



*“Smart means...no waste of space, time, money and natural resources; technology and innovations can help, but being smart is also a mind-set”*

Olaf Merk, Administrator for Ports & Shipping at ITF



INTERNATIONAL  
HELLENIC  
UNIVERSITY

**Smart Cruise Ships; in what way Information and  
Communication Technologies are revolutionizing  
the cruise experience**

**Maria Vafeidou**

**SCHOOL OF ECONOMICS, BUSINESS ADMINISTRATION & LEGAL STUDIES**

A thesis submitted for the degree of

***Master of Science (MSc) in Hospitality and Tourism Management***

January 2019

Thessaloniki – Greece

Student Name: Maria Vafeidou  
SID: 1109160022  
Supervisor: Prof. Dimitrios Buhalis

I hereby declare that the work submitted is mine and that where I have made use of another's work, I have attributed the source(s) according to the Regulations set in the Student's Handbook.

January 2019  
Thessaloniki - Greece

## Abstract

Recent Information Communication Technologies advancements (ICTs) and the extended use of mobile technologies and social media have originated smartness in tourism businesses (Xiang & Fesenmaier, 2017). In the cruise industry, innovative technologies have transformed the cruise experience, by incorporating service delivery and amusement with seeking and exchanging information in an always mobile environment (Tussyadiah & Zach, 2012). Hence, the Smart Maritime Ecosystem has emerged involving cruisers as active actors who interact dynamically with stakeholders within their ambit, creating value for all. Conversely, technology empowers cruise businesses to achieve their key goals; from improving loyalty and customer value, until innovating for competitive differentiation and working with others in new ecosystems to enhance brand strategies and deliver unique real-time travel experiences.

The purpose of this conceptual project is to accumulate the current digital innovations over the maritime ecosystem and investigate the impact of ICTs on the cruiser's experience on board. After clarifying the concept of smart/smartness in tourism and overviewing the cruise industry –citing, in particular, the future trends in cruising- this assignment will try to conceptualise the Smart Maritime Ecosystem focusing on the transformation of guests' experiences, bringing together all the digital features on smart cruise ships from thirteen companies and creating a hypothetical scenario at sea. Moreover, this study will analyse the benefits of using ICTs in terms of efficiency, sustainability, safety, and personalization of the experience, as well as discuss the challenges and limitations associated with these technological improvements.

Keywords: smart ship, innovation, cruise ships, tourist experience, technology

## Acknowledgments

This dissertation was written as part of the MSc in Hospitality and Tourism Management of the International Hellenic University. My decision to return in an academic environment, after years working on cruise ships proved to be harder than I have ever imagined. However, when there is something that you are passionate about, everything becomes easier and achievable.

Firstly, I must express my profound gratitude to my thesis advisor Professor Dimitrios Buhalis who has inspired me and challenged me to improve my writing skills. This accomplishment would be a shipwreck without him being the captain and steering me always in the right direction, even at times when the sea was rough, and without the valuable help of the second captain Professor Alexis Papathanassis.

I would also like to thank all my “without borders” friends for their patient the last two years and their positive energy, especially my classmates Natalie and Viktoria for their continuous support and encouragement all day and all night long.

Finally, I am thankful to those special people in my life, who support and uplift me during this academic period. My mum Dina, who helped me practically in her way, my beloved aunt Angela, who first believed in me and show me the way to deal with difficulties and, last but not least, Marina, the best little cousin in the whole world and the protagonist of this thesis.

This accomplishment would not have been possible without them.

Thank you, Ευχαριστώ, Grazie!

## Abbreviations

AI	Artificial Intelligence
AIS	Automatic Identification System
AR	Augmented Reality
CCL	Carnival Cruise Lines
CLIA	Cruise Lines International Association
DDS	Data Distribution Service
DSS	Decision Support System
FCCA	The Florida-Caribbean Cruise Association
FOC	Flags of Convenience
GDL	Goods-Dominant Logic
GDPR	General Data Protection Regulation
GNTTO	Greek National Tourism Organization
GPS	Global Positioning Systems
ICT	Information and Communication Technology
IMO	International Maritime Organization
IoT	Internet of Things
ITF	International Transport Forum
LTD	Limited Liability Company
MEDCruise	Mediterranean Cruise Ports
PLC	Public Limited Company
RCCL	Royal Caribbean Cruise Lines
RCI	Royal Caribbean International
RFID	Radio-Frequency Identification
SBE	Smart Business Ecosystem
SDL	Service-Dominant Logic
SoCoMo	Social media, Context-based, Mobile
STD	Smart Tourism Destination
UNWTO	United Nations World Tourism Organization
VDR	Voyage Data Recorder
VR	Virtual Reality

# TABLE OF CONTENTS

ABSTRACT .....	I
ACKNOWLEDGMENTS.....	II
ABBREVIATIONS.....	III
TABLE OF CONTENTS .....	IV
TABLE OF ILLUSTRATIONS .....	V
1. INTRODUCTION .....	1
2. THE CONCEPT OF SMART AND SMARTNESS.....	2
2.1. SMART TOURISM.....	4
3. CRUISE TOURISM .....	5
3.1. OVERVIEW OF THE CRUISE INDUSTRY .....	5
3.1.1. The Cruise Market .....	6
3.1.2. The Cruise Experience .....	9
3.2. UPCOMING TRENDS AND FUTURE IN CRUISING .....	10
4. RESEARCH METHODOLOGY .....	13
5. SMART CRUISING.....	16
5.1. CONCEPTUALISING THE SMART MARITIME ECOSYSTEM .....	16
5.2. SMART CRUISE SHIPS .....	22
5.2.1. Digital Innovations On-board.....	23
5.3. TECHNOLOGICAL CATALYSTS THAT BRING SMARTNESS FORWARD .....	30
5.4. REDEFINE THE CRUISE EXPERIENCE.....	33
5.4.1. A Smart Cruising Scenario - A week on board with Marina .....	33
5.5. CHALLENGES AND LIMITATIONS .....	38
6. CONCLUSION AND FUTURE RESEARCH.....	41
7. BIBLIOGRAPHY .....	I

## Table of Illustrations

Table 1: Cruise Market Segments (Source: Worldwide cruise ship activity, 2003) .....	7
Table 2: Cruise travellers' segments (Source: Cruisemarketwatch 2018) .....	8
Table 3: Future trends in tourism and in cruise industry (Source: the author) .....	11
Table 4: The 13 cruise companies analysed in this thesis (Source: the author) .....	14
Figure 1: The Smart Maritime Ecosystem (Source: the author) .....	17
Figure 2: Safety innovations on board (Source: Allianz 2012) .....	21
Table 5: Current digital innovation on board of Smart cruise ships (Source: the author) .....	26
Figure 3: List with new ships debuting in 2019 (Source: CLIA 2018) .....	30
Figure 4: A view of a virtual aquarium (Source: Fastcompany 2017, photo taken by Diane Bondareff) .....	30
Figure 5: The future RCC stateroom (Source: Fastcompany 2017) .....	31
Figure 6: "Zoe" device (Source: Team GTP 2018) .....	31



# 1. Introduction

The rapid expansion of the internet has entirely revolutionised the tourism sector (Ho & Lee, 2007). Information and Communication Technologies (ICTs) have completely reshaped the tourist experience (Neuhofer et al., 2012) and the manner destinations perform and industrial policies must be addressed. Recent tourism advancements such as cloud computing, virtual and augmented reality, sensors as well as the widespread diffusion of mobile technologies and social media have emerged smartness (Xiang & Fesenmaier, 2017). In this framework, the customer using different technological devices (smartphones, tablets, computers, laptops, gadgets, wearables) is always connected online within a digital ecosystem and empowered of making his/her own decisions real-time. Hence, the conceptualisation of smart tourism destinations and management have evolved, raising new challenges for customers, tourism companies and stakeholders mostly as a result of poor interconnectivity and interoperability.

The cruise industry, also, gradually matures with the adoption of innovative technologies. It is worthwhile to note the vital role of ICTs in enhancing guests' experiences, in increasing customers' loyalty and value, as well as recognise them as a tool for cruise operators, businesses and stakeholders regarding cost reduction, management, sustainability, safety, competitive differentiation and market diffusion process. Nonetheless, digital technologies on board could be confusing for consumers and costly for businesses. For this reason, brand strategies need to focus on the rigorous combination of time, differentiation and cost in order to exceed cruisers' expectations and to increase profit for all.

## 2. The concept of Smart and Smartness

Smart includes multitudinous elements<sup>1</sup> and functions which are supported by ICTs (Gretzel et al., 2015). The first item (*Smart Experience*) depends on the ability of destinations to aggregate, link and synchronize information real-time (Neuhofer et al., 2015). Regarding the second feature, in a *Smart Business Ecosystem (SBE)*, (including public-private collaboration), any stakeholder has a role which is not predefined; it can be an actor who can contextually turn into a producer, consumer, monitor, intermediary, and so on (Gretzel et al., 2015). As an outcome of this dynamic interconnection between destinations and stakeholders through computing platforms, interaction networks, marketplaces (Airbnb, Booking, etc.), content crowdsourcing platforms (TripAdvisor, Cruise Critic, etc.), and information systems (DSS) the third component arises; thus, the *Smart Tourism Destination*. Because of this interconnection of smart tourism stakeholders (Buhalis & Amaranggana, 2014), inter/intra-organizational relationships and new methods in collaboration should be also redefined.

On top of that, smartness in hospitality sets tourists in the middle of a new e-ecosystem, where different types of ICTs, such as, Internet of Things (IoT), Cloud Computing and End-User Internet Service System, named as hard smartness are used (Zhang et al., 2012 as cited in Wang et al., 2013). Nevertheless, hard smartness only in combination with soft smartness -innovation, human capital, social capital, and leadership- within a S-D logic ecosystem structure can result in value co-creation involving, not only an entire network of stakeholders, but also the firms (societal value) and their employees, as well as other customers. Moreover, individuals can react to places with approach or avoidance behaviour (Bitner, 1992) and their satisfaction depends on the degree of their participation and co-creation (García-Haro et al., 2015).

In the light of the above mixing, interoperability and interconnectivity play a crucial role in between digital ecosystems. Interoperability refers to the ability of data, information and knowledge sharing between disparate systems (Maheshwari & Janssen, 2014) and

---

<sup>1</sup> Smart Experience, Smart Business Ecosystem, Smart Destination (Gretzel et al., 2015)

has four levels<sup>2</sup> (Rezaei et al., 2014). However, Höjer and Wangel (2015) claim that it is the interconnectivity and not the individual technological advances which assist in evaluating subsystems, and ends up to make better operational and marketing decisions (Buhalis & Leung, 2018). As a case in point, the marketers have now implemented a new framework for adding value inside a wider ecosystem, the *SoCoMo Marketing*, which provides personalised services to tourists according to their preference, location and recent external environment, combining social media (So), context-based (Co) and mobile devices (Mo) capabilities (Buhalis & Foerste, 2015).

Reflecting on the above statements, with this shift in power from the industry to the consumer, from products to services and from a static Goods-Dominant Logic (GDL) to a dynamic one, the burden falls mainly on the individual alone. Based on internal and external (PESTLE)<sup>3</sup> conditions, as well as on real-time interaction, customer's decisions in between a digital ecosystem can shape the financial future of the tourism industries and the purchase behaviour of the coming customers. For instance, tourists share their travel experiences in social networks during all the stages of their journey; before the trip by searching information and planning their itineraries, during the trip by staying connected and share experiences real-time and after the trip by reviving and creating memories or even evaluating online their experience via their social networks (Facebook, Twitter, Instagram) and distribution channels (TripAdvisor, Booking, Airbnb). Thus, online reputation management is vital for tourism organisations, because any negative comments online can directly affect the company image and decrease customer visit and booking intention or, from the other side, the positive ones could increase the customer's loyalty and firms' profit.

