja Leppin and Jesper Bo Nielsen
<u>Group:</u>	RISK4-4
<u>Group members:</u>	Steffen Dolleris Hansen
<u>Hand-in date:</u>	8 <sup>th</sup> of January 2021
<u>Oral presentation:</u>	26 <sup>th</sup> of January 2021
<u>Report language:</u>	English
<u>Number of pages:</u>	68
<u>Word count:</u>	19,468
<u>Research question:</u>	<i>Does the current pre-departure safety briefing need to be changed to adequately protect the cruise ship passengers from transmission of infectious diseases, and which changes are necessary and feasible?</i>

## ABSTRACT

Ensuring the safety of the passengers onboard cruise ships must be paramount for any shipowner, officer and rating onboard any cruise ship. After the Costa Concordia incident on the 13<sup>th</sup> of January in 2012, the cruise ship industry adapted new ways of providing safety instructions to its passengers. Currently, any newly embarked passenger who are expected to be onboard for more than 24 hours are required to receive a pre-departure safety briefing which are completed in large groups either prior to departure or immediately after departure.

However, in the wake of the outbreak of the COVID-19 pandemic, large groups are no longer favourable, as the risk of transmission of infectious diseases increase. Moreover, passengers onboard cruise ships are exposed to a semi-enclosed and confined environment with homogenous mixing for longer than any other type of transport. This also means that cruise ships represent a distinctive *milieu* for transmitting human-to-human diseases (Rocklöv, Sjödin, & Wilder-Smith, 2020).

This thesis studies the current pre-departure safety briefings setup in order to determine whether changes are needed to prevent the spread of diseases onboard cruise ships during the pre-departure safety briefing. This master thesis studies how the pre-departure safety briefing are generally completed and does not centre around a specific cruise line or cruise ship. Furthermore, this thesis studies how the commercial aviation industry has dealt with the spread of infectious diseases during the pre-flight safety demonstration, which framework could replace the traditional pre-departure safety briefings, and whether the frameworks are feasible.

Keywords: Cruise ships, passengers, pre-departure briefing, spread of infectious diseases, COVID-19, Sars-CoV-2, pre-recorded video, e-learning, augmented reality.

## PREFACE

This master thesis is completed during the 4<sup>th</sup> and final semester of the “Master of Science in Technology in Risk and Safety Management” programme at Aalborg University Esbjerg, Denmark. The frame of this master thesis is specified under the “Master thesis” curriculum. The master thesis is to be handed in on the 8<sup>th</sup> of January 2021, with an oral exam on the 26<sup>th</sup> of January 2021.

The master thesis centres around a needs assessment on pre-departure safety briefings onboard cruise ships sailing under a flag-state which has ratified the International Convention for the Safety of Life at Sea of 1974 by the International Maritime Organization.

Main chapters, sub-chapters and figures are numbered continuously to its corresponding chapter.

References used in this project can be found at page 57 and uses the American Psychological Standard (APA); (Author, year). References to other parts in the thesis are underlined; example. By clicking the underlined word, the reader will be directed to the corresponding chapter.

The master thesis is written in English; however, Latin and French phrases are used. These instances are marked with italic font. Likewise, cruise lines and cruise ships are also marked with italic font.

List of acronyms	
CLIA	Cruise Lines International Association
IATA	International Air Transport Association
IMO	International Maritime Organization
SOLAS	International Convention for the Safety of Life at Sea of 1974

## About the author

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Date: Friday, 8<sup>th</sup> of January 2021

Signatures:

A handwritten signature in black ink, consisting of a stylized 'S' followed by a horizontal line.

Steffen Dolleris Hansen

## TABLE OF CONTENT

<b>ABSTRACT</b>	<b>3</b>
<b>PREFACE</b>	<b>4</b>
<b>1 INTRODUCTION</b>	<b>7</b>
1.1 Needs for the study	8
1.2 Scope	9
1.3 Current research in field	10
1.4 Limitations	11
<b>2 METHODS AND TOOLS</b>	<b>12</b>
2.1 Methodology	12
2.2 Thesis tools	14
<b>3 SYSTEMS IDENTIFICATION</b>	<b>19</b>
3.1 Systems identification	19
3.2 Risk assessment	20
3.3 Stakeholder analysis	24
<b>4 PROBLEM DESCRIPTION</b>	<b>35</b>
4.1 Problem description	35
4.2 Problem formulation	35
<b>5 ANALYSIS</b>	<b>37</b>
5.1 Research question 1	37
5.2 Research question 2	41
5.3 Research question 3	47
<b>6 DISCUSSION</b>	<b>52</b>
<b>7 CONCLUSION</b>	<b>53</b>
7.1 Implementation	54
7.2 Future works	55
<b>8 BIBLIOGRAPHY</b>	<b>56</b>
<b>9 APPENDIX</b>	<b>60</b>
9.1 Appendix 1 – SOLAS chapter III, regulation 19, section 2.2 – 2.3	60
9.2 Appendix 2 - Civil Aviation Order 20.11.14	62
9.3 Transcription of interview with Officer A	64
9.4 Transcription of interview with Officer B	67

# 1 INTRODUCTION

In the wake of the *Costa Concordia* incident in 2012, extensive regulatory changes in the cruise ship industry were made by the International Maritime Organization (IMO). Prior to the *Costa Concordia* incident, passengers onboard cruise-ships who were expected to be onboard for more than 24 hours were required by IMO's International Convention for the Safety of Life at Sea of 1974 (SOLAS) to receive a safety briefing onboard within the first 24 hours of their embarkation (IMO, 2014). Investigations of the *Costa Concordia* incident found that around 600 of *Costa Concordia*'s 3,206 passengers onboard was yet to receive their safety training at the time of incident (Ministry of Infrastructures and Transports, 2013), and were therefore unable to make the correct decisions that might have saved their life. In response to the incident, IMO changed the pre-departure safety briefing requirements by including the 2013 amendments ([appendix 1](#)) which now require that passengers receive a safety briefing immediately before departure, or immediately after departure (IMO, 2014).

After the regulatory changes by IMO were set in force, the safety briefings onboard cruise ships are often completed in large groups with either the Master (i.e. the captain) or senior officers giving a verbal instruction on safety measures, procedures and life-saving equipment. Since the outbreak of the COVID-19 (SARS-CoV-2) virus, large assemblies are deemed unsafe as the risk of spreading diseases is increased in large groups. Furthermore, the nature of the cruise ships with its crowded semi-enclosed areas limited medical resources and increased exposure to new environments contributes to the rapid spread of infectious diseases (Tardivel, White, & Duong, 2019). The first cases of COVID-19 onboard cruise ships were seen on the British registered *Diamond Princess* cruise ship on the 3<sup>rd</sup> of February 2020. 619 of the 3,711 passengers and crewmembers onboard were infected and numerous lives were lost (Rocklöv, Sjödin, & Wilder-Smith, 2020). Since the outbreak of COVID-19, cruise lines under the Cruise Lines International Association (CLIA) responded with a risk avoidance strategy by voluntarily suspending all voyages in mid-March 2020 following World Health Organization's pandemic declaration (CLIA, 2020). Since the voluntary suspension, all cruises has been cancelled, which have led to large negative economic consequences to the cruise lines, some of which are now selling or scrapping parts of the fleet to keep costs down (ibid.).

In order to be compliant with the pre-departure safety briefing requirements, while also avoiding large assemblies, one of the largest cruise lines *Royal Caribbean* is ready to replace the pre-departure safety briefing with a digital solution when the suspension is lifted, as the first and only cruise line. Passengers onboard one of *Royal Caribbean*'s cruise ships will complete the pre-departure safety briefings on their mobile devices individually, and thereby avoid large groups and reduce the risk of infectious diseases being transmitted. The programme requires passengers to review safety information individually, followed by a drill and a set of questions which must be completed. After completion, a crew member will verify that the passenger has completed the training prior to departure as required by SOLAS (Royal Caribbean, 2020).

The *raison d'être* of this master thesis is to assess the need for changes in the pre-departure safety briefing given onboard cruise ships in order to prevent the spread of infectious diseases. This master thesis will include the following:

- i. A system identification of cruise ships and the cruise ship industry, including a risk assessment and a stakeholder analysis.
- ii. A study of how/if the commercial aviation industry deals with the transmission of infectious diseases during their pre-flight safety demonstration.
- iii. A study of which frameworks could replace the current pre-departure safety briefing setup and their effectiveness.
- iv. A qualitative interview with officers from cruise ships that will determine whether the proposed frameworks are seen as feasible.

Studies from the commercial aviation industry are compared to the cruise ship industry *mutatis mutandis*.

## 1.1 Needs for the study

Besides the spread of COVID-19 onboard *Diamond Princess* there have been several occurrences of infectious diseases spreading onboard cruise ships:

- i. In September 2000, an influenza-like illness spread onboard a cruise ship off the Australian coast resulting in 1,100 passengers and 400 crew members being infected. 40 passengers were hospitalized, two of whom died (Brotherton, Gilbert, & Delpech, 2003).
- ii. During the global swine flu (A/H1N1) pandemic of 2009, a total of 1,970 passengers and 734 crew members were infected on a cruise ship in May 2009 (Ward, Armstrong, McAnulty, Iwasenko, & Dwyer, 2010).
- iii. In February 2012, a respiratory illness spread onboard *MSC Armonia* resulting in 16 hospitalizations, one of whom died (Borborema, 2014).

Moreover, the cruise ship industry is the fastest growing sector in the travel industry prior to the COVID-19 pandemic. According to CLIA, more than 28 million people went on a cruise in 2018, followed by an estimated 30 million people in 2019. CLIA projects a total of 32 million passengers in 2020, however the total number is expected to drastically decrease due to the COVID-19 pandemic and the voluntary suspension of voyages (Giese, 2020). The graph below shows the development in passengers in millions since 2009.



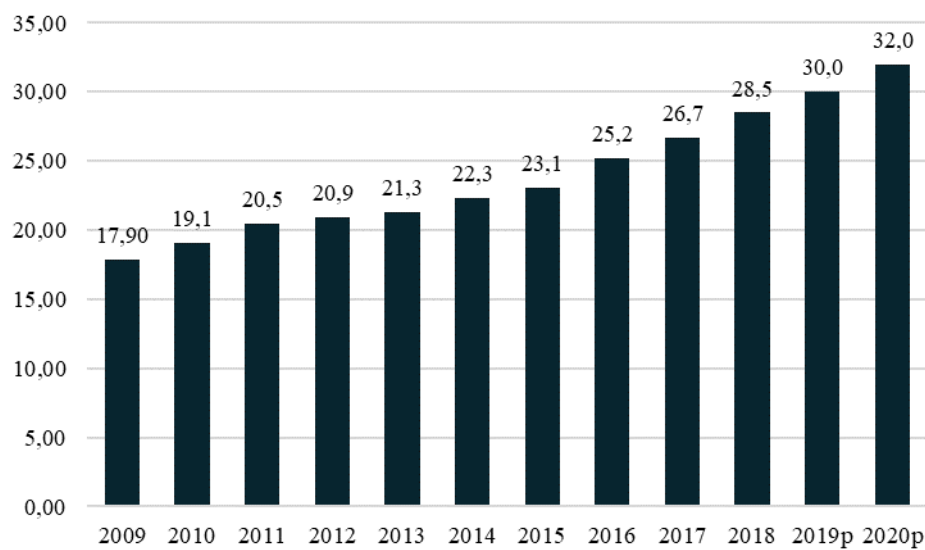


Figure 1: Development of total number of passengers onboard cruise ships in millions. p = projected number (CLIA, 2020).

The outbreak of the COVID-19 pandemic has not only resulted in passengers questioning the industry's ability ensure the health and safety of those onboard the cruise ships, it but may also result in people choosing different means of traveling in the future. If less people purchase a ticket for a cruise, the overall revenue of the cruise ship industry will fall (Giese, 2020). If the cruise ship industry is unable to recover from the loss of passengers, the economic consequences will spread like rings in water. The cruise ship industry held an estimated value of 150 billion USD prior to the COVID-19 pandemic and employed more than 1,1 million people world-wide (CLIA, 2020). Furthermore, the success of the cruise ship industry spreads far and wide, as many small island nations are highly dependent on the arrival of cruise ships, especially in the Caribbean where the cruise ship industry contributes significantly to the GDP (Giese, 2020).

All in all, the rationale for this master thesis lies both in the safety of the passengers by preventing the spread of infectious diseases, but also ensuring the continuity of the cruise ship industry and the economic contribution it provides.

## 1.2 Scope

The scope of this master thesis is to assess the need for changes in the pre-departure safety briefings on cruise ships in order to mitigate or limit the transmission of infectious diseases on cruise ships. This master thesis centres around how the pre-departure safety briefings are generally completed, meaning that it does not focus on a specific cruise line or cruise ship.

This master thesis does not distinguish between the different types of cruise ships based on size or capacity, but excludes ships carrying less than 12 passengers, as they are not defined as passenger ships in SOLAS/1/A/2/F.

The master thesis purely focusses on the transmission of diseases during the pre-departure safety briefing and excludes other situations where the transmission can potentially happen. Likewise, research question 1 purely focus on the pre-flight safety demonstration, meaning that other situations where commercial aviation passengers are exposed to the risk of transmission of diseases are excluded.

### 1.3 Current research in field

The risk of transmission of diseases onboard cruise ships has been studied before. During a hearing before the Committee on Commerce, Science, and Transportation in the United States Senate in 2012, professor Ross A. Klein Ph.D., voiced his concern on the challenge of limiting the spread diseases. Klein stated that viruses on cruise ships previously spread in form of foodborne bacteria such as shigella, salmonella and E coli, but better handling, processing and refrigeration reduced the spread significantly. In recent years, the pattern has shifted to mostly human-to-human transmission (Klein, 2012).

In 2014, Bert et al. studied the outbreak of Norovirus onboard cruise ships from 1990 to 2013. The result of the study were a set of suggestions for monitoring and implementing preventive measures onboard cruise ships, both to improve detection of Norovirus but also to control the outbreak (Bert, et al., 2014).

Similarly, in 2015 Vivek Kak studied preventive could mitigate the risk of being infected with a disease onboard a cruise ship. Kak did not study a specific infectious disease as Bert et al., and focused more on what the cruise ship passenger could do themselves, and less on what the cruise line could do (Kak, 2015).

In 2016, Pavli et al. studied outbreaks of acute respiratory infection, influenza like illness and gastrointestinal illness onboard cruise ships, in order to determine whether the risk were still existing. Like Kak, Pavli's study resulted in suggestions on how the cruise ship passengers themselves can prevent being infected with an infectious disease, but also how the cruise ships can monitor the passengers and potentially detect an infected passenger prior to an outbreak of an infectious disease (Pavli, et al., 2016).

Common for all studies is that they focused on the complete time spend onboard a cruise ship. No publications that only focused on pre-departure safety briefing in terms of mitigating the risk of transmission of infectious diseases were found.