---

<sup>2</sup> technical, syntactic, semantic and organisational (Rezaei et al., 2014)

<sup>3</sup> Political, Economic, Social, Technological, Legal and Environmental (Srdjevic, Bajcetic & Srdjevic, 2012)

## 2.1. Smart Tourism

Smart Tourism refers to Smart Cities and Smart Destinations, which are particular cases of the first one. According to Sigala (2015) Smart Tourism results from altering all or some of the market elements such as, exchange object and market actors/structure/institutions/practices by the use of ICTs. Additionally, Cohen (2012) argues that there are some indicators for each of the smartness dimensions, namely: Smart Governance, Smart Environment, Smart Mobility, Smart Economy, Smart People and Smart Living.

Among the several definitions for Smart Cities and Smart Destinations, the majority underlines the incorporation of technology into material infrastructure and environment, as well as on the interconnection between various platforms including attractions, places, or destinations to provide real-time accessible services for all stakeholders. In this thesis, as the author examines cruise ships, the enlarged concept of a destination as an *“amalgam of tourism products and services having the 6As<sup>4</sup>”* with no geographical limits introduced by Buhalis (2000) will be adopted. On this basis, cruise ships are considered not only as a mean of transportation or part of the destination, but as a destination in itself (UNWTO 2007), combining on board all-in-one the amenities, services, and facilities which tourists can find on land.

Considering the ICT dependence in Smart Tourism, reveal other issues. Technology limitations such as, lack of interoperability between systems or different capabilities depending from the software (e.g., Android OS, iOS), short batteries' life of today's smartphone devices, low Wi-Fi connectivity in some isolate areas, and information overload are the most common one. Another challenge is the poor collaboration between various stakeholders with different vested interests within the smart ecosystem. To overcome the above vulnerabilities, brand new infrastructures have to be built, innovative info structures need to be developed and stakeholders must put the overall interest of the destination before their short-sighted self-interest.

---

<sup>4</sup> Attractions, Accessibility, Amenities, Available Packages, Activities, Ancillary Services (Buhalis, 2000)

### 3. Cruise Tourism

*“Cruise tourism is a socio-economic system generated by the interaction between human, organizational and geographical entities, aimed at producing maritime-transportation-enabled leisure experiences”*

(Papathanassis & Beckmann, 2011)

This definition points out the fragmented multidimensional nature of cruise tourism and explains the difficulties the academics face in examining this complex phenomenon, which includes sociology, business and economics studies along with humanity, environmental, maritime, transportation, and marketing and management studies in hospitality and tourism sector. These unique characteristics of cruise tourism present several challenges also for cruise travellers, cruise lines and cruise destinations.

#### 3.1. Overview of the Cruise Industry

In the recent years, the cruise industry has continued to grow globally from 21,3 million passengers in 2013, to 26,7 million in 2017. For 2018, the positive predictions for cruise passenger's growth<sup>5</sup> show that the number of people taking cruises is increasing at around 1.2% per year despite an economic cycle and recession worldwide (CLIA 2017). Stagnation did not occur even when the Costa Concordia grounded in Italy in 2012. Furthermore, in a two-year period, 37 new cruise ships will be launched by 2020, adding 99,895 to world-wide passenger capacity and €10,25 billion<sup>6</sup> in annual revenue to the ocean cruise industry (Cruisemarketwatch 2018).

The increasing popularity and profitability of the cruise industry have generated more competition between cruise lines and destinations and force them to adapt their business models (Aggett, 2011; Sun, Jiao & Tian, 2011). With the introduction of many new destinations and itineraries for cruises, the capacity and the number of orders for cruise ships have increased (Sciozzi et al., 2015). Nowadays, ships sail in all regions of the world and are often registered in countries that are different from the companies

---

<sup>5</sup> 28 million (CLIA 2017), 27, 2 million (FCCA 2018), 26 million (Cruisemarketwatch 2018)

<sup>6</sup> Converted from \$11, 7 billion in the original text (Cruisemarketwatch 2018) as 1USD = 0.876410€

that own them (flags of convenience). The three major competitors that dominate the global cruise industry are Carnival Corporation & Plc., Royal Caribbean Cruises Ltd. and Norwegian Cruise Line Holdings Ltd. (Cruisemarketwatch 2018). This dominance by only three major firms is one of the oligopolistic characteristics of the cruise industry. Although the threat to these three cruise corporations from new entrants is limited, competition within the market is strong (Lester & Weeden, 2004).

Cruising can cause both positive and negative economic, environmental and social impacts, like any other tourism activity. Through heterogeneous cruise data, tourism researchers have been examined, mainly, the direct and indirect economic effects of cruise tourism primarily based on observational data in specific destinations (eg., Costa Rica, Uruguay, Jamaica, Valetta, etc.). Regarding the environment, one of the higher incidences of total CO<sup>2</sup> production are because of cruising (Horwathhtl 2015). However, this situation is ameliorating and in 2018, Cruise Lines International Association (CLIA) announced a historic global cruise industry commitment to reduce by 40% the rate of carbon emissions across the industry fleet by 2030. After having a brief literature review (Brida & Zapata, 2010; Baker, 2015; Bahja et al., 2018), it is proved that the majority of the central issues is referring to the social impacts of cruising (heritage values, cultural authenticity, etc.) and more specifically to the relationships between residents and guests. In sum, to obtain sustainability in the cruise industry, it is necessary to achieve a balanced economy, make optimal use of environmental resources and conserve natural and cultural heritage.

### 3.1.1. The Cruise Market

The demographic profile of the cruise market and their expectations have changed during the last years, although their motives for choosing this type of holiday remain the same (Papathanassis, 2017). The UN (2010) definition for cruise passengers - *tourists* or *overnight visitors* to the cruise ship and *same-day visitors* or *excursionists* to the individual ports of call- identifies the complex nature of the cruise market.

Following a chronological order, the Florida-Caribbean Cruise Association (2003) based on attitude characteristics, identifies six segments within the cruise market (table 1).

Nevertheless, Douglas and Douglas (2004) claim that there is a need of a fundamental evidence for categorising cruise passengers based on their behaviour, although they recognize the existence of some market segments. For instance, cruisers can be segmented based on whether they are local to the region of the cruise they are taking, or whether they are part of a long-haul market and travel to another region for their cruise vacation (Henry, Hamlin & Simpson 2015). In addition, seven more segments depending on the level of cruiser’s interaction with the onboard amenities and facilities are depicted on table 2. Examining, also, the latest report by CLIA (2018), it is revealed that cruisers -with an average age of 47 years old- love to travel in groups enjoying mostly the onboard entertainment. When it comes to specific generations, the same report found that Millennials, will “definitely or probably” book a cruise for their next trip, trying to combine luxury holidays with new and adventurous experiences, social interaction and authenticity. Cruise tourism, traditionally, was for an elite American class. Meanwhile, this form of vacation has become an affordable holiday option for almost all the income classes and ages. The market has also become saturated and it is gradually conquering Europe, where Germany is the leader.

No. Segment	%	Characteristics
1. Restless baby boomers	33	Cost may be an impediment to trying different vacations
2. Enthusiastic baby boomers	20	Convinced and excited about cruising; live a stressful life; want escape and relax; look forward to vacations
3. Luxury seeker boomers	14	Can afford and are willing to spend money for deluxe accommodations and pampering
4. Consummate shoppers	16	Look for best value (not cheapest); committed cruisers
5. Explorers	11	Well-educated; well-travelled; curious about different destinations; like to explore and learn
6. Ship buffs	6	Most senior segment; cruise extensively

*Table 1: Cruise Market Segments (Source: Worldwide cruise ship activity, 2003)*

As far as the author is concerned, the augmented competition among cruise companies and the composition of a younger and increasingly active clientele (Generation Y and Z) are the main reasons of this demographic shift. Cruise experts need to categorise the cruise market in accordance with their marketing strategy and company’s culture. The segmentation criteria (age, behaviour, origin, etc.) are not as important as the proper selection of the most appropriate tools for targeting a specific group of cruisers. Only in this way, they can deliver a high-quality service for cruise passengers at the right time during their vacations on board, offering them unforgettable experiences.

<p><b>Explorers:</b> The segment we love to love. These folks take four or more vacations per year, have disposable incomes and take longer cruises, exotic cruises and cultural learning cruises. Education and social causes are important to them. So are making friends and socializing. It's a smaller and more saturated segment, but one that is lucrative and important to satisfy to retain their business. This group also represents future opportunity, as more couples become empty nesters and retired upscale boomers.</p>
<p><b>Admirals:</b> These folks have selected their preferred cruise provider and seek a traditional experience. They tend to ritualize their travel experience and don't usually experiment unless their favourites start to become stale or so radically different the attributes they admired become unrecognizable. Great cruise consumers. They tend to be older and a good, loyal customer base but offer less opportunity for growth.</p>
<p><b>Marines:</b> This desirable yet elusive segment is made up of upscale, motivated and active young professionals. They are most likely to snorkel, para-sail, surf and rock climb. Whether new or experienced cruisers, they are always auditioning better ships. They are intellectually curious, media-involved, and they perceive value in not only the appearance of being active but also the reality of learning and being challenged. Cruise companies can grow well in this segment. They are the logical target for active ship design strategies as well as expanding Internet marketing.</p>
<p><b>Little Mermaids:</b> This segment is made up of upper middle class families. They are experiencing an increase the pace of daily activity and a crunch for time. With every non-working moment devoted to family errands (stopping at the Home Depot to pick up an attachment for the air pump for the kids' pool or running to Target for a new basketball for the son's friends' birthday party) they are looking to maximize leisure activity as a family experience that includes opportunities for real quality-bonding.</p>
<p><b>Escapers:</b> This is a desirable segment and probably the core of the cruise market. They are just looking to get away. All-inclusive is just fine. No complications, no worries. From their point of view, after having spent a hectic year in the rat race with traffic jams, bad tempered people and an abundance of things that need to be done, they have earned the pleasures of doing nothing but sitting by the pool, seeing a few sites and relaxing. They are somewhat price sensitive but will always find the money for the trip they deserve.</p>
<p><b>Souvenirs:</b> These folks have jobs (not careers) and lives (not lifestyles). Because the exact line isn't as much a priority for them as price, their cruise habits skew toward just taking a trip more than specific destinations or activities. Lacking intense interest in the world outside they are primarily focused the internalized experience of the moment. They tend to take a cruise vacation only when there's a "really good deal" that everyone's talking about.</p>
<p><b>Adrift:</b> There is a group of people in every society who are disconnected from travel commerce, not curious about what's going on in the world and not likely to possess the disposable income. This segment is a realistic target for the attention of breweries and bait shops - not cruise line marketers.</p>

Table 2: Cruise travellers' segments (Source: Cruisemarketwatch 2018)



### 3.1.2. The Cruise Experience

The subjective and multidimensional nature of the cruise experience is in accordance with the fragmented nature of cruise tourism. Hence, it compasses multiple channels; the port, the local government, the cruise companies (Di Vaio, Lepore & Varriale, 2018), or even cruise travel agents and the particular destination (CLIA 2018). Kwortnik (2008), after examining qualitative data of 260 cruise customers, comes to the conclusion that cruisers react with five different responses -physiological, emotional, behavioural, experiential, symbolic- to their cruise experience, due to ambient, design and social factors.

From the author's personal working experience on board, the cruise experience starts before the time spent on board (*pre-cruise phase*); from the moment that customers decide to go on a cruise, are searching for information online and conclude with the way, they will achieve it (direct bookings, travel agents, online channels). After that, in the *during-cruise phase*, cruise passengers feel that the cruise ship is their own home and respectively fellow cruisers and crew members are their relatives. This could create confusion for any person who passes beyond professional limits and could cause damaging consequences (forced disembarkation, dismissal, severe penalties, fines, etc.). In what way and extend cruisers interact with their "current relatives", has a powerful influence on their overall positive or negative experience, starting and finishing in the gangway. Empirically verified, the peak of the cruise experience is during the check-in and check-out process, where mistakes are not forgivable. Thus, crew members are devoted to welcome guests on board in different languages and are dressed up with colourful and funny costumes, ready to assist cruisers with any issues from finding their cabin till changing instantly all aspects of their cruise! Cruise companies spend, also, more money and time training their employees for managing cruisers and meeting their needs. When the cruise comes to its end, in the *post-cruise phase*, guests like to relive their experience and share it utilising numerous of networks, channels and platforms, or even by contacting in personal other cruisers or staff members who have met on board. In the end, human contact is more important than any technological, object interaction, especially when there is a significant amount of cruisers travelling solo.

### 3.2. Upcoming trends and future in cruising

As the travel industry is characterised by “peak and trough” cycles, the ability to respond to seasonal trends, adapt and innovate is significant for business success. In this highly competitive and asset-intensive market, to sustain growth and profitability, cruise lines and destinations identify tangible and intangible factors providing specific aboard and ashore activities which add value to cruisers’ experiences (Travolution 2017).

Investigating the shape of the future offering in cruising, the author takes into consideration the findings from academic researchers, cruise industries and travel associations. Thus, the latest ten upcoming tourism trends -the first five with strong influence on the demand, and the other five on the supply aspect of tourism respectively- cited by HORWATH HTL, the largest hospitality consulting brand worldwide, and travel trends in cruising from the world’s largest association, CLIA, are summarised in table 3.

As it can be clearly seen, HORWATH HTL and CLIA consent to most of the future trends. Starting from the first one, short-term political issues or long-term concerns and terrorism threats might cause a serious adverse impact on any destination. For instance, during 2017, the total number of cruise passenger visits at the Mediterranean decreased by 4.1% compared to 2016 due to terrorist fallout, and the avoidance of zones, such as Turkey, Tunisia and Egypt (MedCruise 2017). Secondly, cruising has become more affordable and accessible than ever, offering new value for money destinations, due to the growth of middle class. Furthermore, the need for customization and personalization of service is now greater than ever because “Silver-hair” segment<sup>7</sup> with specific needs, and at the same time new generation of cruisers who combine work with leisure time (Working Nomads), travel alone (Going Solo), seek for interaction and exploration (Gen Y) and prefer authentic experiences over material items (Gen Z) demand flexibility and tailored made services in line with their special characteristics.

---

<sup>7</sup> “Silver-hair” is a heterogeneous segment which is not yet clearly defined. Generally, it includes the total economic activity of the 50+ population (Zsarnoczky et.al, 2016)

<i>10 Tourism Megatrends (Horwathhtl 2015)</i>	<i>Cruise travel report 2018 (CLIA 2018)</i>	<i>Cruise trends &amp; industry outlook 2019 (CLIA 2018)</i>
<i>Political issues &amp; terrorism</i>		
<i>Growing middle class</i>	<i>All budgets will cruise</i>	
<i>Emerging destinations</i>	<i>Travelers warm to chilly destinations (Canada, Alaska, &amp; Antarctica)</i>	<i>Off-Peak Adventures, including once-in-a-lifetime experiences during the colder months</i>
<i>Generation Y &amp; Generation Z<sup>8</sup></i>	<i>Millennials (Gen Y) take to the river</i>	<i>Gen Z (iGen) at sea</i>
<i>Silver Hair Tourists</i>	<i>Skip-gen cruising; grandparents &amp; grandchildren will travel together without their parents</i>	<i>Female-centred cruising</i>  <i>Going Solo</i>  <i>Working-Digital nomads</i>
<i>Loyalty V.X.0</i>	<i>Transformational cruise travel</i>	<i>Achievement over Experience</i>  <i>Access is the new luxury, for unreachable destinations by plane</i>
<i>Sustainability</i>	<i>Sustainability at sea</i>	<i>Conscious travel, by implementing innovations that decrease the environmental footprint of cruise travel</i>
<i>Health &amp; healthy lifestyle</i>	<i>Healthy doses</i>	<i>Total restoration offering the latest in fitness innovations</i>
<i>Technological (r)evolution</i>	<i>Smart travel technology</i>	<i>On board with Smart tech</i>
<i>Digital channels</i>		<i>Instagrammable cruise travel</i>
	<i>Tapping travel agents</i>	

*Table 3: Future trends in tourism and in cruise industry (Source: the author)*

<sup>8</sup> Gen Y: those born between 1982 & 1998, Gen Z: those born between 1996 & 2010 (McCrindle & Wolfinger, 2014)

Achieving high satisfaction through customised services leads to loyal cruisers who remain loyal to meanings, images and symbols, especially to those that they produce while they consume (Sigala, 2017). Physical loyalty (e.g., cards) within the industry it will decline because innovative loyalty programs (mobile apps, online portals, etc.), based on precise insights through Big Data, will be developed.

As stated by CLIA, the next evolution sees travellers following a healthy lifestyle and seeking for “transformational experiences”. From the cultural immersion and voluntarism to extreme adventures, tourists returning from a cruise will have a shift in perspective and a sense of accomplishment (CLIA 2018). Consumers buy now benefits, values and emotional experiences (Sigala, 2017) and not material things. They want to have an active role in their vacation process, to co-create, rather than lean back and listen. Cruise companies recognize this shift from “storytelling” to “individual discovery” and thus, offer itineraries where tourists can visit isolated villages and be part of the resident’s everyday life.

Academic specialists and cruise industries, also, identify changes in the foreseeable future in cruising. According to Papathanassis (2017), the new trend in the cruise industry is the mega-ships with over 6,000 passengers’ capacity, containing shopping malls, several restaurants, theatres and various sports activities, accompanying with standardisation of facilities and of itineraries (Castillo-Manzano et al., 2014). This trend underlines the role of on board revenue as a determinant of business sustainability (Papathanassis, 2009) and puts pressure on Port Authorities to expand their infrastructure to accommodate larger cruise ships to ensure safety, health and security to the cruisers (Cheng *et al.*, 2016). Despite these “mega-challenges”, the cruise sector continues to grow particularly in Asia. In 2017, there were more than 50 mega cruise ships operating in Asia, indicating a growth of around 25% per year. “*Over the next few years all eyes will be on China*”, which is predicted to become the world’s second-largest cruise market after the US by 2030, says Nicolas Thoreau, Allianz's regional marine-hull manager for Asia (Allianz 2017).

## 4. Research methodology

The goal of this thesis is to review published studies and analyse the use and the capabilities of ICTs in the Smart Maritime Ecosystem (independent variable), in optimizing cruiser's sailing experience and satisfaction (dependent variable). It aims to answer the questions: a) which are their functions of the latest digital innovations on board and ashore, b) in what way technology benefits the Smart Maritime Ecosystem and c) how technology is revolutionizing the cruiser's experience.

Given the exploratory nature of this assignment, since the topic lacks of literature and the use of ICTs in the cruise industry is dynamic, a multiple case study methodology was adopted. This qualitative conceptual research was conducted in natural settings and intends to develop variables that can possibly be used in future studies (Gummesson, 2000). Also, a cross-case examination (Yin, 2009) between CLIA's and HORWATH's reports was conducted, for identifying interconnections and differences regarding the upcoming trends and future in cruising, providing more compelling and robust outcomes (Gillham, 2000). An aspect not commonly presented in regular conceptual research is the fact the author had extensive professional experience in working on cruise ships, adding her empirical evidence of everyday operations and the crew member's point of view regarding interaction with ICTs on board.

For the completion of this dissertation, desk research was selected as the method of data collection to form the preliminary smart maritime ecosystem. The content analysis was conducted in two stages. Firstly, the "systematic literature review" approach was used (Siddaway, 2014). Secondary data, such as books, journals, articles, reports, press releases, and conference papers acquired from internet sources (Google Scholar, HEAL-Link, OECD i-Library, Elsevier, Science Direct, Research Gate, etc.) and social media (YouTube, Facebook, Instagram) were evaluated and carefully selected to assess the theoretical framework and to identify research patterns. This process has enabled the author to understand deeper the complex concept of the Smart Maritime Ecosystem and to end up with an integrated view of the subject. Due to the contemporary nature of the topic, internet reports, customers' reviews (via Cruise Critic) and interviews from members of the Board of Directors of the examined cruise organizations were used for

composing the developments in maritime information systems both on board and ashore, future trends, challenges, and limitations. For finding resources, the following search words and lots of combinations were used: “innovation”, “smartness”, “smart”, “Smart Tourism”, “Smart City”, “Smart Destination”, “Information and Communication Technologies”, “big data”, “Internet of things”, “value co-creation”, “Information and Communication Technologies” “ICTs in cruise industry”, “maritime ecosystem”, “smart ships” and “future trends in cruising”.

The second stage, was concentrated on an analysis of web presence for 13 cruise companies (table 4) with the emphasis on the Smart Ships: Regal Princess, Carnival Breeze, Norwegian Bliss, Disney Fantasy, Celebrity’s Solstice class ships, Costa Diadema, Seven Seas Explorer, MSC Seaside/Meraviglia/Divina, Queen Mary 2, Celebrity Edge and on Ocean Medallion class ships, Quantum-class ships, and Celebrity’s Solstice class ships.

<b>NAME OF THE COMPANY</b>	<b>OFFICIAL WEBSITE</b>
<b>Carnival Cruise Line</b>	<a href="https://www.carnival.com/">https://www.carnival.com/</a>
<b>Princess Cruises</b>	<a href="https://www.princess.com/">https://www.princess.com/</a>
<b>Holland America Line</b>	<a href="https://www.hollandamerica.com/en_US.html">https://www.hollandamerica.com/en_US.html</a>
<b>Costa Cruises</b>	<a href="https://www.costacruise.com/B2C/EU/Pages/Default.aspx">https://www.costacruise.com/B2C/EU/Pages/Default.aspx</a>
<b>AIDA Cruises</b>	<a href="https://www.aida.de/en/aida-cruises/company.19043.html">https://www.aida.de/en/aida-cruises/company.19043.html</a>
<b>Cunard Seabourn Ltd.</b>	<a href="https://www.cunard.co.uk/">https://www.cunard.co.uk/</a>
<b>Royal Caribbean International</b>	<a href="https://www.royalcaribbean.com">https://www.royalcaribbean.com</a>
<b>Celebrity Cruises</b>	<a href="https://www.celebritycruises.com/">https://www.celebritycruises.com/</a>
<b>Norwegian Cruise Line</b>	<a href="https://www.ncl.com/fr/en/">https://www.ncl.com/fr/en/</a>
<b>Regent Seven Seas Cruises</b>	<a href="https://www.rssc.com/ships/seven_seas_explorer">https://www.rssc.com/ships/seven_seas_explorer</a>
<b>Disney Cruise Line</b>	<a href="https://disneycruise.disney.go.com/">https://disneycruise.disney.go.com/</a>
<b>Crystal Cruises</b>	<a href="https://www.crystalcruises.com/">https://www.crystalcruises.com/</a>
<b>MSC Cruises</b>	<a href="https://www.msccruises.com/en-gl/Homepage.aspx?select=Greece">https://www.msccruises.com/en-gl/Homepage.aspx?select=Greece</a>

Table 4: The 13 cruise companies analysed in this thesis (Source: the author)

The quantity, the capabilities and the effectiveness of ICTs used by cruisers, companies, and stakeholders were examined in each website. In addition, an analysis of three leading organizations providing smart technologies for cruise companies, and of three years' annual reports (2012, 2017, 2018) from ALLIANZ, insurance company, was performed to examine the current services offered in the marketplace. The three major suppliers researched are:

- ✓ ACCENTURE, which provides a broad range of services and solutions in strategy, consulting, digital, technology, and operations
- ✓ WARTSILA, a global leader in smart technologies and complete lifecycle solutions for the marine and energy markets
- ✓ XEVO, which uses analytics and data insights to provide an AI-enhanced driving smart experiences for consumers

At the last part of the author's thesis, for a better understanding of cruiser's interaction and personalization with services on board, a future scenario is proposed. Based on CLIA's demographic results, one "persona", named Marina sails in a fictional autonomous ship (SOCOMO Lines), where she engages and interacts with all the above technologies.

The adopted methodology allowed the researcher to collect qualitative and exploratory information and present the results of this analysis in the following chapters.