#### 1.4 Limitations

The possibility of participating in a real live pre-departure safety briefing onboard a cruise ship was investigated. The intention of the participation was the following:

- i. Study how the current pre-departure safety briefing is completed, in order to avoid assumptions and misinterpretations on the pre-departure safety briefing.
- ii. Study the current preventive measures that are set in place to mitigate the risk of transmission of infectious diseases.
- iii. Study the cruise ship passengers in order to determine demography, the attitude towards the pre-departure safety briefing and level of attention.

However, due to the travel restrictions and the suspension of cruise ship voyages, this has not been possible.

## 2 METHODS AND TOOLS

In this chapter, the methodology, literature research and data collection of the thesis is described. This chapter also describes the tools that is used in the thesis

### 2.1 Methodology

To assure that the master thesis follows a standardized approach to risk management, this master thesis follows the risk management standard of ISO31000:2018. This model is chosen as it takes a generic approach to risk management which is applicable for any type of subject. The model provides guidelines and principles that helps the complete risk analysis for a chosen subject, but the model does not set specific requirements for the risk management, which makes it mouldable for any chosen subject.

The master thesis follows the ISO 31000:2018 standard by:

- i. Establishing the content by identifying earlier similar cases, identifying the system of the chosen subject, identify the external elements (i.e. market conditions, stakeholders and regulatory requirements) and internal elements (general pre-departure safety briefing characteristics).
- ii. Identifying the risk of transmission of infectious diseases on cruise ships during the pre-departure safety briefing.
- iii. Analysing the source of the and the causes of the identified risks, the consequences hereof given the already existing control measures.
- iv. Evaluating the risk of transmission of infectious diseases when compared to other similar industries and environments and concluding on the risk evaluation.
- v. Concluding how mitigating the identified and evaluated risks are to be completed.
- vi. Discussing how the risk is monitored and reviewed after the suggested risk mitigation is put in place by measuring the risk management performance. This also includes measuring the deviations from the risk management plan, whether the chosen risk management frame is applicable and whether the risk management plan is followed.
- vii. Communication were done during the analysis section of the thesis with semi-structured interview with cruise ship officers.

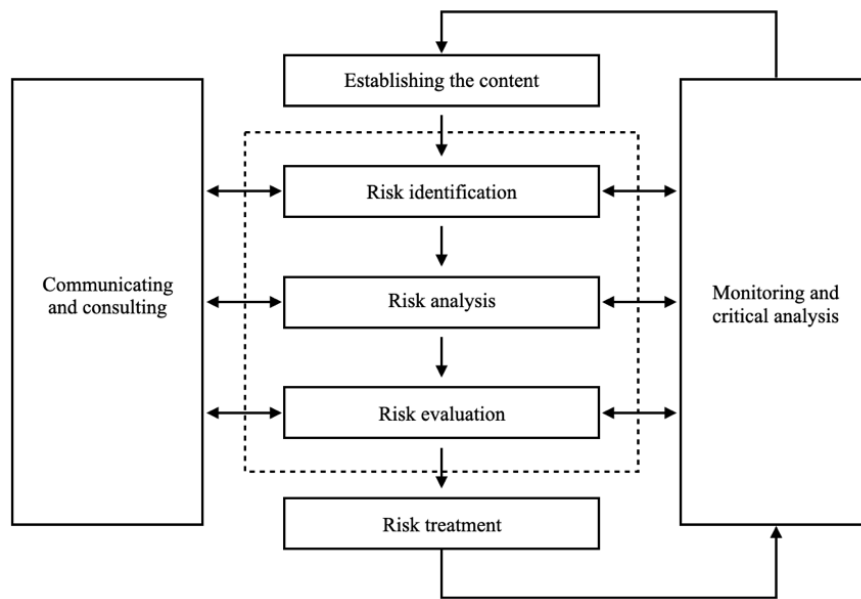


Figure 2: ISO 31000:2018 risk management model

### 2.1.1 Literature search and data collection

The literature search and data collection were based on the following:

- i. IMO's paid-licence database "IMO-Vega" were used to be familiarized with the legal requirements for the pre-departure safety briefings onboard cruise ships. The IMO-Vega database where specifically chosen to ensure the law text where up to date and in its original form.
- ii. Case-studies on previous outbreaks of infectious diseases onboard cruise ships and commercial aircrafts were used to gain insight on how the spread occurred, what could have been done to prevent the spread and how/if the risk was mitigated afterwards. Likewise, an analysis of studies were completed to gain knowledge on frameworks that could replace the current pre-departure briefing setup were completed. These publications were found via search engines, Elsevier and books available at AAU's library and others alike.
- iii. Publicly available debates, hearings and discussions were used to gain insight on the current problematics on the spread of infectious diseases onboard cruise ships.
- iv. A set of semi-structured interviews were completed with cruise ship officers in order to verify whether the proposed frameworks were seen as a feasible replacement for the current pre-departure safety briefing setup.

The master thesis does not work with a specified timeline but works with the newest available data and information on the chosen subject.

Search-words were centred around these categories: Cruise ships, spread of diseases, COVID-19, passenger behaviour, pre-departure safety briefing, SOLAS/3/B/19/2/2, e-learning, augmented reality, pre-recorded safety videos.

## 2.2 Thesis tools

The thesis uses a number of tools in form of analytical risk models. These are described in the following sub-chapters.

### 2.2.1 Bowtie analysis

The bowtie analysis is used to both analyse and visualise the current risks and measures currently set in place in to mitigate the risk of transmission of disease onboard cruise ships and commercial aircrafts. The bowtie analysis consists of a simple model that easily distinguishes between causes, consequences, proactive measures and reactive measures.

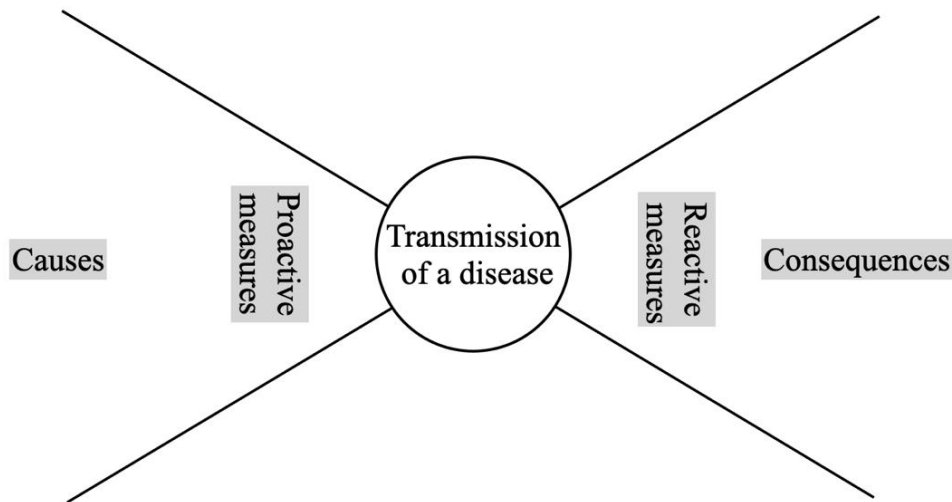
The bow-tie model is separated into three main parts:

- i. A cause analysis (left)
- ii. The event (middle)
- iii. A consequence analysis (right)

The bowtie analysis starts by defining the event, which in this case is the transmission of an infectious disease. From the event, a cause analysis is completed. The cause analysis studies what instances can initiate the event. The causes can be either singular or multiple conditions. The cause analysis also studies which proactive measures (barriers) are set in place to prevent initiating said event. The barriers can be structural design, procedures, policies, social behaviour etc. The proactive measures are used to decrease the probability of the occurrence of the event despite the existence of the cause. As an example, vaccines are used as a proactive measure to prevent a person to catch specific diseases.

Following the completion of the cause analysis comes the consequence analysis, which studies the result of the event along with the reactive measures (barriers) that are currently in place. The reactive measures are used to deal with the event when it happens, meaning that the reactive measures are not used until the event happens. As an example, medical treatment is used as a reactive measure to restore the health of the person whom has been infected with a disease.

The bow-tie analysis looks as following:



*Figure 3: Generic bow-tie analysis model*

The reason for using the bowtie analysis in this thesis is the following:

- i. The cause analysis can be used to both illustrate the risk of the subject, but also as a root cause analysis by highlighting which risks could initiate the event.
- ii. The ability to identify and map the relationship between the causes and consequences, but also both the preventive and reactive measures that are set in place, or needs to be set in place in order to mitigate the risk.
- iii. Improving the understanding of events that have already happened along with its proactive and reactive measures, in order to plan the future risk management.

### 2.2.2 Semi-structured interview

In order to answer research question 3 and determine which of the proposed frameworks were feasible, a set of qualitative semi-structured research interviews were completed. The qualitative interview was used, as it helps the understanding of the social reality of groups and individuals (i.e. the cruise ship passengers), but also helps to investigate new fields (Corbin & Strauss, 2008). In addition, the qualitative interview was completed following a semi-structured plan, meaning that a number of questions were planned and given in a pre-defined order, however the participants were able to talk freely and additional questions were asked when the answer needed further explanation.

Prior to the completing of the interviews, three focus areas were drawn up to better answer research question 3. These were:

- i. Risk awareness of the participant
- ii. Passenger's interest in pre-departure safety briefings
- iii. Feasibility of proposed frameworks

Firstly, the risk awareness of the officers was analyzed. Establishing the risk awareness among the officers is seen as an important factor, as they are key-players in the mitigation of infectious disease transmission due to their front role in the pre-departure safety briefing. The officers' awareness showcases the cruise lines' risk awareness culture and how they value risk management (Aven, 2002).

Secondly, establishing the passenger's attention level is done in order to verify whether the required safety instructions are received. Furthermore, the how much the passengers pay attention to the delivered messages directly affects how much information they are able to recall and able to retain (Buttussi & Chittaro, 2019). This means, that if the passengers do not pay any attention to the pre-departure safety briefings, all efforts to improve the setup are rendered moot.

Lastly, establishing which of the proposed frameworks is seen as feasible by the officers is done in order to determine which of the frameworks is best suited to replace the current pre-departure briefing setup. Establishing which of the proposed frameworks is feasible is an important factor, as the success of the framework will ultimately be whether the passengers are able to use the framework or not. If the framework is so complex that fewer passengers complete the training, the trade-off for a reduced risk of transmission of infectious diseases, will be a reduced chance of survival in a ship emergency.



The officers were interviewed online via video-call, and did not receive the questions prior to the interview. Furthermore, the officers were not informed about the learning outcome of the proposed frameworks, in order to prevent that the effectiveness would make them change their opinion on which framework is seen as the most feasible. The given questions were:

Focus area	Question
Risk awareness of the participant	Do you see the risk of infectious disease transmission as a problem onboard cruise ships?
Passenger's interest in pre-departure safety briefings	Do passengers pay attention to the pre-departure safety briefing?
Feasibility of proposed frameworks	Which of the proposed frameworks do you see as being the most feasible?
	Would changing the current pre-departure safety briefing setup to any of the proposed framework have negative consequences for the overall learning outcome?
	What hindrances do you see in the proposed frameworks?

*Table 1: Overview of questions for research question 3.*

The officers were given full anonymity in order to prevent them withholding personal opinions, if they feared the consequence of their participation.

### 2.2.3 Health belief model

The health belief model is used to understand the cruise ship passengers perception of the risk of transmission of infectious diseases, their belief in effectiveness of the recommended behavior and the perceived barriers. This is done to determine the likelihood of the cruise ship passenger will adapt the recommended behavior. The health belief model consists two components; the desire to avoid illness and the belief of the effectiveness of health actions (Strecher & Rosenstock, 1997).

The health belief model consists of the following parts (ibid.):

- i. Perceived susceptibility: The individual person's perception of the risk,
- ii. Perceived severity: The individual person's perception of the severity of the risk.
- iii. Perceived benefits: The individual person's perceived benefits of changing behaviour to avoid the perceived risk.
- iv. Perceived barriers: The individual person's perceived negative aspects of the particular action.
- v. Cue to actions: The stimulus that triggers the action on the obstacles of the recommended health standards.
- vi. Self-efficacy: The individual person's confidence of ability to successfully perform a behaviour.

In addition, the diverse demographic is also taken into consideration, as it affects each individual component (ibid.).

The health belief model is as following:

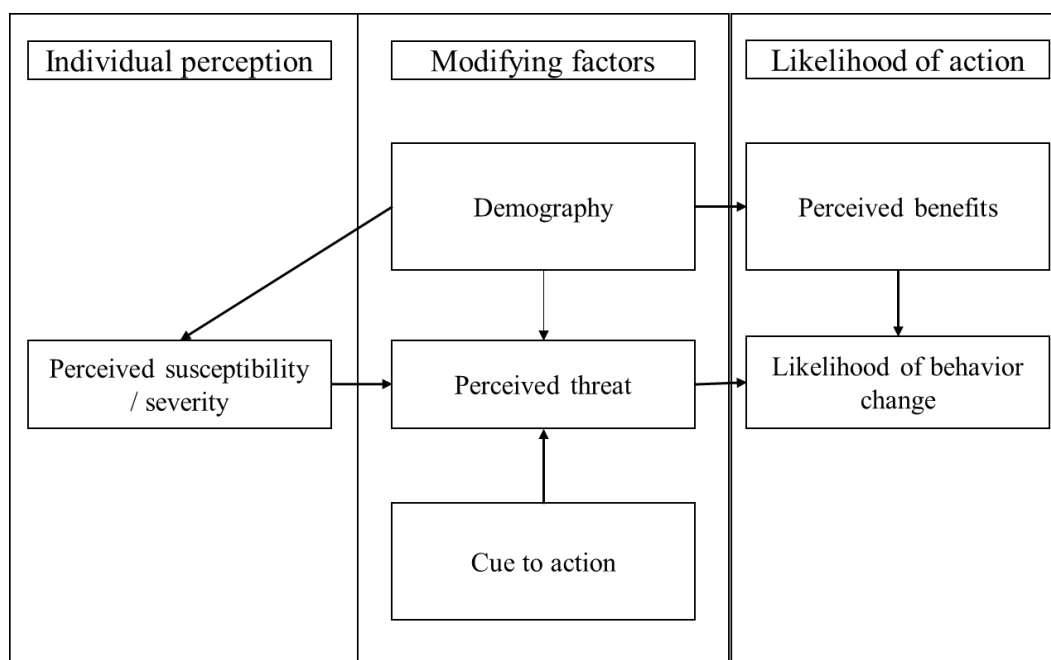


Table 2: Health belief model

### 3 SYSTEMS IDENTIFICATION

This chapter will serve as an in-depth analysis of the system that defines cruise ships, in order to achieve a thorough understanding of its components and the inherent risks. The systems identification consists of the following:

- i. A systems identification that gives an in-depth description of cruise ships in general.
- ii. A risk identification and assessment of cruise ships in general.
- iii. A stakeholder analysis that identifies, groups and plans communication strategies to the key-players, i.e. involved stakeholders.