## 5. Smart Cruising

### 5.1. Conceptualising the Smart Maritime Ecosystem

The maritime industry is a self-organized ecosystem. The various actors operate independently and competitively except for certain cases, when several actors need to jointly coordinate their actions (Watson & Boudreau, 2011), like a cruise ship berthing at a terminal to embark and disembark passengers. However, as individual units without the networks of route, usage and service data they rely upon, are virtually useless. The Smart Maritime Ecosystem, as stated by Mauro Sacchi, Director of Wartsila Marine Solutions, consists of everything that happens from port to port, where an intelligent vessel -which is just one element of the ecosystem- is technologically connected with smart-equipped ports and direct and indirect multi-stakeholders, while striving to optimise every process taking place in between them.

To achieve the digital ecosystem transformation, experts need to embrace digital reinvention and respond to the following current *4D's trends*, as presented by Accenture:

- Deliver and secure margin and time-to-market of complex shipbuilding programs.
- Drive down time and quality issues in design, manufacturing and in the supply chain.
- Drive innovation towards the creation of the connected ship and fleet.
- Develop new services to increase ship availability and effectiveness in operations.

In this multiplex Smart Maritime Ecosystem -formed in two levels-, digital technologies are implemented by several actors with different functions (figure 1). Principally, various innovative ICTs (object detection, IoT, satellite communications, Big Data, automation, robotics, AI, Cloud Computing and apps like AR, VR, etc.), collect and access data which are used on-board, mainly for optimization of cruiser's experience, and ashore for improving operations and asset management. Furthermore, a large amount of fragmented online data from numerous cruise forums, social network groups, cruise-portals and blogs are accumulated to the previous one (Papathanassis et al., 2012).



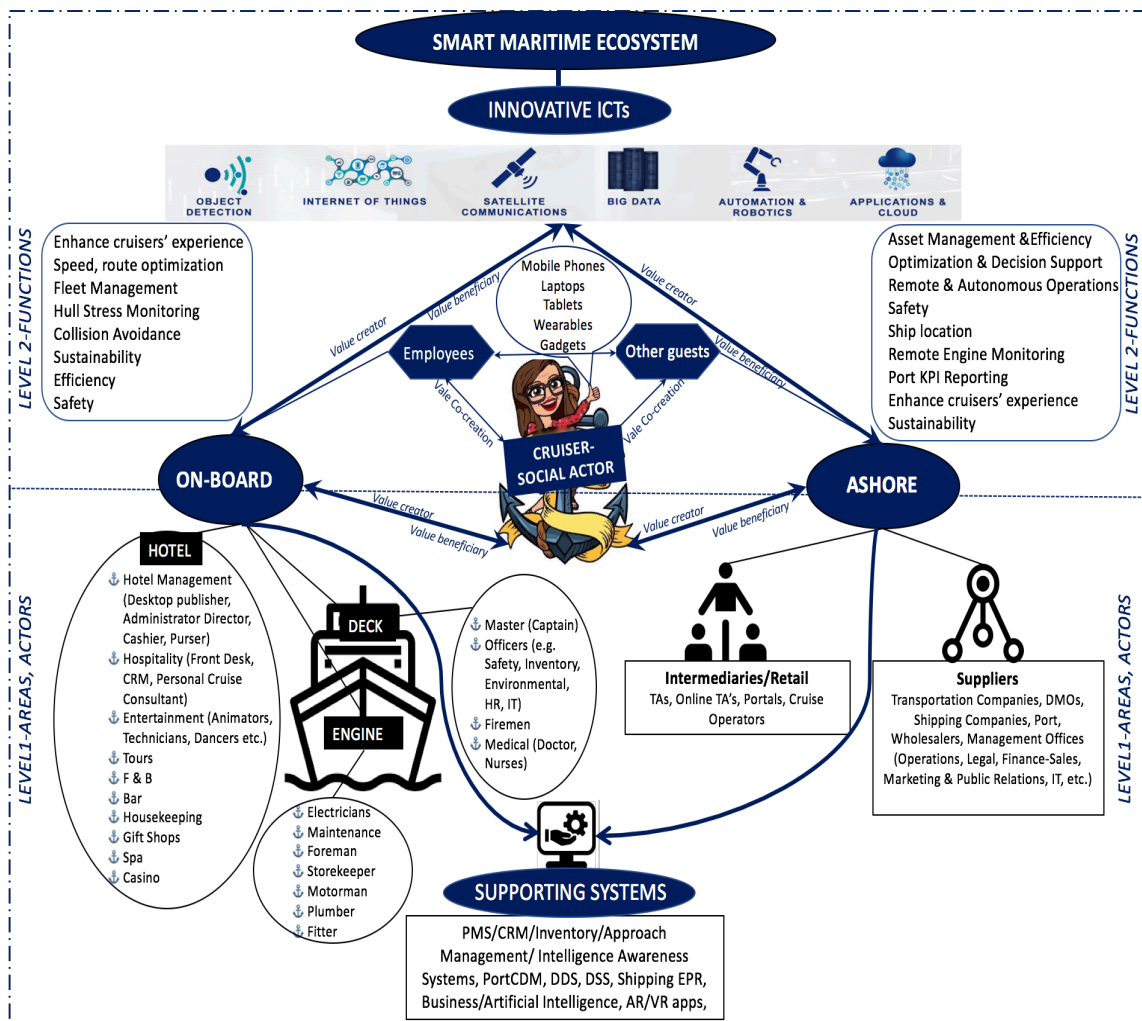


Figure 1: The Smart Maritime Ecosystem (Source: the author)

As the author previously emphasised the extensive power of the customer in a smart environment, as the Smart Maritime Ecosystem is cruiser-centric. Being in the middle of this era of technologies, the cruiser is described as a dynamic social actor who interacts with both hotel employees and other guests during his/her time aboard and ashore (check-in/out process, visits in different destinations, etc.), enabling co-creation and value exchange for all actors. Hence, the Smart Maritime Ecosystem can be defined by the author as “a cruiser-centric multiprocessing environment, where aboard and ashore communities, viewed from a holistic perspective and supported by interwoven digital systems, are coexisting harmoniously, collaborating productively, and are co-creating value for all holding a common mission; create an optimal operation profile in terms of efficiency, safety, sustainability and personalized guests’ experiences”.

To understand better this value chain and the whole process to create an optimal ecosystem, the author, based on Accenture's and Wartsila's reports in 2017, cites underneath the five capabilities smart technology offers.

- *Digital twin and digital thread.* Creating a “digital twin” of the ship design and a “digital thread” which contains all configured product and service information throughout the ship's lifecycle and across the ecosystem.
- *Big Data and analytics with intelligent systems,* such as an “always-on” surveillance solution for monitoring program effectiveness and a “control tower” for providing oversight of vessel performance at sea.
- *Mobility with immersive technology.* Virtual and augmented reality for assisting workers with training, build and maintenance procedures.
- *Intelligent automation.* Use of robots, cobots (collaborative robots), drones and underwater vehicle (AUVs) in the production and maintenance of ships, as well as in customer service.
- *Advanced manufacturing* in combination with IoT, data and analytics into an integrated production operation for the shipyard.

The above capabilities derived from using digital innovative technologies to the maritime sphere generate four major benefits: *Efficiency, Sustainability, Safety,* and *Personalized Guest Experiences.* Efficiency refers not only to operations based upon the minimisation of crew and natural resources, but on a larger scale than just one element. For instance, unlike the widespread perception that robotic machines will decrease human resources, it is fundamental to separate these two different types of resources, to invest in people and to run both at their optimal capacity. Therefore, humans and robots need to co-exist in a proper, positive and open manner in the future marketplace. Another example of efficiency, includes sea traffic management of “connected ports” using Data-Distribution Services (DDSs). In many ports, the necessary data are not shared as a Decision Support System (DSS) among the different actors, so coordination is poor (Wartsila 2017). To address that, the ad hoc full supply of an Automatic Identification System (AIS) platform for designing new digital services providing the raw data to investigate the potential value, and the synthesis of implementing innovations,

such as, green routing (the shortest safe distance), green steaming (the lowest operational speed to arrive on schedule) and the PortCDM concept (Port Collaborative Decision Making) is vital (Lind et al., 2017). Furthermore, efficiency addresses the fleet management of “connected ships” in terms of ship capacity and energy consumption. Occasionally, ships are optimally loaded and utilised, due to unduly ships’ delays or to huge volume of vessel traffic. Thus, operation improvements such as, electric engines and new lighting and air lubrication systems make better use of ship energy. The results of using these technologies include increased asset utilisation, cost reduction and optimization of energy, productivity and operations.

The future of the maritime complex is seen to be also directed by sustainability- the second benefit- and its 3R principles: Reduce, Reuse and Recycle (TravelPulse 2016). Sustainability contains the reduction of marine litter, waste and pollution, the reuse of energy sources and international regulations, and the recycling of materials and production residues. At the time that sustainability awareness is rising among the stakeholders and passengers, the demand for training and education is also growing from cruise ship operators and companies. In this research, all the three supplier companies examined are proved to have the same goal; a future maritime ecosystem with carbon-free emissions and with the least or none possible impact on the environment (Accenture & Wartsila 2017; Xevo 2018). As sustainability comprises not only environmental, but also a social and a financial aspect, together with digitalisation can make possible for stakeholders to maintain, strengthen or, otherwise, lose their current position. To conclude, it is an opportunity to begin reflections on whether and how some newcomers to the market can take the place to the incumbent players.

The third significant advantage is the ameliorated safety in operations. Intelligent ships have systems which assist in preventive maintenance, risk management, accident prevention, and ensure the best possible service (figure 2). A predictive maintenance strategy is based on principles relating to different ship systems, 3D printing of parts in build and product models that contain complete detailed information (Meriteollisuus Finnish Marine Industries 2016), like the history of the vessel, the actual usage, its current sailing schedules, spare parts inventory levels, Voyage Data Recorder (VDR)

data, etc. (Van Dijk et al., 2018). The results of VDR analysis can be used to identify and span the gap (Allianz 2017), even in between the crew's and company's relationship problems. Smart cruise ships contain, also, the latest GPS technology available for both employees and cruisers (wearables, gadgets) to ensure their safety on board.

Ultimately, digital technologies enhance personalized guest experiences. Ideally, in an excellent service quality experience, there would be no delay or other issues whatsoever at the point of embarkation or at the destination. For this reason, from guest's viewpoint, service innovation technologies like facial recognition, artificial intelligence - which escalates to machine-to-machine interoperation, further that the human-machine interaction (Buhalis & Leung, 2018)- and VR applications with virtual walk-throughs of the entire ship or destinations, offer them memorable experiences. Furthermore, augmented reality apps integrated with wearable technology, can position never-before travel deliveries in areas of seamless navigation and information on-the-go with AR aggregators, phone apps and more. From company's perspective, for transforming guests' experiences, real-time data collection and business intelligence (BI) are used to analyse the revenue-generating performance of the various venues and guests' attitudes (Accenture 2017). For instance, in Holland America Line, more business users are empowered to mine data, by using Microsoft Business Intelligence tools. This solution leads to data-based decision-making which increases revenues and improves guests' experiences. More specifically, *"as ships travel between ports and guests change, our company can segment them by demographic, analyse behaviour patterns by passenger groups and dynamically adjust offerings and programs to better reflect cruisers' preferences"*, says Seth Brickman, Director, on-board Revenue and Analytics of Holland America Line.