#### 3.1 Systems identification

A cruise ship is a type of passenger ship. IMO defines passenger ship and passengers in SOLAS/1/A/2/F as:

*“A passenger ship is a ship which carries more than twelve passengers ... A passenger is every person other than (a) the master, crew members and other persons employed or engaged in any capacity on board on ship’s business; and (b) a child under 1 year old”*

Passenger ships’ primary function is to facilitate transport of passengers between one or more ports. Some cargo vessels may have cabins for passengers; however, their primary function is the transport of cargo, and are therefore not seen as passenger ships (Ward D. , 2014). Ships built with the intent of exclusively transporting troops or military personal are considered naval ships, and not passenger ships despite some resemblance (ibid.). Passenger ships are generally categorized into the following:

- i. Ferries: Used for short trips between two ports where the travel is often shorter than two days. Passengers often board the ferry via train, own car or truck (ibid.).
- ii. Ocean liners: Traditional passenger ships carrying passengers between two ports, often between two countries or transatlantic voyages. Ocean liners are often built with high freeboards to withstand rough sea and changing conditions. Since the rise of commercial aviation industry, ocean liners have almost ceased to exist with the only active ocean liner being *RMS Queen Mary 2* (ibid.).
- iii. Cruise ships: Mainly large ships primarily used for vacation purposes and less for transportation between ports. Passengers often stay onboard for multiple days. Cruise ships offer a wide variety of amenities that cater to the needs and wants of the passengers, but also potentially sacrifice some seaworthiness (Klassen, 2017).

Shipowners and operators of cruise ships are referred to as “cruise lines”. Their primary income comes from ticket sales, which account for up to around 70% of their revenue (Carnival Corporation & PLC, 2019). Cruise lines play a dual character in the travel industry as their business is partly transportation and partly leisure. This can be seen on the cruise ships, as passengers are not required to disembark in the same port where they embarked, and by the facilities onboard the cruise ships (Ward D. , 2014). According to CLIA, 278 cruise ships were active in service prior to the suspension of cruise voyages in March 2020 (CLIA, 2020).

Upon embarking a cruise ship, passengers are required by SOLAS/3/B/19/2/2 ([appendix 1](#)) to participate in a pre-departure safety briefing, either before the cruise ship departure or immediately after. The objective of the pre-departure safety briefing is to increase the chances of survival. As the amount of joining passengers are often in the hundreds or thousands, these pre-departure safety briefings are often completed in large groups. The group of passengers are escorted around the cruise ship and are given a safety instruction in accordance to SOLAS/3/B/19/2/2. The Master (i.e. the captain) has the overall responsibility of completing the pre-departure safety briefing but delegating the task to other members of the crew is common practice (Ward D. , 2014).

## 3.2 Risk assessment

In order to complete a full systems identification of the cruise ships, a risk assessment is made. The following risk assessment will be split into the two parts below:

- i. A hazard identification will identify the hazards and factors that could cause harm to the cruise ship passengers.
- ii. A risk evaluation that evaluates the hazards found in the identification.

### 3.2.1 Hazard identification

The basis of the hazard identification is not the spread of diseases itself, but events that can lead to or aids the spread of infectious diseases. Following the hazard identification, the causes and consequences were also identified, however the consequences were not the focal point of the hazard identification. Moreover, hazards that are outside the scope are not included.

According to the Danish Medical Manual (Lægehåndbogen) infectious diseases are spread through direct transmission, indirect transmission and faecal-oral transmission (Sundhed.dk, 2020). According to Bert et al. who studied cases of infectious diseases onboard cruise ships since 1990 to

2013, the risk of faecal-oral is almost non-existent (Bert, et al., 2014), and is therefore not included in the risk identification.

Direct transmission		Indirect transmission	
i.	Person-to-person contact.	i.	Airborne particles.
ii.	Droplets from nose and throat.	ii.	Contaminated objects.
		iii.	Food and drinking water.

*Table 3: Initial hazard identification*

Firstly, direct person-to-person transmission requires physical contact between the source of infection and the recipient of infection. Transmission via droplets happens when the droplets from the source of infection gets into contact with the mucus membrane, eyes, nose or mouth of the recipient. This source of transmission can happen during sneezes, coughs and regular conversation as long as the persons are within close proximity of one another (Sundhed.dk, 2020). In order to deliver the pre-departure safety briefing to as many as possible in as little time as possible, newly embarked passengers are often divided into large groups where they receive the required information. During the pre-departure safety briefing, the passengers are escorted around the ship, where they are familiarized with muster stations, location of lifeboats and liferafts for evacuation and other life-saving equipment such as lifejackets and immersion suits (IMO, 2014). As the passengers walk around the ship and are assembled in large groups, they are likely to come into close contact with each other, which is likely to cause person-to-person transmission (Bert, et al., 2014).

Secondly, indirect transmission can happen via airborne particles and contaminated objects (consumable and non-consumable). When the cruise ship passengers sneezes, coughs or even talks, a number of particles are emitted into the air. Some heavier particles will either fall to the floor or will remain suspended in the air. Lighter particles (i.e. aerosols) are affected to the airflow and are able to travel around the cruise ship via the ventilation system degree (Hertzberg, Weiss, Elon, Si, & Norris, 2018). This means that when the passengers stay inside during the pre-departure safety briefing, aerosols are able to travel from one section of the cruise ship to the other, and thereby infect other cruise ship passengers. However, not all parts of the pre-departure safety briefings are completed indoors. Muster stations are often located inside the ship with sufficient space (Ward D. , 2014), whereas lifeboats and liferafts are located outside. When the passengers move outside, the aerosols are affected by the airflow outside and are often blown away and the risk of indirect transmission of infectious disease are hereby reduced (Bert, et al., 2014).

Furthermore, as the passengers move around the ship, they are likely to come into contact with objects such as doorknobs and handrails. If a cruise ship passenger's hand is contaminated with particles that contains a virus, touches a doorknob or a handrail, the object is likely to be contaminated as well (ibid.). The object can then transmit the next person who gets into contact with the object if the object has not been cleaned or sterilized in the meantime (ibid).

By placing the above-mentioned causes for transmission in a bow-tie analysis, the model is as following:

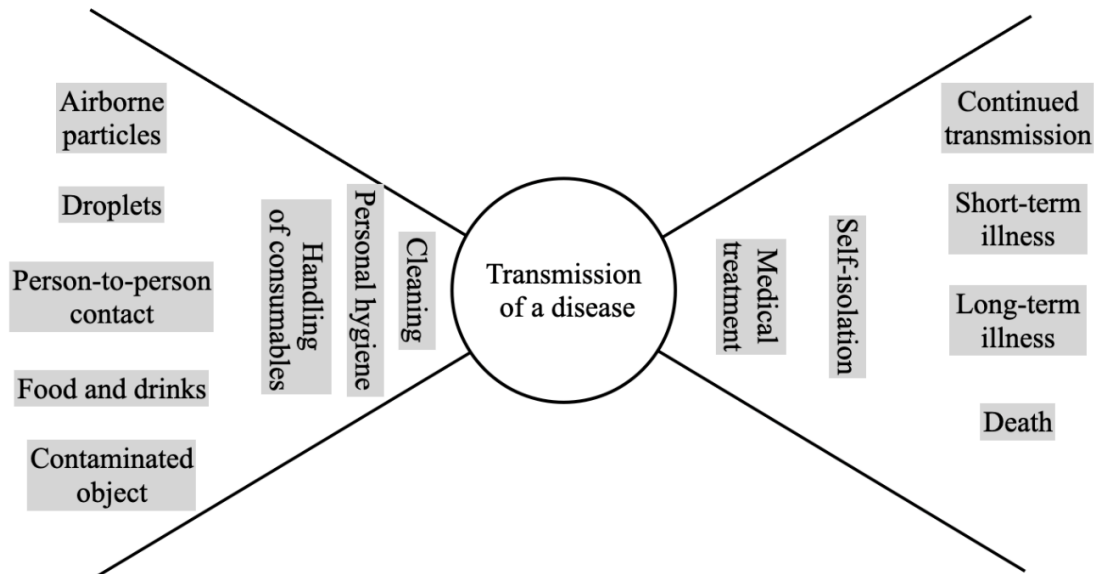


Figure 4: Bow-tie analysis of pre-departure safety briefing

The bow-tie analysis shows several ways that diseases can transmit from one passenger to the other. It should be noted that the bow-tie analysis shows the *status quo* and does not show what should be done to prevent the spread of infectious diseases. The cruise ship industry has set some proactive measures in place to limit the transmission of diseases, but these are mostly preventing indirect transmission. Correct handling and refrigeration of consumable products works as a proactive measure for transmission by consumable products and has almost eliminated the risk hereof (Klein, 2012). However, person-to-person contact, transmission by droplets or airborne particles are still unmitigated (pre-COVID-19 outbreak). In addition, insufficient cleaning of contaminated surfaces can also lead to transmission of diseases during the pre-departure safety briefing.

### 3.2.2 Risk evaluation

The above hazard identification and bow-tie analysis shows that diseases can spread in several ways during the pre-departure safety briefing.

Mitigating the risk of direct person-to-person transmission could be introducing a social distance policy. As the distance between people increase, the risk of direct transmission decreases (Centers for Disease Control and Prevention, 2020). A social distance policy would be easy to adapt, as it in itself only requires people to stand with a greater distance from one another. However, as cruise ships have a limited available space, this would mean that fewer people could be assembled at the same time at once, and the groups of newly embarked cruise ship passengers were to be smaller in size, but larger in number. The increased number of groups would require an increase in qualified officers to deliver the pre-departure safety briefing. One could argue that able-bodied seamen (i.e. ratings) with sufficient experience, could also deliver the pre-departure safety briefing to the newly embarked cruise ship passengers in corporation with the officers. However, since IMO requires that only the Master or senior officers deliver the pre-departure safety briefings, this is not possible (IMO, 2014). Therefore, in order to limit the time used for the pre-departure safety briefings, the cruise lines would have to hire additional Masters (there can be more than one) or senior officers, and the expense for payments would increase. Whether it is possible to raise the payment expenses without also raising ticket prices is unclear from the cruise line's annual reports.

Mitigating the risk of indirect transmission by aerosols could be to move the entire pre-departure safety briefing outdoors, as aerosols would be carried away by the outside airflow (Bert, et al., 2014). However, since the cruise lines are required to show the passengers the cruise ship's muster point (which are always located inside), this poses some challenges. One could argue, the muster point could be moved outside and hereby removing the need for large indoor assemblies altogether, but this solution is not ideal. The location of the muster point is specifically chosen to act as a safe haven for the passengers and the crewmembers onboard, and must protect all onboard from dangers (such as rough weather) as long as the ship is still seaworthy (Ward D. , 2014). If the muster point is moved outside under open sky, the cruise ship passengers and the crewmembers are no longer protected against outside danger. It should be noted, that the area around the lifeboats and liferafts is also a muster point, but not the primary, and should only be used in case of an abandonment (i.e. evacuation) of the ship (ibid.). The argument hereby is, that moving the entire pre-departure safety briefing outside is not possible.

The consequence of passengers getting infected with a diseases during the pre-departure safety briefing can vary on significance. If an infected passenger only transmit a disease to a low number of other passengers, it is likely that the passenger either are able to recover by themselves, with help from the onboard medical staff or can be escorted off the cruise ship when the cruise ship arrives in

port. On the other hand, if the infected passenger transmit the disease to a large number of passengers who are not able to recover from the disease themselves, it is likely that the medical staff onboard will not be able to provide sufficient medical care, as they have limiting resources (Bert, et al., 2014). Furthermore, during the voyage from one port to the other, it is likely that the cruise ship are well into open ocean with a great distance to shore (Ward D. , 2014), meaning that medical help from shore can be hours or days away.

From the arguments above, it can be seen that changes are needed in the way that the pre-departure safety briefings are currently done to better protect the passengers from transmission of infectious diseases. Due to the requirements for the pre-departure safety briefing itself, resources and cruise ship design, the argument stands that some other solution needs to be made. This means that either the requirements needs to be changed, additional resources has to be given or changes are needed in current and future cruise ship design. Alternatively, changing the pre-departure safety briefing setup to an entirely different framework that are compliant with the requirements set by the IMO, that does not require large assemblies and would not require additional Masters or senior officers could be solution.

### 3.3 Stakeholder analysis

The following stakeholder analysis is completed as an integral strategic part of this thesis, in order to identify key players in the cruise ship industry. The overall goal of the stakeholder analysis is to list key players, gaining an objective alignment and address potential conflicts in interest in an early state. To fulfil these objectives, the following stakeholder analysis will include the following:

- i. Mapping of relevant stakeholders that are affected either directly or indirectly by the cruise ship industry.
- ii. Placing the stakeholders in a power-interest grid.
- iii. Plan the communications strategy in order to obtain support from the stakeholders.



### 3.3.1 Stakeholder mapping

The following stakeholder mapping lists the relevant stakeholders. The stakeholders are listed in no particular order of importance, based on the following three categories (London, 2014):

Cruise ship industry	Port side stakeholders	Shore side stakeholders
i. Passengers. ii. Employees. iii. Shipowners. iv. Investors and shareholders. v. CLIA.	i. Local communities. ii. Governments.	i. Regulatory organizations. ii. Non-governmental organizations.

*Table 4: Stakeholder grouping*

#### 3.3.1.1 Passengers

As mentioned in “Systems identification” (chapter 3.1) a total of 70% of the revenue in the cruise ship industry comes from ticket sales (Carnival Corporation & PLC, 2019). The passengers are the costumers of the cruise ship industry, and can be divided into the following categories:

- i. Potential passengers: The are customers who have not yet travelled with a cruise ship before. All people are initially potential passengers prior to purchasing a ticket.
- ii. New passengers: Passengers who are sailing on a cruise ship for the first time. These passengers may not be new to the travel and leisure industry but have no previous experience on cruise ships.
- iii. Returning passengers: These are passengers from the “new passenger” group, who have re-purchased a ticked. According to CLIA, a total of 82% of passengers who have travelled with a cruise ship once, will consider to re-purchase a cruise ship ticket (CLIA, 2020).
- iv. Non-returning passengers: Passengers who have experience on a passenger ship but does not consider re-purchasing a ticket for various reasons.

According to a 2018 report on the passenger demographic made by CLIA, North Americans represents the highest number of passengers followed by Western Europeans and Asians (CLIA, 2018):

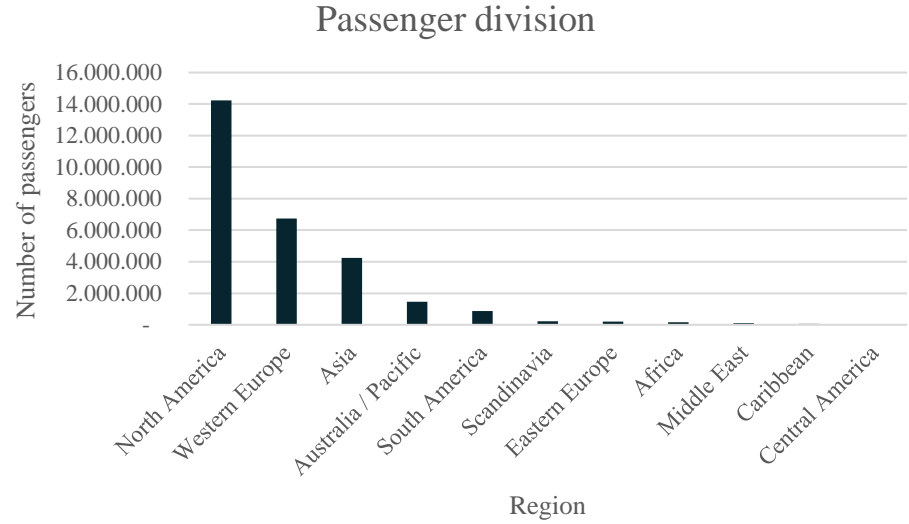


Figure 5: Division of passengers based on nationality (CLIA, 2018)

The report also shows that the passenger’s age are divided as following:

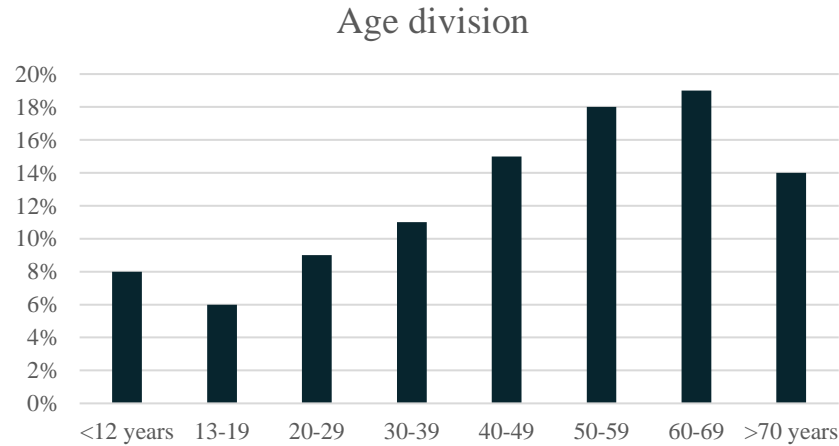


Figure 6: Passenger age-groups (CLIA, 2018)

The average age of cruise ship passengers are 47 years (ibid.), however, by looking at the graph above, it can be seen that the age-group of 60-69 represents the largest number of passengers. It can also be seen, that the age division is skewed towards this age-group. The report does not specify the division of genders, and it therefore expected to be divided evenly.

The risk perception among the cruise ship passengers is expected to be higher than average. The rationale for this statement comes from a 1999 report by Herman, Mullet & Romptaux that studied the risk perception among children, adolescents, adults and elderly people. The cruise ship passengers fall into the between the adults-group (average age of 40.1 years) and the elderly-group (average age of 70.3 years). In the study, Herman et al. recreated a 1985 study completed by Slovic, Fischhoff & Lichtenstein and asked volunteers to answer how they perceived different the risk of different events (Herman et al. did not include the risk of transmission of infectious diseases, but did include getting AIDS). The study concluded that the adults-group and elderly group perceived risk higher than the children-group and adolescents-group (Herman, Mullet, & Romptaux, 1999). Wändi Bruin, PhD, studied the perceived risk of being infected with COVID-19 among the elder generation. Bruin found that the elder generation perceived the risk of being infected with COVID-19 as high, but dying from COVID-19 as even higher (Bruin, 2020).

By applying the passenger demography and the studies completed by Herman et al. and Bruin into the health belief model, the first three components are given. These are the demography, perceived susceptibility and perceived severity. These two components also gives the perceived threat. The studies by Herman et al. and Bruin shows how the demography affects the perceived susceptibility and the perceived severity of the risk of transmission of diseases. The health belief model as of this point looks as so:

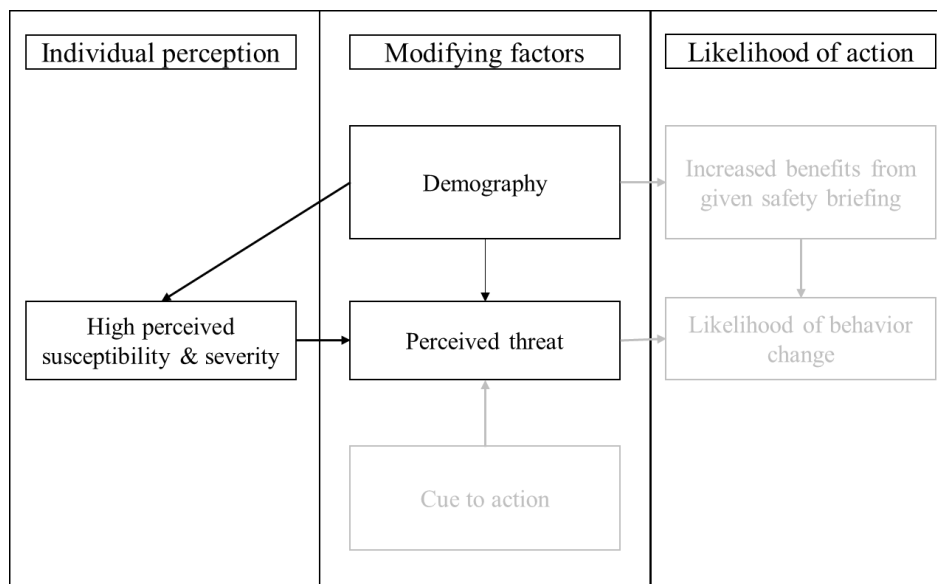


Figure 7: Health belief model

#### 3.3.1.2 Employees

According to CLIA a total of 1,1 million full-time equivalent employees worked in the cruise ship industry in 2019 (CLIA, 2020). Employees in the cruise ship industry can be divided into two categories; shore-based and non-shore-based. Shore-based employees works ashore (such as office employees and agents) and non-shore-based are employees works on the cruise ship (crewmembers). Despite their different locations and role in the cruise ship industry, they all have the cruise ship industry as a source of income, either as a primary or secondary. This makes the employees dependant on the popularity of the cruise ship industry in order to ensure and keep their income. Whether the interest of the employees reaches beyond their income, and into their work-environment, safety and personal development, is unclear.

#### 3.3.1.3 Shipowners

Shipowners are referred to as “cruise lines” in the industry and are the companies that owns the ships. The three largest companies are *Carnival Corporation & plc*, *Royal Caribbean Cruises Ltd.* and *Norwegian Cruise Line Holdings*, which hold a 75% market-share in the cruise ship industry (CLIA, 2018). The shipowners manages the ships much like floating hotels with the addition of engineers, navigators and able-bodied seamen who are in charge of ensuring the seaworthiness of the cruise ship (Wolber, Papathanassis, & Vogel, 2012).

#### 3.3.1.4 Investors and shareholders

Investors and shareholders are those that either invests (directly in cruise lines or indirectly in maritime technology and products) and those who owns shares in the cruise ship industry. Investors and shareholders are not necessarily a part of a cruise line or a supplier, but may be another individual or company. How much of the cruise ship industry as a whole that is owned by the investors and shareholders are unknown, yet, the interest of these are still to be included.

#### 3.3.1.5 CLIA

CLIA is the largest trade association within the cruise ship industry and its members consists of 60 cruise shipowners, which provides a unified voice in the cruise ship industry. The most pronounced in the organization is *Carnival Corporation & plc*, *Royal Caribbean Cruises Ltd.*, *Norwegian Cruise*

*Holding*. CLIA participates in public relations (i.e. advertising), education, publications and promoting the interest of its members.

#### 3.3.1.6 Local businesses and suppliers

Local communities are situated in close proximity to the destination-port of the cruise ship and consists of everyone living or conducting business there. The local communities can be local business that target the passengers with products, and suppliers of the cruise ship. According to CLIA, a passenger will on average spend 101 USD during their stay in the local community, and with a cruise ship carrying thousands of passengers, the spending ashore can have a large economic gain for the local communities (CLIA, 2020). Suppliers are seen as all companies that have the cruise ship industry itself as a costumer. These companies supply the cruise ships with maritime technology, furniture and equipment for accommodations, equipment for leisure, life-saving equipment, consumable products and bunker oil (i.e. fuel). The suppliers are not necessarily locally based companies but can be subsidiaries of companies based elsewhere.

#### 3.3.1.7 Governments

The governments can be divided into local and national. The national government's interests may lie more on a macro-level, meaning attracting the cruise ships and passengers to the country, while keeping negative impacts (such as pollution) in check. The local government may be more interested in attracting the cruise ships to their specific port or region and focus on the cruise ship on a micro-level. Common for both is their interest in the economic gain brought by visiting cruise ships and their passengers. As mentioned in "Needs for the study" ([chapter 1.1](#)), some countries are highly dependent on the business that the cruise ship industry brings, especially in the Caribbean (Giese, 2020).

#### 3.3.1.8 IMO

IMO is a specialised agency of the *United Nations* and is responsible for shipping. The primary responsibility of the IMO is to develop and maintain an inclusive and comprehensive regulatory framework. The works includes the environment, legal matters, technology, security etc. This means that the IMO serves as the regulatory body in the maritime industry, and therefore also the cruise ship

industry. The IMO sets the standards and regulations that the maritime industry must follow, and thereby holds a tremendous power.

#### 3.3.1.9 Non-governmental organizations

The non-governmental organizations (NGOs) may have interests in the cruise ship industry that reaches beyond the pre-departure safety briefings and may focus more on the cruise ship industry as a whole. Their interests may lie in the environmental concerns, work-environment and conditions and the social responsibilities of the cruise ship industry.

#### 3.3.2 Stakeholder grouping

The above listed stakeholders are grouped in a power/interest grid. The goal of grouping the stakeholders is to prioritize the attention to each stakeholder in order for the project to succeed. The stakeholders above are divided into the following four groups:

- i. High power/high interest: These stakeholders are the key-players as both their power and interest are high, and gaining their support is crucial for the success. These stakeholders are to be managed closely.
- ii. High power/low interest: These stakeholders also have a high power; however, their interest be lower, meaning that they may not be as essential, yet they are still important. These stakeholders are to be kept satisfied.
- iii. Low power/high interest: These stakeholders has a low power, yet their interest is high, meaning that they may not be the group that can make the big changes. These stakeholders are to be kept informed.
- iv. Low power/low interest: These stakeholders have the lowest power and interest, and are the least important of the stakeholders, yet they should not be excluded. These stakeholders are to be kept monitored.

The stakeholders are grouped in a power/interest grid as following:

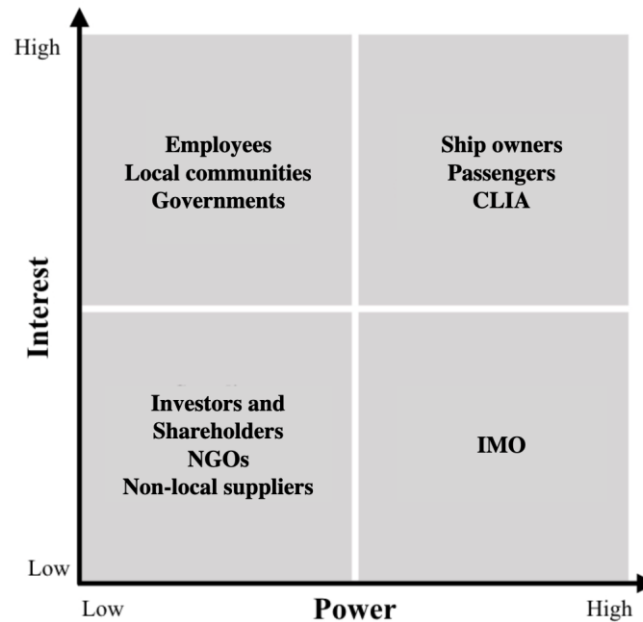


Figure 8: Power/interest grid of stakeholders

### 3.3.3 Communication strategies

Winning the support of the stakeholders are important in order to secure the success of the potential project. To do so, a communication strategy is drawn up, and is based on the stakeholders' objectives and goals. The specific interests and best communication towards the stakeholders in the cruise ship industry has not been scientifically proven, meaning that the foundation is limited and will need to be researched. The following communication strategies are therefore based on personal assumptions.

#### 3.3.3.1 High power/high interest

This group consists of the shipowners, the passengers and CLIA. It is expected that the shipowners focus on bringing as much business to their company as possible by attracting more passengers, while placing as many passengers in the "returning passenger" group. Moreover, the shipowners are responsible for facilitating training and standards for the non-shore employees to follow while working onboard the ship, and thereby also how the pre-departure safety briefings are completed whilst complying with relevant legislation.

The passengers are categorized as a *high power/high interest* group, as the cruise lines are solely dependent on ticket sales. This means, that if the passengers are dissatisfied with the service provided by the cruise lines, feel unsafe during their stay or have unaddressed concerns, they may be reluctant to re-purchase a ticket for another cruise. If the number of ticket sales are reduced, the overall revenue of the cruise ship industry will thereby follow suit. Catering to the needs and wants of the passengers are therefore seen as important. As mentioned in the stakeholder mapping, the passengers onboard cruise ships are mainly adults and elderly people. Their perception of the risk of infectious disease transmission is higher than the general public, and the shipowners will need to address this concern.

Lastly, CLIA has the same interest and objectives as the shipowners, but on a macro-level. The shipowners will mostly focus on bringing business to their own company, whereas CLIA will focus on bring business to the industry altogether. CLIA also holds a stronger voice than the individual shipowners and will service as a representative for the shipowners.

The communication must firstly be directed towards the shipowners to convince them on the need to alter the current setup on the pre-departure safety briefings, as already done by *Royal Caribbean*. The focus will primarily lie on the larger shipowners in the industry, as their economic power gives them larger freedom to take-on new projects. The shipowners may not see the need for changes in the pre-departure safety briefings, however they ultimately need to meet the concerns of the passengers, as they represent their largest income. If the shipowners does not, their existing passengers may choose other cruise lines that do address their concerns, or choose a different form of travel, which will lead to an economic loss for the cruise lines.

#### 3.3.3.2 High power/low interest

This group consists a single stakeholder, namely the IMO. As an overall authority in the maritime industry, IMO is *ipso facto* also an authority in the cruise ship industry, and thereby hold high power. The interests of the interests of the IMO is most likely spread far beyond the pre-departure safety briefings, as these are but a small part of the overall concerns in the maritime industry. Thus, it is expected that the IMO's interest lies in the needs in the maritime industry as a whole, and less in the pre-departure safety briefings. Communication for this group will firstly proving that the re-invented pre-departure safety briefings are still compliant with relevant legislations, and secondly nudge the IMO into making regulatory changes to force the industry wide adaptation.



#### 3.3.3.3 Low power/high interest

This group consists of employees, local communities and governments. The interest from the employees lies in their dependency on the popularity of the cruise ship industry, in order to keep their income. Both shore-based and non-shore-based employees are important in terms of changing the pre-departure safety briefings. Especially non-shore-based employees play a key-role, as they are to execute the re-invented pre-departure safety briefings. However, their power is limited, as they ultimately will have to follow orders from the shipowners, unless they are willing to go against their employer and potentially compromise their position in the company.

The local communities may also have a high degree of interest, as they are just as dependant on the economic gain from the cruise ship industry, as pointed out by Giese (2019). In terms of diseases, their interest may primarily lie in avoiding passengers in bringing diseases from the cruise ship and into local communities during their stay a shore. However, as some local communities are so dependent on the business the cruise ship industry brings, that they may not be able to deny the arrival of the cruise ships, and thereby needs to live with the risk of foreign diseases.