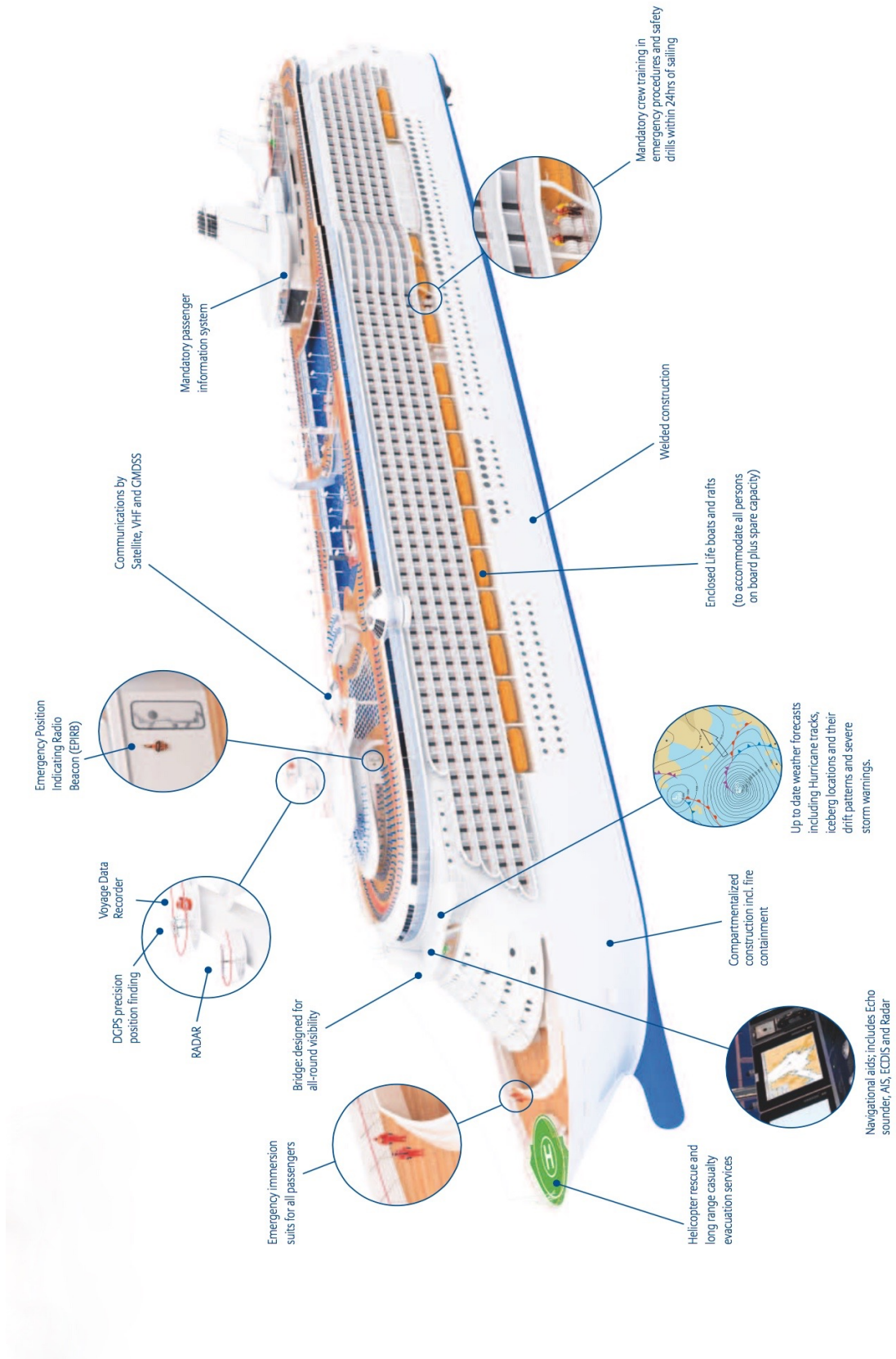


Figure 2: Safety innovations on board (Source: Allianz 2012)

## 5.2. Smart Cruise Ships

The concept of the Smart Cruise Ship provides a constant digital insight into the physical status of a vessel and it is made up of multiple layers such as, the product hardware itself, the embedded software, connectivity, the product cloud with software services, security tools, and end-to-end integration with existing enterprise systems (Uhlemann et al., 2017). Smart cruise ships are consisted of four main features, which are converted into commands for the various hardware positioning systems on the ship, as set out below (Van Dijk et al., 2018). The primary driver of technological innovation -reported by Papathanassis (2017) after comparing a mega-ship with a smart ship- is for enhancing customer's holiday experience and not for the human-related cost-reduction.

- ✓ *Navigation*: The navigation subsystem receives data from various sensors on the ship, which are combined with a Situation Awareness (SA) and a software-based system to create and assess an image of the real world.
- ✓ *Guidance*: This image is used by the guidance subsystem to chart the ship's path.
- ✓ *Physical ship*: Additional hardware for data collection is needed to support the software-based decision-making system.
- ✓ *Control*: The control subsystem or, otherwise, the motion controller is what steers the ship in the right direction.

Upon recalling the last five years, from the author's professional experience on board, smart TVs, interactive displays and mobile devices could be found on cruise ships, although guests' interactions with them weren't necessarily noticeable to others and crew members' training was poor. Slowly but surely, cruise lines have created a culture of innovations by using the most up to date technology aboard, always in the light of the cruiser's preferences, needs and demands. The basic challenge regarding the cruise ships transformation is to convince their guests to engage with the new technologies and be fearless to share and communicate their experience during and after their vacation. As a result, cruise businesses will gain market recognition and exceed passengers' expectations, offering distinctive and high quality-related products, services and experiences.

### 5.2.1. Digital Innovations On-board

At the dawn of the Ship Intelligence era, technology is transforming the floating hotels-cruise ships into smart cities-smart ships, claims Michael Bayley, President and CEO of RCI. To get a sense of the current technologies that change radically the cruise industry, in this chapter the author has tried to aggregate all the present digital innovations on-board -divided by holding companies- and to examine cruisers' interaction and integration in their new community (table 5).

#### CARNIVAL CORPORATION & PLC

COMPANIES	INNOVATIONS
Carnival Cruise Line	<ol style="list-style-type: none"> <li>1. EA Sports Bar using iPads</li> <li>2. IMAX cinema</li> <li>3. The Thrill 5D Theatre</li> <li>4. Crew Compass</li> </ol>
Princess Cruises (Regal Princess and Ocean Medallion Class ships)	<ol style="list-style-type: none"> <li>1. MedallionNet, Wi-Fi connection at sea</li> <li>2. <i>Ocean Medallion</i></li> <li>3. <i>Ocean Compass</i>: a schedule of on board activities</li> <li>4. <i>Ocean Ready</i> to submit travel documents and go paper free</li> <li>5. <i>Play Ocean</i>: mobile video games that can be played on or off the ship</li> <li>6. <i>Ocean Now</i>: for personalized guest service on demand</li> <li>7. <i>Ocean Concierge</i>: for purchase shore excursions, view stateroom account and all activities offered on board</li> <li>8. <i>Ocean View</i>: app offering more than 100 acclaimed "Ocean Original" episodes with compelling experiential travel content</li> <li>9. <i>Ocean Casino app</i></li> <li>10. <i>Seawalk</i>, an over-ocean walkway</li> </ol>
Holland America Line	<ol style="list-style-type: none"> <li>1. Microsoft business intelligence (BI) software</li> <li>2. Oracle BI software</li> </ol>
Costa and AIDA Cruises	<ol style="list-style-type: none"> <li>1. "<i>Pepper</i>": the first robot which recognizes human emotions and interact with the surrounding environment</li> <li>2. 4GOODFOOD for reducing food waste (only in Costa)</li> </ol>
Cunard Seabourn Ltd (Queen Mary 2 ship)	<ol style="list-style-type: none"> <li>1. 11-bed hospital with an x-ray machine and lab</li> <li>2. Reverse osmosis to make sea water drinkable</li> <li>3. Planetarium</li> <li>4. Cunard ConneXions, educational and entertainment programme of activities all day every day via computer</li> </ol>

#### GENTING GROUP

COMPANIES	INNOVATIONS
Crystal Cruises	<ol style="list-style-type: none"> <li>1. In-room tablets</li> <li>2. Mobile app</li> </ol>

**ROYAL CARIBBEAN CRUISES LTD.**

<b>COMPANIES</b>	<b>INNOVATIONS</b>
<p>Royal Caribbean International (Quantum class ships)</p>	<ol style="list-style-type: none"> <li>1. <i>iQ app</i> which integrates customers' on board experience with the <i>Cruise Planner app</i>, a tool that helps you pre-plan your vacation</li> <li>2. <i>VOOM</i>, Wi-Fi connection at sea</li> <li>3. GPS mapping and Bluetooth for navigation on-board</li> <li>4. Facial recognition technology</li> <li>5. <i>Excalibur app</i></li> <li>6. <i>Sea Beyond app</i> to help customers prioritize their activity choices</li> <li>7. <i>WOW</i> electronic bracelets using RFID technology</li> <li>8. <i>Star Trek</i>-looking digital boards for monitoring the engine</li> <li>9. AR for steering the ship in low visibility</li> <li>10. Air lubrication system for fuel savings</li> <li>11. Virtual balconies using HD LED screens</li> <li>12. <i>FlowRider</i>, surf simulators</li> <li>13. <i>RipCord</i>, virtual skydiving simulators</li> <li>14. <i>Sky Pad</i>, VR bungee trampoline</li> <li>15. The <i>North Star</i>, a glass-enclosed pod with 360°-degree view</li> <li>16. The <i>Ultimate Abyss</i>, waterslide</li> <li>17. <i>Laser tag battle for planet Z</i></li> <li>18. Bionic Bar with two robotic bartenders</li> <li>19. <i>Rising Tide Bar</i>, which goes up and down between decks</li> <li>20. VR Dining</li> <li>21. Rock climbing walls</li> <li>22. VR mini-golf</li> <li>23. Real-grass parks</li> <li>24. <i>X-ray vision app</i></li> <li>25. The <i>Wayfinder</i> interactive LCD touch-screen using RealMotion technology</li> <li>26. <i>GoBe interactive platform</i> offering Virtual shore excursions, tours and lots of activities worldwide</li> <li>27. <i>Two70</i>, digitally transformable public venues using roboscreens</li> <li>28. IMAX cinema</li> <li>29. Suite Club accommodations</li> <li>30. <i>ARKit and ARCore</i> games to make better use of ship space.</li> </ol>
<p>Celebrity Cruises</p>	<ol style="list-style-type: none"> <li>1. Interactive Menus on iPads (<i>Qsine restaurant</i>)</li> <li>2. Luxury "<i>Smart Glass</i>" Shower, using electro chromatic tech</li> <li>3. <i>Edge Sky Suites/Villas</i></li> <li>4. <i>Edge Access Tour app</i>, a behind-the-scenes 3-D tour using AR</li> <li>5. <i>Eden space</i>, a multi-purpose space whose design is based on a mathematics equation</li> <li>6. <i>Magic Carpet</i>, a floating platform which changes mood, function, and even its location</li> </ol>



### NORWEGIAN CRUISE LINE HOLDINGS

COMPANIES	INNOVATIONS
Norwegian Cruise Line	<ol style="list-style-type: none"> <li>1. App which allow passengers to check in before their embarkation or to make purchases</li> <li>2. Virtual game with virtual ocean views (in widow-sized for interior rooms)</li> <li>3. Go-kart tracks</li> <li>4. Rock climbing walls</li> <li>5. Virtual mini-golf, water slides and water parks, real-grass parks,</li> <li>6. <i>Norwegian's Freestyle Concept</i> for personalised dining experiences</li> <li>7. Interactive digital signage on board</li> <li>8. <i>Epic app</i>, an iConcierge for connecting guests and crew</li> <li>9. Interactive touchscreens for navigating and booking activities</li> <li>10. Facial recognition for matching guests to photos captured on board</li> </ol>
Regent Seven Seas Cruises	<ol style="list-style-type: none"> <li>1. Digital backdrops in lieu of elaborate sets</li> <li>2. Cooking classes with state-of-the-art show kitchens creating intriguing classes for wannabe food wizards</li> <li>3. <i>CRM</i> system to track and record guest preferences</li> </ol>