Lastly, the governments' interest in the economic gain from the cruise ships are similar to the local communities. The difference lies in that the governments hold some power over the cruise ships as long as the ships are within national waters (12 nautical miles from the shoreline), or if the ships sails under the flag of said nation. Otherwise, the cruise ship will be outside of the government's jurisdiction. Upon arrival the cruise ships will be well inside national waters, and both national and local governments hold some power. This also means, that the power held by the governments are less when compared with the IMO and are therefore placed in the low power group.

Communication for this group will primarily being informing them of the changes, while listening to their needs or concerns, yet they may not be as prioritized as the high power/high interest group. The non-shore employees working onboard the cruise ships are likely to hold valuable information that are useful in re-inventing the pre-departure safety briefing. The other stakeholders are to be included less in the process but are not to be ignored completely.

#### 3.3.3.4 Low power/low interest

This group consists of investors and shareholders, NGOs and non-local suppliers. The interest of the investors and shareholders may primarily lie in the profitability of the cruise ship industry, and less in the pre-departure safety briefings. Likewise, some NGOs may have a larger interest in the overall concerns regarding the cruise ship industry, such as air and water pollution. This is not to say, that they are not interested in the safety of the passengers, yet it may not be their primary point of focus.

Non-local suppliers that supply the industry with technology may also be more interested in the popularity of the cruise industry, as it may lead to more ships being built, and thereby more technology sold. In addition, since the technology used in cruise ships also can be applied to other vessels and naval ships, they are less dependent in the cruise ship industry. Similarly, their power in the cruise ship industry is limited. The investors and shareholders may have some power due to their economic contribution to the industry, yet it is smaller when compared with authorities, governments and passengers.

Communication for this group are not as prioritized as the other groups, and these are mainly to be kept monitored. This also means, that communication to this group are only to be done whenever necessary, if at all.

## 4 PROBLEM DESCRIPTION

This chapter rounds up the initial problem identification, gives the problem description and the problem formulation. This chapter also includes research questions what with help answering the problem formulation.

### 4.1 Problem description

The above problem identification shows that infectious diseases have spread on cruise ships before and continue to do so, despite the efforts of the shipowners and the cruise ship industry. Studies on the transmission of infectious diseases shows a transition away from foodborne bacteria and into human-to-human transmission (Klein, 2012). This transition is not only a result of improved handling and storage of food, but also the nature and characteristics of the cruise ships (Rocklöv, Sjödin, & Wilder-Smith, 2020). Furthermore, the nature of the cruise ships with its crowded semi-enclosed areas, limited medical resources and increased exposure to new environments contributes to the rapid spread of infectious diseases (Tardivel, White, & Duong, 2019). The pre-departure safety briefings haven't been significantly re-evaluated since the *Costa Concordia* incident of 2012.

The risk assessment ([chapter 3.2](#)) shows that the cruise ship passengers are not only exposed to direct transmission during the pre-departure safety briefing, but are also exposed to indirect transmission as they move around the ship and potentially come into contact with contaminated objects.

The stakeholder analysis ([chapter 3.3](#)) shows a difference in power and interest in the cruise ship industry. The cruise lines needs to meet the demands and concerns of the cruise ship passengers, as the cruise lines are highly dependent on the income that comes from ticket sales. The cruise lines works with a large degree of freedom when it comes to their own ships, however they all need to be compliant with relevant legislations and requirements set by the IMO.

### 4.2 Problem formulation

The problem identification shows a need for changes in the pre-departure safety briefings onboard cruise ships. The current voluntary suspension of cruises gives an opening into re-evaluating and re-inventing the pre-departure safety briefing without disrupting the industry, as it is already at a halt.

The following problem formulation is therefore relevant to investigate:

**Does the current pre-departure safety briefing need to be changed to adequately protect the cruise ship passengers from transmission of infectious diseases, and which changes are necessary and feasible?**

In order to answer the above problem formulation, the following research questions is chosen:

- i. How have the commercial aviation industry dealt with the spread of infectious diseases during the pre-flight safety demonstration?
- ii. Which frameworks of safety training could replace the current pre-departure safety briefing setup, and how effective are they?
- iii. How is the problem seen from the perspective of crewmembers and do they see the proposed frameworks as feasible?

Research question 1 is answered by studying how the commercial aviation industry is mitigating the risk of transmission of infectious diseases during the pre-flight safety demonstration. Research question 1 purely focus on situations where commercial aviation passengers are exposed to the risk of disease transmission during the pre-flight safety demonstration as per the master thesis scope (chapter 1.2).

Research question 2 is answered by studying different frameworks that could replace the current pre-departure safety briefing setup, and study their effectiveness. Research question 2 studies frameworks that can be completed either in smaller groups or individually.

Research question 3 is answered by completing a set of semi-structured interviews with officers working onboard cruise ships. This is done to determine whether the proposed frameworks are seen as feasible for replacing the current pre-departure safety briefing setup.

## 5 ANALYSIS

This chapter seeks to answer the problem formulation and the research questions.

### 5.1 Research question 1

This research question will answer the following:

*How have the commercial aviation industry dealt with the spread of infectious diseases during the pre-flight safety demonstration?*

The pre-departure safety briefing given onboard cruise ships resembles the pre-flight safety demonstration given onboard commercial aircrafts. The reason for both is to inform the passengers on procedures in case of an emergency, life-saving equipment and escape routes. Due to the difference between the form of travel, the information given during the pre-flight safety demonstration is not identical to the pre-departure safety briefing, but some similarities do exist. In addition, passengers onboard commercial aircrafts are seated throughout the pre-flight safety demonstration and do not move around, as passengers on cruise ships do. Furthermore, most pre-flight safety demonstrations are pre-recorded videos with demonstrations by the cabin-crew. The content of the pre-flight safety demonstration is dictated by the Civil Aviation Order 20.11.14 ([appendix 2](#)).

Hertzberg et al. published an article in 2018 named “*Behaviours, movements, and transmission of droplet-mediated respiratory diseases during transcontinental airline flights*” where transmission of respiratory diseases onboard commercial aircrafts were studied. Hertzberg et al. found that the passengers onboard commercial aircrafts are exposed to a number of situations where diseases can be transmitted from one passenger to the other throughout the length of the travel including the stay in the departure airport, the aircraft and the arrival airport (Hertzberg, Weiss, Elon, Si, & Norris, 2018). Since the scope of this master thesis excludes any situation outside the pre-flight safety demonstration, these situations are not included in this research question. In the study, Hertzberg et al. simulated the movement of airborne particles in the cabin and tested contaminated surfaces such as safety pamphlets, armrests, belt-buckles and seat trays. The study found a low risk of transmission via contaminated surfaces due to effective cleaning during the stay in the airport (ibid.), which since the outbreak of the COVID-19 pandemic has increased even further (IATA, 2020). However, the simulation of particles by Hertzberg et al. found that some particles are able to travel around in the cabin via the ventilation system. When a passenger on a commercial aircraft sneezes, coughs or even

talks, a number of particles are emitted into the cabin. Heavier droplets are impervious to the airflow and will either remain suspended in the air or fall to the cabin floor. Lighter particles (i.e. aerosols) on the other hand are affected by the airflow and can travel around in the cabin via the ventilation system. What is unique about the pre-flight safety demonstration when compared with the pre-departure safety briefing is that the back of each seat on the aircraft works as a barrier for heavier particles and the risk of transmission are therefore limited in some degree (Hertzberg, Weiss, Elon, Si, & Norris, 2018).

To mitigate the risk of airborne transmission of infectious diseases, You et al. has proposed a re-engineered version of the ventilation system in commercial aircrafts. Instead of channelling air into the cabin from the overhead diffusers, You et al. are reversing the airflow and blow air from vents near the cabin floor. The system “envelopes” each passenger on their own personal airflow and air is extracted from the cabin ceiling. Simulations in a mock-up aircraft showed a reduction in airborne transmission and improved air quality overall without compromising the thermal comfort of the commercial aviation passengers (You, et al., 2018). In an interview with CNN, mechanical professor Qingyan Chen emphasises the effectiveness of high-efficiency particulate air filters (HEPA filters) on commercial aircrafts. In modern commercial aircrafts, HEPA filters are used to filtrate ultra-fine particles from the ventilated air in the aircraft. NASA-engineers Perry et al. studied the possibility of using of HEPA filters to remove submicron and nanoparticulate matter in spacecrafts. The conclusion of the study was, that HEPA filters where able to block >0,3micron particles (Perry, Agui, & Vijayakumar, 2016). In an interview with CNN, Qingyan Chen stated:

*"Cruise ships in principle look like a building, so their air conditioning systems are similar to those in buildings. There's nothing wrong with that in normal circumstances, but with a viral outbreak that's a problem, because the filters they use don't block viruses."* (CNN, 2020)

During the flight and stay onboard the commercial aircrafts, passengers come into close contact with each other due to the seating arrangement. The close contact over long periods of time increase the risk of direct transmission of infectious diseases from one passenger to the other (Centers for Disease Control and Prevention, 2020). To mitigate this risk, most airlines are enforcing a social distancing policy, which places passengers onboard commercial aircrafts in sufficient distance (around 1-2 meters) from one another (Salari, Milne, Delca, Kattan, & Cofas, 2020).

However, not all support the social distancing policy onboard commercial aircrafts. The trade organization for the commercial aviation industry *International Air Transport Association* (IATA) criticise mandating the social distance policy and states in a press release:

*"IATA does not support mandating social distancing measures that would leave 'middle seats' empty"* (IATA, 2020)

The reason behind this statement is that the commercial aviation industry is already enforcing strict policies for the prevention of infectious diseases, and that mandating social distancing onboard commercial aircrafts will only lead to economic consequences for an already struggling industry (ibid.). According to IATA's press release, most commercial airlines will need their aircrafts to be at a 75% load factor (the ratio of how much of an aircraft's total passenger capacity is being used) in order to breakeven and not suffer an economic loss. This means, that if the social distance policy is mandated, commercial airlines are either forced to fly without making a profit, raise ticket prices to breakeven or cut cost by cancelling flights. IATA's calculations show that some airlines may need to raise the ticket price up to 54% in order to breakeven if the social distancing policy is mandated (ibid.). How many of the commercial airlines are enforcing the social distancing policy is unclear.

Lastly, passengers onboard commercial aircrafts are required to wear a protective surgical face mask or face shields (EASA, 2020). Epidemiological studies on the use of surgical face masks or face shields found that the "source control" significantly reduces the emission of droplets and aerosols (Center for Disease Control and Prevention, 2020). The use of surgical face masks or face shields onboard commercial aircrafts by both cabin crew and passengers thereby reduces the emission and inhalation of droplets and aerosols into the cabin of the aircraft.

Upon looking at the bowtie analysis for the pre-flight safety demonstration, it can be seen that the causes and consequences for transmission of diseases remain similar. The commercial aviation industry has set more proactive barriers in place, such as HEPA filters, surgical masks and face shields. It can be debated whether the backrest of the seats can be seen as a proactive barrier, as its primary function may not be to protect against droplets, but simply fortunate result of the design and lay-out. The bowtie analysis also shows that the commercial aviation industry has not set additional reactive barriers (such as increased medical care) in place. This is likely due to the possibility of landing the plane in case of a medical emergency.

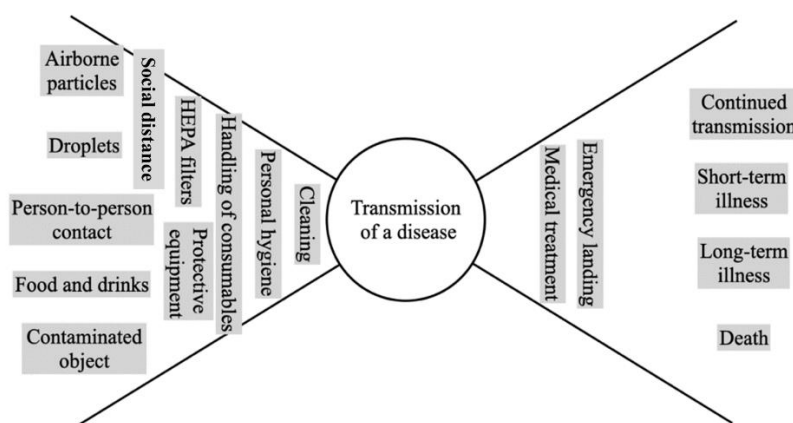


Figure 9: Bowtie analysis for pre-flight safety demonstration

### 5.1.1 Learning points from research question 1

The learning points of research question 1 is the following:

- i. The pre-departure safety briefing given onboard cruise ships resembles the pre-flight safety demonstrations given onboard commercial aircrafts. Passengers onboard cruise ships move around the ship during the briefing, whereas passengers onboard commercial aircrafts remain seated.
- ii. The commercial aviation industry has mitigated the risk of transmission of infectious diseases in several ways. These are technical solutions such as HEPA filters in the ventilation system, new requirements for personal protection equipment such as masks and face shields and social distancing between the passengers.
- iii. The study by Hertzberg et al. showed the risk of transmission of infectious diseases from contaminated surfaces onboard commercial aircrafts are low due to effective cleaning by the cabin crew. Since the outbreak of the COVID-19 pandemic, the cleaning onboard commercial aircrafts has increased which lowers the risk further. The study also showed that heavier droplets will either remain suspended in the air or will slowly fall to the floor. The heavier particles are impervious to the airflow whereas lighter particles are able to travel through the ventilation system.
- iv. Using HEPA filters in the aircrafts ventilation system can potentially decrease the risk of airborne droplets. The cruise ship industry may be able to either directly replace their filters in their ventilation systems with HEPA filters or retrofit them with minor adjustments to the current design. The proposed re-engineered ventilation system by You et al. can decrease the risk of airborne particles even further, however adapting the same system on cruise ships is most likely not be possible, as the passengers move around during their stay onboard. The cruise ships could possibly use a system that channels air from the floor in an upwards direction, but enveloping each passenger in their own airflow is most likely not possible.
- v. The cruise ship industry can adapt a social distancing polity similar to the commercial aircraft industry by reducing the capacity of its ships. The risk of transmitting infectious diseases is likely to be reduced from this, but it will also lead reduced income from ticket sales. None of the cruise lines nor CLIA states the breakeven point, and the minimum load factor is therefore unclear.



## 5.2 Research question 2

Research question 1 showed that the cruise ship industry can adapt several technical solutions from the commercial aviation industry to limit the transmission of diseases during the pre-departure safety briefing. This research question will study what framework could be replace the pre-departure safety briefing to further reduce the transmission of diseases. This is done by answering the following:

*Which frameworks of safety training could replace the current pre-departure safety briefing setup, and how effective are they?*

Upon choosing a different framework, cruise lines may have different criteria, however the effectiveness of the chosen framework must be the upmost important criteria *par excellence*. Effective communication between two or more participants consists of the exchange of information and common understanding of the topic being communicated (Parker, 2006). What defines the term “effectiveness” in learning varies, although measuring the learning outcome is the most prominent (Noesgaard & Ørngreen, 2015). Thalheimer & Cook and categorizes the effectiveness of the learning outcome as low (<40%), medium (40%-75%) and high (>75%) (Thalheimer & Cook., 2002)

Potential applicable frameworks for an alternative pre-departure safety briefing onboard cruise ships could be, but are not limited to, the following:

- i. Pre-recorded videos
- ii. E-learning
- iii. Augmented reality

### 5.2.1 Pre-recorded videos

Taking further inspiration from the commercial aviation industry and adapting pre-recorded safety videos could be one way of completing the required pre-departure safety briefings. By giving the cruise ship passengers the opportunity to watch pre-recorded safety briefings either at home or in their cabins, the need for large assemblies no longer exists, and the risk of direct transmission is reduced as a result hereof.

The commercial aviation industry’s focus on the effectiveness of safety announcements has been credited as key to their overall success in terms of safety (Molesworth, 2013). However, Brett Molesworth’s study on the passenger’s ability to recall from pre-recorded safety videos onboard

commercial aircrafts begs to question the effectiveness of pre-recorded videos. In a study, Molesworth showed 61 participants three different pre-recorded videos with different content and characteristics; non-humorous, humorous and featuring a celebrity.

Molesworth's study found that of the 41 points, the participants were able to recall the following:

- i. 32% for participants who watched the non-humours video.
- ii. 45% for participants who watched the humours video.
- iii. 50% for participants who watched the video that featured a celebrity.

The study also found that passengers generally were able to recall 4% less two hours after the pre-flight safety demonstration (ibid.).

In his study, Molesworth is especially critiquing the use of humorous content in pre-recorded safety videos. The humorous content of pre-recorded safety videos is used as technique to capture the attention of the listeners (i.e. the passengers) since paying attention during the video has proven to be a challenge (ibid.). The humorous content is not only used to grab the attention of the listeners but also to lighten the mood of the safety video. Molesworth critique of the humorous content centres around a study completed by Y. F. Chan in 2011. According to Chan, a humorous content in pre-recorded safety videos may not be as favourable as one may think (Chan, 2011). In Chan's study on the influence of the humorous content in safety videos, five different videos were shown to 254 university students; two non-humorous videos, two humorous and one filler video. Chan's study concluded despite the positive effect that humour had on grabbing the attention of the participants, it also disrupted the processing and perceived seriousness of the key messages in the videos, making the humorous content a double-edged sword (ibid.). The conclusion of Molesworth study is that commercial airlines have found ways to increase how much passengers remember from pre-recorded safety videos, yet there is still some way to go before the ideal state is reached.

In addition, a 2015 study by Ratchada Ruenruoy found that passengers on commercial aircrafts had overconfidence in their familiarity of the airplane or prioritised relaxation over the safety pre-recorded safety videos. This means that the passengers paid less attention to the safety briefing and thereby also missed important key-points (Ruenruoy, 2015). Furthermore, Ruenruoy found that passengers on commercial aircrafts often had little confidence in their chances of survival in an off-runway landing and found the pre-flight safety demonstration redundant. Especially the male-group of the passengers had high confidence in their familiarity and perceive the risk of a flight-emergency as low (ibid.). The results from Ruenruoy's study mirrors the results found by D. A. Johnson in 1979, meaning that the issue is well-known.

A different approach to successfully securing the attention of the commercial aircraft passengers is by the use of fear appeals. By using persuasive messages with emphasis potential danger or harm that could fall upon the listener, a feeling of fear is created in the listener (Dillard, Plotnick, Godbold, Freimuth, & Edgar, 1996). Fear appeals are often used in campaigns with the objective of changing behaviour and attitudes (Tannenbaum, Zimmerman, Hepler, Saul, & Jacobs, 2015). In a 2019 study, Buttussi & Chittaro studied the use of humour and fear appeals in pre-recorded safety videos onboard commercial aircraft. The study showed, that when the passengers where shown a pre-recorded video with both a humorous content and fear appeals, the level of attention rose. As a result of the risen level of attention, the ability to recall information also saw an increase (Buttussi & Chittaro, 2019). The use of fear appeals aids as a cue to action in the health belief model. The passengers will not experience the consequences of not paying attention to the pre-recorded videos, but will be exposed the illustrations or information about the consequences, which will increase their perceived threat (ibid.), and hereby also their perceived benefits of listening to and following the instructions given. By applying the studies from the studies by Dillard et al., Tennerbaum et al. and Butti & Chittaro another component of the health belief model is given, namely the perceived benefits and the cue to action. The health belief model looks as so:

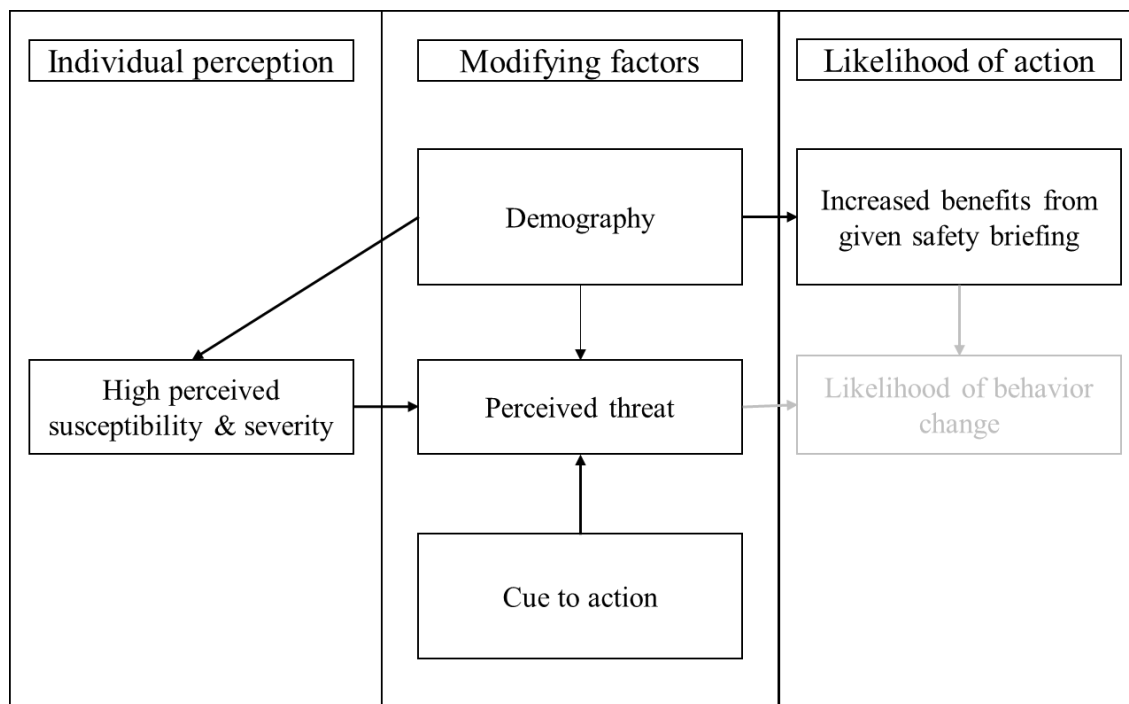


Figure 10: Health belief model

### 5.2.2 E-learning

In recent years, the use and demand for e-learning has seen a significant increase and has evolved away from text-based lectures into a multimedia experience (Thalheimer W. , 2017). The use of e-learning is often seen as a replacement for traditional face-to-face learning in classrooms or as an additional tool, but development in technologies has helped e-learning in standing alone (Al-Fraihat, Joy, Masa'deh, & Sinclair, 2020). By adapting an e-learning framework, cruise lines are able to give individual safety instructions, and passengers are able to complete these at their own pace. In addition, information that are not understood can be repeated in necessary. (Thalheimer W. , 2017).

In a 2017, Will Thalheimer studied the effectiveness of e-learning when compared to traditional face-to-face teaching, like what is done during the pre-departure safety briefings onboard cruise ships. What Thalheimer found in his study was:

- i. When the learning methods were held consistent, both classroom and e-learning had generally equal learning outcomes.
- ii. When the methods were no longer consistent, e-learning generally outperformed traditional classroom teaching moderately.
- iii. The method of teaching was far more important than the modality.

In his study, Thalheimer puts high emphasis on the importance of the method in the teaching. As stated above, when the methods are held consistent between the two modes of teaching, the outcome is generally similar. Yet, since the methods used in e-learning is often more consistent than what is seen in traditional teaching, e-learning often outperforms traditional teaching moderately. Thalheimer adds, that if e-learning programmes were better at utilizing their full potential, they would outperform traditional teaching significantly. Thalheimer points out that the use of retrieval practice in e-learning has been overlooked despite the proven positive effect on learning. A meta-analysis completed by Thalheimer shows that e-learning programs with retrieval practice far out-perform e-learning programmes without. Thalheimer's study does not reveal how much is remembered from the two modes of learning.

A similar study completed by N. Kemp and R. Grieve in 2014, found similar results when comparing face-to-face learning with e-learning. Kemp and Grieve completed similar lectures with a group of undergrad students, and found that the learning outcomes of the two modes were almost identical, with a learning outcome of 64% ( $\sigma = 0.14$ ) (Kemp & Grieve, 2014).

### 5.2.3 Augmented reality

Augmented reality is a relatively new technology that has showed potential to radically transform education by making challenges and concepts visible to the novice learner (Radu & Schneider, 2019). By using a mobile device, the learner can see and interact with animated objects in a real-world environment and experience its characteristics (ibid.).

A 2012 study completed by Duenser et. al. compared the learning outcome of traditional instructional books to augmented reality. The study divided the participants into two groups with one group reading the instructional book, and the other group using augmented reality to visualize the material (Duenser, Walker, & Bentall, 2012). The study found the following:

- i. The group that used augmented reality had a learning outcome of 71.8% ( $\sigma = 0.08$ ) and the group that used traditional instructional books had a learning outcome of 59.7% ( $\sigma = 0.1$ ).
- ii. Both groups were able to retain around 10% less of the information after four days.
- iii. Since the augmented reality group had a higher learning outcome, the augmented reality group were able to retain more information than the group of traditional instructional book group.

In a similar study, Ibáñez et. al. compared augmented reality to e-learning in 2014. Like Duenser et. al., Ibáñez et. al. separated the participants into two groups, one using augmented reality and one using e-learning. The results of the study mirrors the results of Duenser et. al. with the group using augmented reality having a higher learning outcome (77.8%,  $\sigma = 0.15$ ) when compared to the group that used e-learning (73.3%,  $\sigma = 0.24$ ) (Ibáñez, Serio, Villarán, & Kloos, 2014).

### 5.2.4 Learning points from research question 2

Regardless of which mode is chosen the potentially replace the current pre-departure safety briefing setup, all have to comply with SOLAS/3/B/19/2/2 & SOLAS/3/B/19/2/3 as dictated by the IMO. Fortunately, SOLAS/3/B/19/2/2 & SOLAS/3/B/19/2/3 does not specify how the pre-departure safety briefing is to be completed, but only the content. This means that the cruise ship may foresee and smooth transmission away from large assemblies and into more individualised pre-departure safety briefings.

The learning points of research question 2 is the following:

- i. The pre-recorded videos may be easy to adapt and replace the current setup, yet studies from the commercial aviation industry begs to question the effectiveness. The results by Molesworth are categorized as low to medium in Thalheimer and Cook's scale of effectiveness.
- ii. E-learning showed no significant increase in learning outcome when compared to traditional learning when the methods are kept identical but does deliver higher learning outcomes than pre-recorded videos. E-learning scores in the upper end of the medium category on Thalheimer and Cook's scale of effectiveness.
- iii. Augmented reality had higher learning outcome than pre-recorded videos and e-learning, but with somewhat similar decrease in retention over time. The results by Duenser et. al and Ibáñez et. al. adds to the notion that choosing the method of augmented reality will secure higher learning outcome among the cruise ship passengers. Augmented reality scores high on Thalheimer and Cook's scale of effectiveness.
- iv. By the results found in research question 2, the augmented reality framework seems to be the most effective, and is thereby the best contender to replace the current pre-departure safety briefing setup.

### 5.3 Research question 3

Research question 2 showed that augmented reality had a higher learning outcome than pre-recorded videos and e-learning. Even though the learning outcome is an important factor upon recommending which framework could replace the current pre-departure safety briefing, one must also consider which framework is feasible. This research question will firstly study whether the crewmembers are aware of the risk of infectious disease transmission during the pre-departure safety briefing, whether passengers pay attention to the pre-departure safety briefing and which framework the crewmembers find feasible. In order to do this, a series of qualitative interviews with officers who works in cruise ships is completed to better answer the following research question:

*How is the problem seen from the perspective of crewmembers and do they see the proposed frameworks as feasible?*

To answer research question 3, a number of cruise lines were invited to participate. However, due to the financial challenges from COVID-19 and the voluntary suspension of all voyages, none of the invited cruise lines were able to (or unwilling to) locate the time and resources to participate in the interview. In addition, due to GDPR, none of the cruise lines were able to provide names for non-shore-based employees that could participate in the interview. Therefore, personal and professional network were used instead, and with greater success. The following officers from cruise ships were able to participate:

Person	Rank	Years of experience	Cruise line / number of passengers
Officer A	1 <sup>st</sup> Officer	3 year	Cruise Line A / 1,700 passengers
Officer B	2 <sup>nd</sup> Officer	2,5 years	Cruise Line B / 2,600 passengers

*Table 5: List of participating officers*

### 5.3.1 Risk awareness of participant

The interview with the officers showed a difference in the risk awareness. This is likely due to the difference in how the pre-departure safety briefing is completed onboard the different cruise ships where the participating officers work.

Officer A acknowledged the risk of infectious diseases being transmitted during the pre-departure safety briefing but perceived the risk as low. In the interview, Officer A explains that *Cruise Line A* has replaced the “traditional” pre-departure safety briefing setup with pre-recorded videos. The videos are shown in the passenger’s cabins and on all available monitors around the ship. By doing so, the crewmembers onboard have the possibility of dividing the passengers into much smaller groups, and thereby limiting the risk. Officer A explains that the adaptation of pre-recorded videos is not a new thing in *Cruise Line A*, and it is something that has been done for years.

Officer B perceived the risk of infectious disease transmission as high. Officer B explains that *Cruise Line B* is using the “traditional” pre-departure safety briefing framework setup, meaning that newly embarked passengers are divided into large groups when the pre-departure safety briefing is given. Whether the cruise line where Officer B works is planning to adapt a different pre-departure safety briefing framework is unclear.

### 5.3.2 Passenger’s level of interest in pre-departure safety briefings.

To the question on whether the passengers onboard cruise ships paid attention to the pre-departure safety briefings, there were again conflicting opinions.