### THE WALT DISNEY COMPANY

COMPANIES	INNOVATIONS
Disney Cruise Line	<ol style="list-style-type: none"> <li>1. <i>Magical Porthole</i>, virtual window, showing Disney animated characters together with live ocean view</li> <li>2. The <i>Animation Magic Show</i> (Animator's Palate restaurant)</li> <li>3. <i>MyMagic+ technology project</i></li> <li>4. <i>MagicBand</i> bracelets to connect cabin keys, payments and PhotoPass information using RFID, Bluetooth Low Energy (BLE), and Near-Field Communication (NFC) technologies</li> <li>5. <i>MagicBand No. 2</i> for additional interactivity</li> <li>6. <i>Magic PlayFloor</i>, an interactive floor which blends the latest in gaming technology with Disney-style storytelling</li> <li>7. <i>MyDisneyExperience app</i></li> <li>8. Two phones for free in each stateroom for internal communication</li> <li>9. Skyline Bar, with virtual windows on the bar's walls recreate realistic skyline views of the world's capitals</li> </ol>

**MEDITERRANIAN SHIPPING COMPANY**

COMPANIES	INNOVATIONS
MSC Cruises	<ol style="list-style-type: none"> <li>1. MSC for Me app with 130 different technological functions</li> <li>2. MSC for Me bracelets</li> <li>3. MSC for Me touchpoints</li> <li>4. The longest zipline at sea (around 105m) which soars 20 stories above sea level</li> <li>5. RFID bracelets</li> <li>6. Waterproof wristband as ID</li> <li>7. Beach condo design with a 360° outdoor promenade, two glass-floor catwalks and glass elevators with a panoramic ocean</li> <li>8. Reverse osmosis system for fresh water production using 40% less power</li> <li>9. 114 interactive screens (MSC Meraviglia) for booking several activities on-board</li> <li>10. Interactive maps to guide guests around the ship</li> <li>11. For children: interactive game shows, touch screens and 3D printers</li> </ol>

*Table 5: Current digital innovation on board of Smart cruise ships (Source: the author)*

The first step in technological advancements can be traced to the Great Wolf Lodge’s indoor water park resorts in 2005, where smart wristbands were used for electronic access control and cashless payments (Digitaltrends 2017). Based on this conceptual research, the author recognizes a pattern in cruise industry; a continuous tech-competition between cruise companies with a common goal; providing a technology ecosystem that can empower ideation through the prototyping, increasing guest’s engagement and changing the perception of the guest experience. This technological transformation encompasses areas like ship management, hospitality service, entertainment, and overall cruiser’s experience.

Regarding the first area, the innovations include AR that assists navigation and manoeuvring under extreme ambient conditions, as well as energy savings and waste management from a holistic approach. As an example, Richard Fain, Chairman and CEO of RCC, mention the importance of weather mitigation in *upholding scheduled arrivals and departures to itineraries*. The newest ships are also more environmentally friendly considering the vessel’s energy consumption than the previous one. For instance, “Harmony of the Seas” ship, has all lighting provided by low-energy LED or fluorescents and motion sensors. Moreover, Royal Caribbean reduces the company's environmental

footprint by using alternative energy sources like solar panels, and by introducing a new air lubrication system that coats ship hulls with millions of microscopic air bubbles, cutting down fuel consumption at speed by 7%-8%. Other ships, like “Queen Mary 2” and “MSC Divina” use reverse osmosis to make sea water drinkable and, further, COSTA ships try to reduce food waste by “4GOODFOOD program” or by imposing a penalty payment for buffet guests, who consume excessive food and leave it in their plates!

For excellent quality service on board, both leading companies (Royal Caribbean and Carnival Corporation) aim to give the passengers back the first day of their vacation, the time wasted in lines, waiting for bags to arrive, or for ordering food and for booking activities, which per Jay Schneider, Senior vice president of digital of RCL, *“it is time stolen from their time off, wasted effort and wasted energy”*. Using Royal Caribbean’s WOW Band electronic bracelets, facial recognition technology and smartphone apps (Excalibur, Sea Beyond and so on) guests can streamline the embarkation process, follow the progress of their luggage, open automatically their cabin doors, adjust lighting and temperature in their cabin, as well as sign up for shore excursions, organize dinner reservations, make purchases, geo-locate their children and even order drinks and have them delivered wherever they may be! Likewise, launched on November 2017 by Princess Cruises, Ocean Medallion, the first-of-its-kind wearable device, which can be worn in a variety of ways (as a wristband, pendant, clip, or even be tossed in a pocket or purse), is the “key” to opening a world of possibilities in every moment before, during and after guests’ vacation. Before starting cruising, the company ships it at customers’ home for free, or for extra personalization with an additional cost<sup>9</sup> the guests can customize their ocean-themed Tagalong avatar with accessories and stickers. According to John Padgett, Chief Experience Innovation Officer of Carnival Corporation, Ocean Medallion is *“an experience IoT platform with an orchestrated multi-sensor experience ecosystem”*. Beyond its ability to be used with the same way as WOW Band, the Ocean Medallion ecosystem embraces also artificial intelligence that tracks guests with every interaction and evolves in real-time to offer suggestions for cruisers based on their

---

<sup>9</sup> Franke and Schreier (2010), find that customers are willing to pay more for self-designed products, which add higher value than standardised products.

location, time of day, and activities occurring at that time. The idea of Ocean Medallion comes from the same person, Padgett, who launched the MagicBand, *“a wearable before wearables were a thing”*, four years ago, in the interests of Disney Cruise Lines. Moreover, the newest MSC cruise ships in collaboration with Deloitte Digital, Hewlett Packard Enterprise and Samsung provide tailor-made services through *“MSC for Me”*, an app with 130 different technological functions. Lastly, Norwegian Cruise Line offers an app which allows passengers to check in before their embarkation or make purchases. The app provides the option of going paperless on-board, but doesn't change the embarkation process, like the one in the Carnival or the Royal Caribbean versions.

Entertainment on cruise ships has become big business as cruise lines have become more and more competitive in their bid to provide the most e-technology based entertaining experiences at sea. Royal Caribbean which was the first company to put a rock climbing wall, an ice skating rink and so on, is now focusing on experiences and on finding whimsical ways to surprise cruisers; *“our vision is to make the guest experience hassle-free, personalized and fun”* said Schneider. This new trend continued with water parks, surfing and skydiving simulators, the North Star, roboscreens-video entertainment, digitally transformable public venues, and IMAX cinema, with six robotic moving screens, while projecting images onto ultra-HD screens (like the *“Wayfinder”* interactive LCD touch-screen). Entertaining elements include also the X-ray vision apps which give the ability to cruisers to *“see”* through certain walls interesting places, like the galley, as well as Bionic Bars with robots, instead of bartenders, and Virtual dining. For the last one, RCC claims to be the first offering this option at sea, although earlier in 2012 Norwegian Cruise Line introduced the Freestyle Concept for personalised dining experiences, a term which has been mimicked by other cruise lines. Both Carnival and Norwegian follow, also, Royal's example offering VR and AR experiences that transform ship spaces into virtual environments and active games, or interactive HD screens in public areas. Lastly, tech partners, like Xevo, with live performers create shows that take onboard entertainment to new heights.

High-tech cruise apps are another way for vessels to enhance the passenger experience by supporting experiential travel, as a growing source of ancillary revenue. Cruisers are

spending more on shore excursions, high-speed internet access and by joining in the preceding tech-entertaining experiences. Padgett of CCL, explains that technology disappears into the customer experience and can act either as an enabler, or as a disruptor depending on how it is used. Holding to his convictions, Carnival's mission is to deliver whole new levels of differentiating personalization by using distributed intelligence in combination with smart sensors worn by passengers. Carnival's interactive customer experience, named "ICX" (I for the interaction, C for the consumer and X for any band or pass technology) begins for each guest at the moment a trip is booked and ends upon guest's disembarkation. In collaboration with Accenture, a new app capability -including streaming analytics, contextual awareness and machine learning- provides in each guest his/her own personal digital concierge that can customize his/her experiences, based on his/her individual preferences. From the cruiser's service side, once on board, customer-service Bots (Sheffield, 2016), like Pepper, provide useful information for the cruise trip and, also, ask guests for evaluating their on board and ashore experience. Nevertheless, there is a long way for future tech developments regarding robot-human interaction (Buhalis & Leung, 2018). Inside their cabins, guests can find cabins with interactive Virtual balconies<sup>10</sup> or Virtual windows, even with animated characters (Disney Cruise Line)! On the contrary, cruiser's interaction with external information, such as weather conditions can improve the value co-created (Buhalis & Leung, 2018) and affect even in an indirect way the tourist overall satisfaction (Jin et al., 2014). But the technology goes beyond, connecting also each ship with its guests and crew members in an effective way. Crew members are empowered to respond to and even anticipate each guest's preferences delivering a high-level quality experience, by incorporating the crew interface component -the Crew Compass app- with the guest-experience design. Additionally, the same technology enables officers to track people during muster drills or during an emergency. In an advanced state of upgrading, Royal Caribbean Cruises offers the possibility for crew members to stay connected to family and friends while on board, which from the author's personal experience it is extremely important for crew members' psychological well-being.

---

<sup>10</sup> 80-inches high-definition LED screens, which show real-time video of the outside the ship, having also the option for volume adjustment

### 5.3. Technological catalysts that bring Smartness forward

Before, discussing the technological miracles in the foreseeable future, it is worth to mention that this year fourteen cruise companies are going to launch eighteen new ships on their maiden voyage, using the latest technological innovations (figure 3). The paradox is that the Royal Caribbean's new smart cruise-vessel generation will be smaller than its antecedents. According to Papathanassis (2017), this may give a sign to a new trend towards smaller, but smarter cruise ships.

<b>NEW SHIPS DEBUTING IN 2019</b>	
<b>CLIA Ocean Member Cruise Lines Represented</b>	
<b>CRUISE LINE</b>	<b>SHIP NAME</b>
Aurora Expeditions	Greg Mortimer
Carnival Cruise Line	Carnival Panorama
Celebrity Cruises	Celebrity Flora
Costa Cruises	Venezia   Smeralda
Coral Expeditions	Coral Adventurer
Hapag-Lloyd	Hanseatic Nature   Hanseatic Inspiration
MSC Cruises	MSC Grandiosa   MSC Bellissima
Norwegian Cruise Line	Norwegian Encore
PONANT Yacht Cruises and Expeditions	Le Dumont-d'Urville   Le Bougainville
Princess Cruises	Sky Princess
Royal Caribbean International	Spectrum of the Seas
Scenic Luxury Cruises and Tours	Scenic Eclipse
Saga Cruises	Spirit of Discovery
TUI Cruises	Mein Schiff 2

Figure 2: List with new ships debuting in 2019 (Source: CLIA 2018)

In 2017, RCC held the experiential event "Sea Beyond", where technological examples which are driving change across the fleet were showcased. A virtual aquarium, as depicted in figure 4, where technology and environment are combined harmoniously was exposed.



Figure 3: A view of a virtual aquarium (Source: Fastcompany 2017, photo taken by Diane Bondareff)

Furthermore, the space-age stateroom of the future was presented. The stateroom, by turning walls into nature via digital installations, overcomes a common challenge of cruise cabin spaces with NASA's spaceships; the lack of an environment, visually speaking (figure 5).



Figure 4: The future RCC stateroom (Source: Fastcompany 2017)

Royal's competitor, Luca Pronzati, Chief Innovation Officer of MSC Cruises, introduces the intelligent device "Zoe", the first digital cruise personal, which will be available 24/7 to address cruise passengers' needs and give information inside each cabin (figure 6). "Zoe" will be launched firstly on board of "MSC Bellissima" on March 2019, but the company plans to expand its use in more vessels.



Figure 5: "Zoe" device (Source: Team GTP 2018)

The latest technological evolution concerns Rolls-Royce's project in partnership with Google Cloud to make a remotely-operated local vessel a reality by 2020, and fully autonomous unmanned ocean-going ships by 2035 (Rolls-Royce 2017). The vessels "virtual captain" will operate in an ecosystem, where decision-making is based on data, smart algorithms, artificial intelligence, drones, and ultimate optimisation. The next years, remote controlled and autonomous ships, using Intelligent Awareness (IA)

systems will reduce the risk of injury -even death amongst the ship's crews and guests-, and the potential loss or damage of valuable assets (Rolls-Royce 2018). Because of the removal of human-related facilities and the use of 15% less fuel, it is forecast that cruise companies will save around 2,600-3,500<sup>11</sup> euros per day! The benefits of autonomous shipping to support timely, safe<sup>12</sup>, environment-friendly and cost-efficient sailing are well recognized in the shipping industry (Van Dijk et al., 2018), however, there are still many legal and regulatory issues that need to be resolved (Allianz 2017).