Although Officer A had a lower risk perception than the officers, he/she was concerned about the level of attention among the passengers. In the interview, Officer A mentions that the crewmembers had little chance to verify whether the passengers were watching the pre-recorded safety videos in their cabin, or in the common areas around the ship. In addition, Officer A states that some passengers had even made complaints about the pre-recorded video as they disrupted their relaxation. The observations from Officer A mirror a 2015 study by Ratchada Ruenruoy that examined commercial aircraft passenger’s level of attention. Ruenruoy found that most passengers either had an overconfidence in their familiarity with the cabin and its escape routes, had little confidence in the chances of survival in an emergency landing and thereby found the safety instructions redundant, or prioritized relaxation (Ruenruoy, 2015). Whether the passengers onboard cruise ship are overconfident in their knowledge or perceive the chances of surviving in an emergency is unclear, however from Officer A’s statements, it is expected that passengers prioritize their relaxation and find the pre-recorded safety videos to be a disturbance.



Officer B experienced a different level of attention among the cruise ship passengers. Officer B mentions that passengers often asked relevant questions during the pre-departure safety briefings and during their stay onboard the cruise ship. The study by Ruenruoy is therefore not mirrored on *Cruise Line B*. Whether the dissimilarity can be explained by a difference in passenger demography was investigated, but neither *Cruise Line A* or *Cruise Line B* has published data on their passenger demography. In order to determine whether the level of attention comes from the individual officers own perception, the use pre-departure safety briefing framework or the passenger's demography has to be studied further to reach a clear conclusion.

### 5.3.3 Feasibility of proposed frameworks

The participating officers both found the pre-recorded safety videos the most feasible framework, followed by the augmented reality and lastly e-learning. The reason for the ranking were the cruise ship passenger's expected familiarity with the proposed frameworks.

The participating officers were positive that changing the current pre-departure safety briefing setup would mitigate the risk of transmission of infectious diseases. However, both had concerns about the feasibility of the proposed frameworks. The concerns mostly centred around the familiarity of each framework and whether the cruise ship passengers were able to use them as intended. In a 2015 study, Gagné et al. studied how the familiarity of framework affects the learning outcome and the ability to recall information. The study concluded that when a familiar framework is used, the learning outcome are higher when compared to an unfamiliar framework (Gagné, Bell, Yarbrough, & Weidemann, 2015). This means that the officer's concern on how the familiarity would effect the learning outcome is a valid point, and focusing on the familiarity of the framework may be more important than focusing on the learning outcome alone. The unfamiliarity is seen as a perceived barrier in the health belief model, and will potentially lead to cruise ship passengers being reluctant to complete the needed change in behaviour that will mitigate the risk of transmission of infectious diseases during the pre-departure safety briefing. In order to determine which of the three proposed frameworks is the most feasible to replace the current pre-departure safety briefing setup, the learning outcome of each framework has to be studies when it is used by the cruise ship passenger demographic. This also means, that the familiarity of the frameworks affects the likelihood of the passengers completing the pre-departure safety briefing. This component is the last and final in the health belief model, which now looks as so:

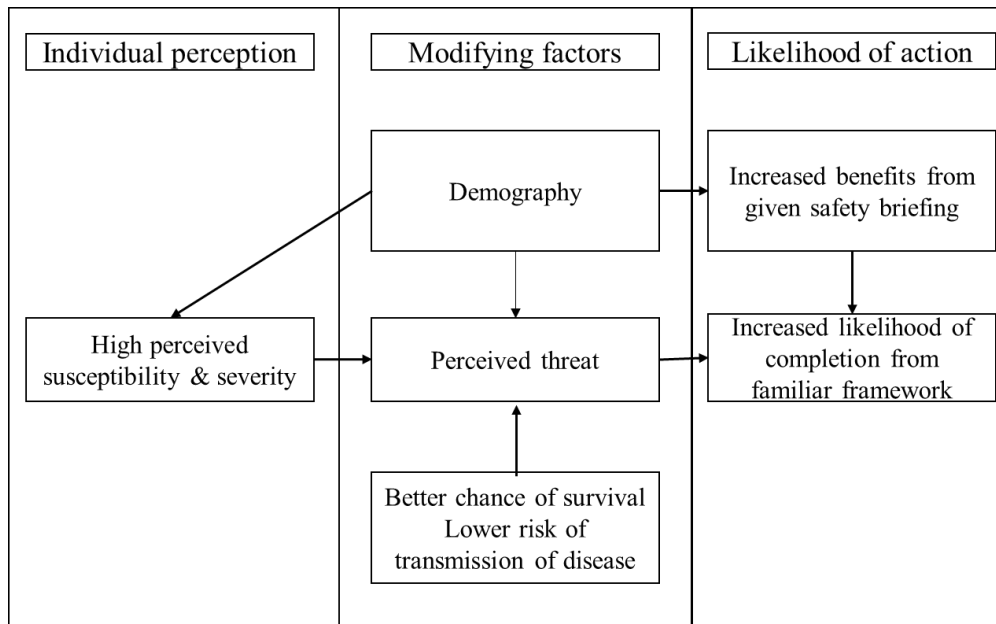


Figure 11: Health belief model

Even though augmented reality showed the highest learning outcome, may not be the most feasible framework to replace the current pre-departure safety briefing setup. The unfamiliarity with the framework may lead to a lower learning outcome than what was seen in the studies by Duenser et al. and Ibáñez et al. The studies completed by Duenser et al. and Ibáñez et al. did not specify the average age of the participants, but both used undergraduate and graduate students. It is assumed that the participant's average age is lower than the cruise ship passenger's, and that the participants in Duenser et al. and Ibáñez et al. had a higher familiarity with the framework or were faster to learn how to use it. This means that although the augmented reality framework showed a higher learning outcome when compared to pre-recorded videos and e-learning, the potential unfamiliarity of the cruise ship passengers will reduce the overall learning outcome, and the augmented reality may therefore not be feasible to replace the current pre-departure safety briefing setup.

Neither of the officers saw e-learning as a feasible replacement for the current pre-departure safety briefing. Officer A suspected the cruise ship passengers would see the e-learning programme as a chore more than an actual educational tool, and that the cruise ship passengers would either postpone completing the e-learning programme to the last minute or rush through it with little regards to the learning outcome. In a 2014 study, Tehrani & Molesworth studied how the mood affected the information retention from pre-flight safety demonstrations among commercial aircrafts passengers. The study found that passengers that found the pre-flight safety demonstration tedious and boring retained less information than those who didn't (Tehrani & Molesworth, 2014). Whether cruise ship

passengers finds e-learning to be useful or boring is not scientifically documented, and Officer A's statement can therefore not be verified. However, since all the participating officers saw e-learning as the least feasible framework, the statement may hold some validity.

All participating officers agreed that pre-recorded safety videos were the most feasible of the proposed frameworks if the current pre-departure framework was not an option. Although Officer A found the attention level as low, he/she still found the framework more feasible than e-learning and augmented reality due to the familiarity of the framework. How familiar the cruise ship passengers are with the pre-recorded safety videos is not scientifically documented, however if the passengers have flown on a commercial aircraft in the last 30 years, they have been exposed to the framework after the commercial aviation industry adapted the framework in the mid-1980's (Molesworth, 2013). Despite the lower learning outcome that is seen from the pre-recorded safety videos, it may be the most feasible framework to replace the current pre-departure safety briefing setup due to the cruise ship passenger's familiarity. However, studying the learning outcome of all three proposed frameworks with the cruise ship passenger demography is needed to determine which framework has the highest effectiveness.

The learning points of research question 3 is the following:

- i. The participating officers showed a difference in risk awareness, but all acknowledge the risk as existing. The difference in the risk awareness is likely due to the difference in the pre-departure safety briefing framework that is used onboard the cruise ships where the officers work. Neither of the officers works for the same cruise line.
- ii. The level of attention among the passengers where perceived differently among the participating officers. The officer A who works for a cruise line that uses pre-recorded safety videos experienced low level of attention among the passengers, which mirrors the study by Ruenruoy (2015). Officer B works at a cruise line that uses the "traditional" pre-departure safety briefing setup and experienced high level of attention. Whether the difference in levels of attention can be explained by the framework used, the officer's own perception or the passenger demography is unclear.
- iii. All officers saw the pre-recorded safety video framework as being the most feasible out of the three proposed. The reason for their perceived feasibility is down to what they expect that the passengers are mostly familiar with. This notion is supported by the study completed by Gagné et al. that found a higher information retention when the participants used a familiar framework.
- iv. The results from the qualitative interview goes against the results from research question 2. Despite that augmented reality has a higher learning outcome, the unfamiliarity of the framework is likely to cause it's failure, and the pre-recorded safety seems to be the most feasible framework to replace the "traditional" pre-departure safety briefing framework.

## 6 DISCUSSION

Ensuring that the specific passenger demographic is able to use the chosen framework is not the only challenge that may befall the cruise lines, if the decision is made to replace the current pre-departure safety briefing setup. Regardless of which framework is chosen, all efforts will fall short if the cruise ship passengers do not pay attention or do not complete the training. The cruise lines therefore also need to consider how they will make sure that passengers complete the pre-departure safety briefing, if the framework is changed. As mentioned in “introduction” ([chapter 1](#)) passengers onboard one of *Royal Caribbean*’s cruise ships are to complete a set of questions in order to show that they have understood and completed the pre-departure safety training. The included set of questions may seem like a tedious task for the cruise ship passengers, but it will give the cruise lines a deep insight into what is understood and what is not. By using the answers in a statistical analysis, the cruise lines can obtain vital information on which subjects to deliver differently to secure that more cruise ship passengers understand the delivered message.

However, this does not mean that the ensuring that passengers complete the pre-departure safety briefing is the only challenge that faces the cruise ship industry. The challenge of mitigating the risk disease transmission reaches beyond the pre-departure safety briefing. When the passengers move around the ship, they are constantly exposed to new ways of catching a disease. In addition, as pointed out by Ross Klein, Ph.D., the behaviour of the passengers is different than the crew members upon falling ill:

*“... most passengers learn that if they report being ill, they will be quarantined to their cabin until they are asymptomatic—reportedly a very unpleasant experience. As a result, there are many cases where ill passengers do not report their illness in order to avoid being quarantined”* (Klein, 2012).

Klein points out, that some passengers will try to disguise their symptoms to avoid being quarantined in their cabin during their stay onboard, and potentially “wasting” part of their holiday. Klein calls this behaviour not only self-centred but also dangerous to other passengers, but also points to the cruise ship industry’s attempts to cover-up the risk of illness onboard cruises as a part of the problem (*ibid.*).

The cruise ship industry may be able to recover and limit the exposure to disease transmission during the pre-departure safety briefing. However, the industry needs to consider the whole system that makes the cruise ship, passengers will continuously be exposed to new risks elsewhere. The cruise ship industry may find itself in the same fate as that of the legend of King Sisyphus. Forever pushing a large boulder uphill only to see it roll back down and having to start over for all eternity.

## 7 CONCLUSION

The spread of diseases on cruise ships is not a new phenomenon. What has changed is how the diseases are transmitted. Where the diseases previously spread via foods and drinks, they now spread person-to-person (Klein, 2012). The risk assessment ([chapter 3.2](#)) shows that the passengers are exposed to both direct and indirect transmission during the pre-departure safety briefing. The stakeholder analysis ([chapter 3.3](#)) shows that a large number of people and communities are affected by the cruise ship industry, some more than others. This means, that if passengers are concerned about their safety and chooses other forms of travel and leisure, the economic consequences will reach beyond the industry itself.

Research question 1 shows some similarities between the pre-departure safety briefings onboard cruise ships, and the pre-flight safety demonstration given onboard commercial aircrafts. Research question 1 shows that since passengers onboard commercial aircrafts are seated throughout the pre-flight safety demonstration, the risk of direct transmission is reduced to only those seated next to the potentially infect passenger. The studies mentioned in research question 1 shows that the risk of transmission between passengers is mostly indirect transmission from airborne articles carried in the cabin's ventilation system, which the commercial aviation industry is mitigating by the use of HEPA filters. The cruise ship industry may be able to either directly replace their filters in their ventilation systems with HEPA filters, or by retrofitting HEPA filters with minor adjustments to the current design. In addition, by adapting a social distancing policy, the risk of transmitting infectious diseases is likely to be reduced further, but it will also lead reduced income from ticket sales.

Research question 2 shows a number of different frameworks that could replace the current pre-departure safety briefing setup. Each framework shows different levels of effectiveness, when the learning outcome and information retention is measured. The pre-recorded safety videos as seen on commercial aircrafts has the lowest effectiveness, which is likely due to low attention levels among the commercial aircrafts passengers as shown in the study by Ruenrouy (2015). E-learning has the second highest learning outcome. E-learning shows no significant difference in learning outcome when compared to "traditional" teaching as long as the learning method is kept similar. Augmented reality has the highest learning outcome of the three proposed frameworks, but this framework may also require a more advanced technology and maturity before the cruise lines are able to adapt the framework. Nonetheless, augmented reality still shows the highest level of effectiveness, and may be a better framework than pre-recorded videos and e-learning.

Research question 3 goes against the results found in research question 2, and finds the pre-recorded video framework as the best contender to replace the "traditional" pre-departure safety briefing setup. The participating officers expressed concern in whether the cruise ship passengers would be able to use the augmented reality framework, and expected a lower learning outcome than what was found

in the studies completed by Duenser et al. and Ibáñez et al. The concerns are backed-up by the results from Gagné et al.'s study that found a reduction in learning outcome when an unfamiliar framework is used. This means that although the pre-recorded safety briefings showed a lower learning outcome than augmented reality, the pre-recorded safety briefing is likely to be the better framework due to its familiarity.

## 7.1 Implementation

The needed changes to the current pre-departure safety briefing is seen as structural changes to the ventilation system and changes in the pre-departure safety briefing setup.

Firstly, depending of the lay-out of each individual cruise ship, installation of HEPA filters may be a direct replacement of the current ventilation filters, where others will need to be retrofitted. The primary stakeholders for the structural changes are the cruise lines, suppliers and potentially employees with an adequate technical knowledge to complete the installation of HEPA filters. If the cruise lines fully own the cruise ships in their fleet, they work with a large degree of freedom and are able to implement the needed structural changes to the ventilation system, as long as they are compliant with relevant legislation. On the other hand, if the cruise liners are leasing (formally known as a “chartering”) the cruise ships, they will need to convince the owner of the needed changes.

Secondly, adapting a new pre-departure safety briefing is seen as needed. The interview with cruise ship officers found the pre-recorded video framework as the most feasible, however further studies are needed to determine which framework secures the highest learning outcome among the specific cruise ship passenger demography. Since the passengers are a high power/high interest stakeholder, they hold a strong position in demanding changes from the cruise lines to make the necessary changes. If the cruise lines which to keep their passengers in the “returning passenger” group, they need to meet the demands and concerns of said group.

The risk of transmission of infectious diseases could be reduced by changing the to a framework that allows the cruise ship passengers to complete the pre-departure safety briefing individually or in smaller groups, however if the framework is too complex or doesn't catch the attention of the cruise ship passengers, it may lead to fewer cruise passengers completing their training. The result of this will be nothing but a Pyrrhic victory.

## 7.2 Future works

In order to determine which framework results in the highest effectiveness, studies need to be completed with the specific cruise ship passenger demographic.

Research question 2 found that augmented reality had the highest learning outcome, but the study also used university students that may be more familiar with the technology than the passenger demographic. Regardless of which framework is chosen to replace the current pre-departure safety briefing, all will fall short if the cruise ship passengers are unable to use the framework as intended. The studies by Duenser et al. and Ibáñez et al. did add to the notion that augmented reality would secure the highest learning outcome. However, the study completed by Gagné et al. shows that all efforts to secure high learning outcome with augmented reality is redundant if the cruise ship passengers are unfamiliar and unable to use the framework.

To determine which framework has the highest effectiveness when it is used by the specific cruise ship passenger demographic, the following study is proposed:

Firstly, the participants (i.e. the cruise ship passengers) are to complete a “traditional” pre-departure safety briefing onboard a cruise ship as a part of their stay onboard. This is to ensure the participants are exposed to the same environment and have the same mindset as they normally would onboard. During the completion of the “traditional” pre-departure briefing, the passengers’ level of attention is to be observed to study how/if the attention level changes when the framework is changed. Upon completion, the passengers’ ability to recall information is to be studied to create a baseline that will be the benchmark for the other frameworks. In addition, the passengers’ ability to recall the same information by the end of their cruise is also to be studied, as this will show how much information is retained throughout the cruise.

When the initial study is completed and the baseline for the passenger’s level of attention, recalled information and retained information is established, the framework is then changed to pre-recorded videos, e-learning and augmented reality. Following the change of framework, the level of attention, recalled information and retained information is again studied to determine which has the highest effectiveness, and if any of the proposed frameworks outperforms the “traditional” pre-departure safety briefing setup. If neither of the proposed frameworks outperforms the “traditional” pre-departure safety briefing frameworks, a different study must then be initiated to identify other ways to mitigate the risk of transmission of infectious diseases during the pre-departure safety briefings.

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## 9 APPENDIX

### 9.1 Appendix 1 – SOLAS chapter III, regulation 19, section 2.2 – 2.3

SOLAS/3/B/19/2/2 & SOLAS/3/B/19/2/3 states the requirements for pre-departure safety briefings for passengers onboard cruise ships and are therefore referenced throughout the project. SOLAS/3/B/19/2/2 - SOLAS/3/B/19/2/3:

*Chapter III life-saving appliances and arrangements*

*Part B requirements for ships and life-saving appliances*

*Section I passenger ships and cargo ships*

*Regulation 19 Emergency training and drills:*

- 2.2      *On a ship engaged on a voyage where passengers are scheduled to be on board for more than 24 h, musters of newly embarked passengers shall take place prior to or immediately upon departure. Passengers shall be instructed in the use of the lifejackets and the action to take in an emergency.*
- 2.3      *Whenever new passengers embark, a passenger safety briefing shall be given immediately before departure, or immediately after departure. The briefing shall include the instructions required by regulations 8.2 and 8.4, and shall be made by means of an announcement, in one or more languages likely to be understood by the passengers. The announcement shall be made on the ship's public address system, or by other equivalent means likely to be heard at least by the passengers who have not yet heard it during the voyage. The briefing may be included in the muster required by paragraph 2.2. Information cards or posters or video programmes displayed on ships video displays may be used to supplement the briefing but may not be used to replace the announcement.*

*Chapter III life-saving appliances and arrangements*

*Part B requirements for ships and life-saving appliances*

*Section I passenger ships and cargo ships*

*Regulation 8 Muster list and emergency instructions:*

- 2 *Clear instructions to be followed in the event of an emergency shall be provided for every person on board. In the case of passenger ships these instructions shall be drawn up in the language or languages required by the ship' s flag State and in the English language.*
- 4 *Illustrations and instructions in appropriate languages shall be posted in passenger cabins and be conspicuously displayed at muster stations and other passenger spaces to inform passengers of:*
  - 1 *their muster station;*
  - 2 *the essential actions they must take in an emergency; and*
  - 3 *the method of donning lifejackets.*

## 9.2 Appendix 2 - Civil Aviation Order 20.11.14

### 14 Briefing of passengers

#### 14.1 General

14.1.1 *The operator of an aircraft shall ensure that all passengers are orally briefed before each take-off on:*

- (a) smoking, including the prohibition of smoking in toilets; and*
- (b) the use and adjustment of seat belts; and*
- (c) the location of emergency exits; and*
- (d) the use of oxygen where applicable; and*
- (e) the use of flotation devices where applicable; and*
- (f) stowage of hand luggage; and*
- (g) the presence on board of special survival equipment where applicable.*

14.1.2 *The operator of an aircraft shall ensure that a handicapped person, and the person assisting the handicapped person, if any, is given individual briefing appropriate to the needs of that person in the procedures to be followed in the event of emergency evacuation of the aircraft. The briefing should include which emergency exit to use and when to move to the exit. The person giving the briefing should also enquire as to the most appropriate manner of assisting the handicapped person so as to prevent pain or injury to that person.*

14.1.3 *The operator of a charter or regular public transport aircraft with a seating capacity of more than 6, including crew, shall supplement the oral briefing required by paragraph 14.1.1 with printed matter carried in convenient locations for the use of passengers and containing:*

- (a) diagrams of the emergency exits and methods of operating; and*
- (b) other instructions necessary for the use of emergency equipment; and*

*(c) the brace position for emergency landing or ditching.*

- 14.1.4 Each card required by paragraph 14.1.3 shall contain only information that is pertinent to the type and model aircraft being used for the flight. Different seating configuration for a particular aircraft may be included on 1 card providing the oral briefing includes advice of the configuration in use.*
- 14.1.5 In the case of aircraft engaged on charter or regular public transport operations, the procedures to be followed in the briefing required by paragraph 14.1.1 shall be specified in the aircraft's operations manual or in another document specified in the operations manual.*
- 14.1.6 Aircraft engaged on regular public transport operations with a passenger seating capacity of 10 seats or more shall be equipped with an approved and serviceable electronic public address system for the purpose of making announcements relative to emergency procedures. The system shall be an integral part of the aircraft and shall be accessible and capable of immediate operation by the pilot in command, the co-pilot or an appropriately trained crew member. The transmission shall be audible throughout the passenger cabin.*

### 9.3 Transcription of interview with Officer A

Original Danish transcription	English translation
Spørgsmål: Mener du der er en smittefare ombord krydstogt skibe?	Question: Do you see the risk of infectious disease transmission as a problem onboard cruise ships?
Svar: Ikke lige umiddelbart. Alt kører over anlægget, ikke? Der er ikke noget tæt kontakt mellem folk når vi har de der videoer. Det er ganske almindelig PA der kører rundt omkring, og så er der skærme ombord på skibet, hvor der kører videoer. Det er kun hvis folk stimler sammen omkring en skærm.	Answer: Not really, no. Everything is run on the system. There is no close contact between the people when we have the videos. It is just the regular PA there is used along with screens onboard where the videos are shown. It is only if people gather around a screen.
Spørgsmål: Følger passagererne med i sikkerhedsinstruktionerne?	Question:
Svar: Nej. Absolut ikke. Det gør folk ikke. Der er måske få mennesker der gør det, men for mange mennesker er der noget irriterende der kører. Det er lige såvel som opslagene bagpå dørene, hvor nærmeste nødudgang er. Alle de her ting er nok irriterende for folk. Et godt eksempel på det er at vi her i Corona-tiden er begyndt at sejle fra [havn], hvor vi har en ankomst klokken 00:15, og kravet er, at vi skal spille en safety briefing efter hver afgang og ankomst. Det skal jo så spilles ud i hele skibet, men klokken 00:15 ligger folk jo og sover på deres kabiner, så vi har haft en masse klager fordi vi spiller de her safety briefings når folk ligger og sover. Og det ser jo noget om at folk er meget irriteret over det. Vi har været i dialog med Søfartsstyrelsen for at finde ud af, hvad vi kan gøre for ikke at spille de her videoer, men de siger at vi skal. Der er ikke så meget vi kan gøre ved det.	Answer: No. Absolutely not. People do not. There may be few people who do it, but for many people there is something annoying going on. It is just as well as the notices on the back doors where the nearest emergency exit is. All these things are probably annoying to people. A good example of this is that here in the Corona era we have started sailing from [port], where we have an arrival at 00:15, and the requirement is that we must play a safety briefing after each departure and arrival. It has to be played out in the whole ship, but at 00:15 people are sleeping in their cabins, so we have had a lot of complaints because we play these safety briefings when people are asleep. And it sees something about people being very annoyed about it. We have been in dialogue with the Danish Maritime Authority to find out what we can do to not play these videos, but they say we should. There is not much we can do about it.



Spørgsmål: Hvilke af de fremlagte rammer finder du mest gennemførlig?	Question: Which of the proposed frameworks do you see as being the most feasible?
Svar: Det er svært at sige. Man skal jo også have passagerene til det, ikke? For det klientel vi sejler rundt med, så er det jo sådan at når folk kommer ombord på skibene, så vil de absolut ikke tænke i sikkerhed. De er jo på ferie nu, ikke? De har ikke det mindset, altså for dem så skal de jo slappe af og på ferie, og alt det med sikkerhed, det har besætningen jo nok styr på, så jeg tror det er ekstremt svært at få folk til at skulle selv gå rundt og gøre noget. Man kan jo bare se når folk sidder i restauranten på hvordan alt vores brændslukningsudstyr er gemt væk i skabe og malet over. Folk vil simpelthen ikke kigge på alt det sikkerhed der. Så det skal helst være gemt væk, men stadigvæk tilgængeligt. Folk skal gerne se, at der er styr på sikkerheden, det vil de gerne have, men alt det her med at øve det tror jeg er svært for dem.	Answer: It's hard to say. You have to have the passengers for that too, right? For the clientele we sail around with, it is the case that when people get on board the ships, they will definitely not think in safety. They're on vacation now, aren't they? They do not have that in mind, so for them they have to relax and go on holiday, and all that for sure, the crew has enough control over that, so I think it is extremely difficult to get people to have to walk around and do something. You can just see when people are sitting in the restaurant how all our fire extinguishing equipment is hidden away in cupboards and painted over. People simply do not want to look at all that security there. So it should preferably be tucked away but still accessible. People should like to see that there is control over safety, they want that, but all this with practicing it I think is difficult for them.
Spørgsmål: Vil et skifte fra de nuværende sikkerhedskald til et af de fremlagte rammer medføre negative konsekvenser til læringen?	Question: Would changing the current pre-departure safety briefing setup to any of the proposed framework have negative consequences for the overall learning outcome?
Svar: Jeg tror de vil være negative omkring det. Der skal være et alternativ, for det er jo ikke alle mennesker der kan gå rundt og lære. Der er jo mange svage personer i kørestole. Der skal også være et alternativ for dem.	Answer: I don't think they will like it. There must be an alternative, because not all people can walk around and learn. There are many weak people in wheelchairs. There must also be an alternative for them.
Spørgsmål: Hvilke hindringer ser du i de fremlagte rammer?	Question: What hindrances do you see in the proposed frameworks?
Svar: Folks prioriter. Man skal huske, at man skal have dem alle sammen med. Nu siger du selv med digitale løsninger. Der er mange der ikke er digitale, men der kommer færre og færre af dem. Der ligger nok noget i kulturen	Answer: People's priorities. One must remember that one must have them all with. Now you say yourself with digital solutions. There are many that are not digital, but there are fewer and fewer of them. I could imagine

<p>også. Jeg kunne forestille mig at amerikanere er meget mere villige til sådan noget sikkerhed. Det ligger nok i deres kultur, at de gerne vil deltage i sådan noget. De er nok mere interesseret i sikkerhed, hvor danskere ikke rigtig gider.</p>	<p>that Americans are much more willing to such security. It is probably in their culture that they would like to participate in such a thing. They are probably more interested in security, where Danes do not really bother.</p>
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## 9.4 Transcription of interview with Officer B

Original Danish transcription	English translation
Spørgsmål: Mener du der er en smittefare ombord krydstogt skibe?	Question: Do you see the risk of infectious disease transmission as a problem onboard cruise ships?
Svar: Ja, det mener jeg helt bestemt, at der er. Vi har nok ikke været så opmærksomme på det før, men efter Corona-krisen, så har folk fået øjnene op for faren. Passagererne står tæt sammen under instruktionerne, så der er bestemt risiko for at folk bliver smittet. Der er vel 500-1000 mennesker i grupperne, så de er mange!	Answer: Yes, definitely. We might not have been as aware of it before, but people have become more aware after the Corona-crisis. The passengers stands close together, so there is definitely a risk of transmission of infectious diseases. There is about 500-1,000 people in the groups, so they are a lot of people together.
Spørgsmål: Følger passagererne med i sikkerhedsinstruktionerne?	Question: Do passengers pay attention to the pre-departure safety briefing?
Svar: Ja, det vil jeg mene. Der er forskelligt, hvor meget folk følger med, men generelt mener jeg, at folk følger med i sikkerhedsinstruktionerne. Der er flere der stiller spørgsmål til de vi fortæller, både under instruktionerne og efter. Det er min opfattelse, at folk er interesseret i at vide mere, da de måske ikke ved så meget i forvejen.	Answer: Yes. There are differences in how much people follow, but in general I think people follow the safety instructions. There are several who ask questions to what we tell, both during the instructions and after. It is my opinion that people are interested in knowing more as they may not know that much in advance.
Spørgsmål: Hvilke af de fremlagte rammer finder du mest gennemførlig?	Question: Which of the proposed frameworks do you see as being the most feasible?
Svar: Sikkerhedsvideoerne.	Answer: The pre-recorded videos.
Spørgsmål: Vil et skifte fra de nuværende sikkerhedskald til et af de fremlagte rammer medføre negative konsekvenser til læringen?	Question: Would changing the current pre-departure safety briefing setup to any of the proposed framework have negative consequences for the overall learning outcome?
Svar: Det vil nok tage længere tid, hvis folk skal bruge e-learning eller augmented reality. Jeg tænker, at mange nok vil have spørgsmål til hvordan de kommer i gang, eller at deres telefon ikke kan bruge programmet. Jeg tvivler	Answer: It will probably take longer if people have to use e-learning or augmented reality. I think that many will probably have questions about how to get started or that their phone cannot use the program. I also doubt that

også på, at alle vil være i stand til at bruge augmented reality, selvom det kunne være fedt.	anyone will be able to use augmented reality, even if it could be cool.
Spørgsmål: Hvilke hindringer ser du i de fremlagte rammer?	Question: What hindrances do you see in the proposed frameworks?
Svar: Som sagt, så er det ikke alle der måske ved hvordan man bruger e-learning eller augmented reality, som også vil kræve at vi enten har enheder til rådighed til dem, hvis telefon ikke er i stand til at bruge programmet, eller at vi kommer til at bruge en masse til på at få startet programmet op. Jeg tror folk vil blive trætte af at bruge det. Ligeledes, hvordan kontroller vi, at folk har gennemgået øvelsen? Skal vi stå og kigge dem alle sammen over skulderen?	Answer: As I said, not everyone knows how to use e-learning or augmented reality, which will also require that we either have devices available to those whose phone is unable to use the program, or that we come to spend a lot on getting the program started. I think people will get tired of using it. Likewise, how do we check that people have undergone the exercise? Should we stand and look at them all over the shoulder?