Last but not least, to examine the technological innovations also in the marketing and management department, the author obtained inside information by contacting via e-mail the Senior Manager of Regent Seven Seas Cruises, Nicolas Gregori. The abovementioned claims that the use of digital innovations within the on board experience is limited, as the company invests in crew-cruisers personal interaction with the aim of providing "a very personal experience" to its guests. The pivotal technology used on board is a robust Customer Relationship Management system (CRM) to track and record guest preferences for current and future usage to anticipate guests' needs where possible. On the contrary, for business functions ashore, in Regent Seven Seas Cruises there is extensive use of the following, which indicate the future in marketing:

- machine learning algorithms and data modelling to:
  - drive new-to-brand traffic to company's website (e.g., via programmatic advertising)
  - increase the conversion rate of existing customers, by serving dynamic content based on web-user behaviour
  - identify new segments in company's database with high propensities for conversion
  - optimise email marketing performance (e.g., with the use of machine learning to split test and optimise the content of marketing emails)
- VR to showcase ship hardware at trade shows
- Geo-location and behaviour based digital advertising to generate sales leads

---

<sup>11</sup> Converted from USD 3,000-4,000 in the original text (Allianz 2017) as 1USD = 0.876410€

<sup>12</sup> Based on Allianz reports (2012, 2017,2018), 75%-96% of marine accidents occur due to human error!



## 5.4. Redefine the cruise experience

The empowered cruisers and numerous generated technologies redefine the cruise experience, as a combination of “*experiences, co-creation and technology*” (Neuhofer et al., 2015). For a deeper understanding of this change, and as going on a cruise for interact with all the preceding technologies could be unaffordable for most the readers, the author decided to create a “Smart Cruising Scenario” on board. This seven days’ hypothesis describes a potential way in which a cruiser can interact with all the smart technology innovations on SOCOMO Lines (an autonomous ship with its virtual captain), co-creating value for himself/herself and other consumers or employees in all stages of his/her cruise (pre-during-after). Meanwhile, it gives an idea of how ICTs could be used strategically by all cruise stakeholders based on internal and external contextual data, achieving a highly personalised experience, an increasing level of consumption and ultimately their brand loyalty. Although this scenario might seem to be set in the future, the transformational role of ICTs in the travel industry has already been examined and the concept of the autonomous ship is not far away. All things considered, most of the companies are willing to expand their apps in the future adding extra features and to become smarter, safer, and with less environmental footprint.

### 5.4.1. A Smart Cruising Scenario - A week on board with Marina

Building the scenario upon the outcome of the demographic characteristics reported by CLIA (2018)<sup>13</sup>, the author created her persona, named Marina, 30 years old female cruiser (Generation Y or Millennials) from Miami, Florida, who is starting a 7-day cruise with her spouse in a loop itinerary<sup>14</sup> towards Western Caribbean (Miami-At sea-Mexico-Honduras-Grand Cayman-At sea-Miami). Marina is a “fashion icon” obsessed with collecting necklaces from all around the world. She adores the red colour and she, also,

---

<sup>13</sup> According to CLIA (2018), 62% of cruise travelers with income between €131K-€175K, come from the U.S., 17% from Florida, followed by California (11%), Texas (9%), New York (6%), and Georgia (4%). They prefer travelling with their spouse (78%) mostly to the Caribbean/Bahamas/Mexico, including Florida (86%), requesting adventure travel (61%). Millennials prefer luxury or premium cruises and are expected to raise the sales and embrace cruise travel more than ever before.

<sup>14</sup> Loop itineraries have the same embarkation and disembarkation port (Wang et al., 2016).

enjoys international cuisine, although she had an athletic figure. A week ago, Marina received a package at her home with two SOCOMO wearables (one red necklace for her and one bracelet for her husband). She has registered her personal data, food and beverages preferences (she is allergic in nuts and she loves Pina Colada-cocktail), preferable athletic activities ashore (scuba diving, climbing and golf), and her favourite Latin music and horror movies. The above information is now distributed in the cloud and it is accessible only from crew members of SOCOMO Lines. From her social media profiles -she uses mostly Instagram<sup>15</sup>- employees also know that Marina is a cultural traveller who prefers transformational experiences in a conscious, mindful way. At this point, it becomes critical to take also into consideration that Marina is a tech-savvy Millennial woman, curious to explore the digital and the real world on board and ashore respectively. In the end, the Socomo applications gather certain types of contextual information that might affect Marina's tourist behaviour during her cruise.

*First day, Miami:* Marina arrives at the cruise terminal and skips all check-in lines by flashing her mobile at the security scanner and smiling at the facial-recognition camera. A 3D map of the ship guides her to her stateroom, and the Socomo necklace that she wears automatically opens the door, where she finds her favourite Pina Colada, as a “welcome drink” and a personalised message with her name on the screen of her HD Smart TV. Inside her interior cabin, she gazes out the virtual balcony at a real-time image of the sunny Miami’s port. Looking down, there is no carpet, but an artificial-reality glass floor watching the foaming ocean. She is now worried about her luggage, so using the app1, she tracks her bags and feels released. Meanwhile, her husband is sweating; Marina adjusts the temperature of her room and the LED lightning with her necklace, which is synchronised with the TV and her mobile app2 via Bluetooth, for a more romantic atmosphere. While they are enjoying their moment, the app3 informs them that it is dinner time (today they can choose between Chinese or Italian cuisine on deck 5 or 10 respectively), so they are going upstairs. The same app3 is alerting her for nut-free recipes, as well as for dietary and health restrictions to keep in shape. After eating,

---

<sup>15</sup> On Instagram, there can be 351 million posts per day with the hashtag #travel (CLIA 2018)

Marina checks on displays in real-time the entertainment program and the tomorrow's activities, but she decides to go to bed looking at the stars on her VR ceiling.

*Second day, At sea:* Today, Marina is lying on the open pool and she feels thirsty. She makes her order with the Socomo app<sup>4</sup>, which uses GPS location tracker, and after 10' her drink is delivered to her by a robot! Sensors in Marina's mobile phone, which directly interact with the social media context-based application, spotted that in an hour is going to rain. She feels dissatisfied with the weather, but at the same moment, she receives at her phone the following message:

*"Hello again, Marina! As it is going to rain soon, perhaps you might want to spend a little time on culinary workshops hosted by Le Cordon Bleu Chefs today, at 18:00, at Ferranti's restaurant.*

*Click here if you want to book your place now and you will have a 10% discount. Just a suggestion! Wish you the best for the rest of your holidays with us!"*

In that case, her Socomo wearable -which works in concert with her mobile software- has combined her preferences in recreational experiences with the external environment and the real-time activities on-board, and made this specific recommendation. Marina goes to the workshop and returns to her cabin very satisfied.

*Third day, Mexico:* Because of features cookies placed on her device which saved her participation on the culinary workshop yesterday, Marina receives the notification for visiting on an excursion another experiential activity, a vastness Mexican beer brewery with Latin music and authentic tacos. She is happy with this option; she visits this place and she notices that the popular singer Shakira is also there, as they have both checked-in on Facebook! She documents their meeting on Instagram and on a review website, which impresses her friends and others who consider the beer brewery for their future travel plans. For dinner, she experiences Greek VR diving, wearing a high-tech headset over her eyes and ears. The experience began walking down next to Acropolis, when she drinks virtually and in real world her first ouzo aperitif. Then, she transports to a virtual traditional restaurant, where she sees herself dancing, cooking and making "tzatziki" sauce together with the Greek residents and at the same time she consumes it!

*Fourth day, Honduras:* In the morning, Marina uses a digital display located at the middle of the ship for organizing a special dining experience to celebrate her wedding anniversary; she does not only create a unique menu “only for two”, but also chooses a moveable place for their table with digitally transformable roboscreens, which recreate realistic skyline views of the world's capitals. Later on, before arriving in Honduras, she connects to i-concierge app<sup>5</sup>- which provides details of all the upcoming ports of call- asking for advice ashore. She completes the interactive platform and an exhilarating jungle zip line experience, high on a mountainside on the west of the Island is offered for her. As she loves climbing, she finds this option ideal and she leaves the ship. During her visit, she posts on Social Media real-time pictures about her experience which she tags, generating live content. When she returns on board, she joins the Socomo’s bionic bar with robots for bartenders, where she is creating the recipe of her own-named cocktail, while she is sharing her experience on a live video on Facebook.

*Fifth day, Grand Cayman:* From usage patterns saved in her mobile phone data, the app<sup>6</sup> knows that Marina enjoys scuba diving and other athletic activities, as she frequently checks-in at various athletic centres. This contextual information is sent to the Grand Cayman’s destination marketing organisation (DMO), who is now able to design and deliver real-time marketing message focused on her preferences, using the location-based and proximity-awareness system. A scuba-diving and a snorkelling experience in the world’s best diving sites at “Eden Rock” or “Devil’s Grotto” diving centre are offered to Marina, as well as vouchers for a free Coco-Loco cocktail (similar to her favourite) at the famous “Vicky’s bar”. At night, back on the ship, she decides to go to IMAX Cinema. She enjoys this innovative experience, but not the variety of films. Hence, she returns to her cabin to watch her favourite horror series on Netflix.

*Sixth day, At sea:* Today Marina chooses to visit the Spa area, where 3D art walls represent the colours and movement of the ocean. Spa therapists, who share with her the common app<sup>7</sup>, already know her passion with eco-friendly products. Upon her arrival, they promote her a naturally made face cream in a biodegradable package. Marina seems enthusiastic and makes the purchase. After her beauty treatment, she receives on her phone an invitation for participating in an online gamification process for

creating her own outfit. By combining products from the e-commerce Socomo website and then implementing virtual apps, she designs and receives through a 3D printer her own personalized T-shirt. Marina is feeling like the originator of her T-shirt and same while proud of her co-created accomplishment. This concept is defined by Franke, Schreier and Kaiser (2010, p. 125) as the “*I designed it myself effect*”. Since she spent more time than planned there, her husband is worried. Thus, they are texting using the free app<sup>8</sup> and they arrange a meeting at the 5D theatre. Marina loses her orientation, but she, finally, finds her spouse using the geo-location app<sup>9</sup>. After that, she finds a message on her smartphone with the “last day promotions” and she decides to join the skydiving simulator and the VR bungee trampoline.

*Seventh day, Miami:* Her last day, Marina goes to buy her photos captured on board, using her Socomo necklace for last time. There, the app<sup>10</sup> scans her face and in 30” matches and finds her personal photos between thousands. Before her disembarkation, “Soco-robot” is asking for feedback of her overall experience and is waving goodbye. She jumps on the Socomo autonomous shuttle bus and she arrives at Miami’s port terminal.

Returning home, Marina is completely delighted by her cruise experience. She shares online more context (photos, videos, updates) with her friends and creates proactive and reactive itineraries, as well as recommendations for future travelling. She also follows SOCOMO company on Social Media, reviews positively her experience on *Cruise Critic*, and registers on the newsletter for receiving promotion vacation packages. Her friend Marta, engaged with Marina’s experience and they both now are planning their next cruise with the same company. It seems that, eventually, the persona’s loyalty<sup>16</sup> to SOCOMO Lines has been achieved through personalisation of services, with benefits for both sides.

---

<sup>16</sup> According to CLIA (2016), brand loyalty is the major factor in cruise choice.

## 5.5. Challenges and limitations

The use of innovative technologies creates some key concerns for cruise companies and stakeholders. In this chapter, we are going to discuss and access the 10 major challenges for cruise companies and the way they respond.

- 1) Limited communication and poor connectivity bandwidth on board: To respond to this challenge, companies use the fastest internet connection via Wi-Fi (like VROOM in RCC) offering different pricing packages for guests and the possibility to enjoy on board even movies on Netflix, video chatting on Skype, and playlists on Spotify (Royalcaribbean 2019).
- 2) Roaming high charges for using Wi-Fi connection at sea: After years of consumer advice to not use smartphones on-board for avoiding high fees, cruise lines must now educate customers emphasizing on the benefits of using ICTs on board. Major companies, also, collaborate with leaders in communication services, offering a big variety of pricing packages for all cruise segments and incomes.
- 3) The cyber threat: In the future, cases of a data breach, malicious attacks and ransomware, will be more frequent with an 80% of offshore security breaches as the result of human error (Allianz 2017). To deal, companies are using cyber-security, secure cloud and blockchain technology<sup>17</sup> or follow the IMO guidelines on Maritime Cyber Risk Management and the “Cyber Security On board Ships” by the International Maritime Council, to develop recovery plans. Furthermore, standard practices, such as crew education and back-up systems, should be implemented to reduce cyber risk.
- 4) Sharing personal data online without guests’ permission. Guests are worried more than ever about the security of their data compliance across the ecosystem. Companies need to follow the General Data Protection Regulation (GDPR) rules to address that. In Princess Cruise Line -which abides by strict European Union data collection and retention rules- the guest is empowered to choose if the company can

---

<sup>17</sup> The blockchain is a digital ledger that can record virtually everything of value (Tapscott & Tapcott, Blockchain Revolution 2016). It will find wide acceptance in the cruise sector in vessel maintenance, over bookings, fraud in refunds and chargebacks, real-time alerts for data breaches etc.

hold his/her information for future usage. Cruisers can, also, control the extent of using ICTs and uploading personal data by not downloading apps on their mobile devices.

- 5) Tourists' low destination awareness: By using interactive HD screens and specific robots on board cruisers can find all the information needed for the destination they visit in a timely manner, avoiding complaints.
- 6) Selecting the appropriate technology for each guest: Technology should be used for the benefit of the guest and for improving his/her experience avoiding any technology traps just for the sake of it. For instance, cruisers during their interaction with lots of apps and devices may feel that the human touch is getting lost and maybe this is what they were really searching for. In the end, it's all about the user experience and deploying the right technologies (native or web apps, offline or online portals) to ultimately make it feel like an extension of the ship itself, where it belongs (TravelPulse 2016).
- 7) The abundance of technology: Customizing the system for individual cruise lines is the key. Travis Beaven, Chief product officer and GM of consumer engagement of Xevo, declares, *"I think each brand, each flag, has its own thing...the biggest thing we can do is just make sure that their message, the way they're trying to interact with the guest, and the experience they're trying to create, comes through to the technology"*. Gilad Berenstein, CEO of Utrip (2017)<sup>18</sup>, also, underlines the importance of long-time digital marketing based on the customers' discovery and of the creation of their own story.
- 8) Political risks and piracy: With changes in piracy risk, tensions are increasing in the South China Sea and conflict in Yemen. From the other part of the world, Venezuela saw a significant increase in piracy activity, with one happening every month on

---

<sup>18</sup> Utrip is a data-driven personalization platform and A.I. recommendation engine built specifically for the travel industry, combining local expertise, human experience and artificial intelligence.

average during 2017 (Allianz 2018). To deal, innovative technology is used for testing a priori the waters using increased automation and e-navigation (Allianz 2017).

- 9) Engine problems, which are related to fuel and combustion systems (Van Dijk et al., 2018). The hybridization and electrification of vessels are one of the developments that will address this challenge to some extent (Negenborn, et al., 2018).
- 10) Drawbacks from automated sailing: The absence of human intervention, could lead to lower fuel consumption, lesser idle hours, possibly fewer personnel and lower costs of operating the ship (Negenborn, et al., 2018). Economic, social and environmental pillars need to be balanced and the participation of all relevant stakeholders as well as strong political leadership is crucial for the foreseeable future, ensuring sustainability.

To the best of the author's knowledge, the maritime sector, as part of an overall technological transformation, is changing radically due to internal (administration, stakeholders, suppliers, etc.) and external factors (PESTLE). This shift creates challenges for cruise companies, operators and passengers. To respond, they all try to find solutions, having a common goal; optimization of the operations. Nevertheless, the vision for the future should be viewed more holistically at business operations. Optimising a single vessel is insufficient; optimization of a fleet is required and later, of the whole business entities and of the Smart Maritime Ecosystem.



## 6. Conclusion and future research

Previous research has demonstrated that the modern way of life and the quick growth of technology transform the cruise ecosystem from a static into a dynamic one, where innovation and cutting-edge interactions between cruisers, organizations, stakeholders and vice versa lead to value co-creation, efficiency, effectiveness, and increased profitability for all. Cruisers act as active co-creators of service experiences, creating positive value outputs for themselves, for others cruisers, and even for the company. However, several challenges still need to be addressed and overcome regarding the way and the extent which cruisers engage with digital technologies. From another perspective, cruise companies and stakeholders, also, need to make optimal use of the new innovations technologies to meet dynamically the current needs of cruise guests, delivering personalized tailor-made experiences in real-time.

This analysis has shown that each cruise company takes advantage of different technological tools and applications depending on its strategy and distinguishing features, but having a common goal; offering unique innovative personalized experiences to its guests. The main contribution of this thesis is to create the framework of the Smart Maritime Ecosystem and to show the way and the value co-created in using different types of ICTs from the cruiser's perspective. Making a future scenario, the findings provide evidence that there are more benefits for all the actors of the cruise ecosystem than drawbacks and limitations. This assignment, also, introduces the idea of how the cruiser's experience could be transformed by using technologies, however, there is still room for further growth, as there is a gap to date between the interoperability and the interconnectivity of all devices and applications, as well as several limitations regarding customer's data processing. Moreover, further research is necessary to evaluate this thesis hypothesis. What is clearly needed to be undertaken is a quantitative research for a more critical perspective on smart tourism experiences focusing on the psychological aspect of cruisers using smart technologies on board. For instance, it would be a good thought combining health, technology and cruise experience, by analysing in what extent technology helps cruisers with claustrophobia, agoraphobia or other disorders.

## 7. Bibliography

- 1) Accenture. (2017). *Maritime in the view*. [online] Available at: [https://www.accenture.com/t20180306T185620Z\\_w\\_/th-en/acnmedia/PDF-73/Accenture-Maritime-In-The-New.pdf](https://www.accenture.com/t20180306T185620Z_w_/th-en/acnmedia/PDF-73/Accenture-Maritime-In-The-New.pdf) [Accessed 6 Jan. 2019].
- 2) Aggett, M. (2011). Cruise passengers' complaints: An analysis of online reviews. In P. Gibson, A. Papathanassis, and P. Milde (Eds.), *Cruise sector challenges*, pp. 147-161. Wiesbaden, Germany: Gabler Verlag-Springer Fachmedien.
- 3) Allianz. (2012). *Safety and Shipping 1912-2012. From Titanic to Costa Concordia*. [online] Available at: [https://www.agcs.allianz.com/assets/PDFs/Reports/AGCS\\_safety\\_and\\_shipping\\_report.pdf](https://www.agcs.allianz.com/assets/PDFs/Reports/AGCS_safety_and_shipping_report.pdf) [Accessed 7 Jan. 2019].
- 4) Allianz. (2017). *Safety and Shipping Review 2017*. [online] Available at: [https://www.agcs.allianz.com/assets/PDFs/Reports/AGCS\\_Safety\\_Shipping\\_Review\\_2017.pdf](https://www.agcs.allianz.com/assets/PDFs/Reports/AGCS_Safety_Shipping_Review_2017.pdf) [Accessed 7 Jan. 2019].
- 5) Allianz. (2018). *Safety and Shipping Review 2018*. [online] Available at: [https://www.agcs.allianz.com/assets/PDFs/Reports/AGCS\\_Safety\\_Shipping\\_Review\\_2018.pdf](https://www.agcs.allianz.com/assets/PDFs/Reports/AGCS_Safety_Shipping_Review_2018.pdf) [Accessed 7 Jan. 2019].
- 6) Bahja, F., Cobanoglu, C., Berezina, K. and Lusby, C. (2018). Factors influencing cruise vacations: the impact of online reviews and environmental friendliness. *Tourism Review*.
- 7) Baker, D. (2015). Exploring Cruise Passengers' Demographics, Experience, and Satisfaction with Cruising the Western Caribbean. *International Journal of Tourism and Hospitality Reviews*, 1(1), pp.23.
- 8) Bergmann, M. (2018). *Collaborative decision making in support of global maritime trade*, Presentation at IHO HSSC 10, Rostock-Warnemünde. [online] Available at [https://www.iho.int/mtg\\_docs/com\\_wg/HSSC/HSSC10/HSSC10%20-%20STM-PortCDM.pdf](https://www.iho.int/mtg_docs/com_wg/HSSC/HSSC10/HSSC10%20-%20STM-PortCDM.pdf) [Accessed 7 Jan. 2019].
- 9) Bitner, M.J. (1992), Servicescapes: The Impact of Physical Surroundings on Customers and Employees, *Journal of Marketing*, 56, pp.57-71.
- 10) Boes, K., Buhalis, D. and Inversini, A. (2015). Conceptualising Smart Tourism Destination Dimensions. Springer, pp.391-403.
- 11) Boes, K., Buhalis, D. and Inversini, A. (2016). Smart tourism destinations: ecosystems for tourism destination competitiveness. *International Journal of Tourism Cities*, 2(2), pp.108-124.
- 12) Borges-Tiago, T., Tiago, F., Faria, S.D. and Couto, J.P. (2016). Who is the better player?

Off-field battle on Facebook and Twitter. *Business Horizons*, 59(2), pp.175-183.

13) Boy, C. (2011). The development and meaning of vessel flags in the cruise industry. In P. Gibson, A. Papathanassis, and P. Milde (Eds.), *Cruise sector challenges*, pp.57-75. Wiesbaden, Germany: Gabler Verlag-Springer Fachmedien.

14) Brida, J. and Zapata, S. (2010). Cruise tourism: economic, socio-cultural and environmental impacts. *International Journal of Leisure and Tourism Marketing*, 1(3), pp.205-226.

15) Brida, J., G., Bukstein, D. and Tealde, E. (2015). Exploring cruise ship passenger spending patterns in two Uruguayan ports of call. *Current Issues in Tourism*, 18(7), pp.684-700.

16) Brida, J., G., Pulina, M., Riaño, E. and Zapata Aguirre, S. (2012). Cruise visitors' intention to return as land tourists and to recommend a visited destination. *Anatolia: An International Journal of Tourism and Hospitality Research*, 23(3), pp.395-412.

17) Brida, J.G. and Risso, W.A. (2010). Cruise passengers' expenditure analysis and probability of repeat visits to Costa Rica: a cross section data analysis. *Tourism Analysis*, 15(4), pp.425-434.

18) Brida, J.G., Garrido, N. and Such Devesa, M. (2012). Cruise passengers' satisfaction: Cartagena de Indias. *Benchmarking: An International Journal*, 19(1), pp.52-69.

19) Brown, S. and Hutton, A. (2013). Developments in the real-time evaluation of audience behaviour at planned events. *International Journal of Event and Festival Management*, 4(1), pp.43-55.

20) Brownell, J. (2008). Leading on land and sea: Competencies and context. *International Journal of Hospitality Management*. 27(8), pp.137-150.

21) Buhalis D. and Amaranggana A. (2015). Smart Tourism Destinations Enhancing Tourism Experience Through Personalisation of Services, *Information and Communication Technologies in Tourism*. pp.377-389

22) Buhalis D. and Amaranggana A., Smart Tourism Destinations (2014), *Information and Communication Technologies in Tourism*. (2015), pp.553-563.

23) Buhalis, D. (2000). Marketing the competitive destination of the future. *Tourism Management*, 21(1), pp. 97-116.

24) Buhalis, D. (2003). *E Tourism: Information Technology for Strategic Tourism Management*. London, UK: Pearson.

25) Buhalis, D. and Foerste, M. (2015), SoCoMo Marketing for Travel and Tourism: Empowering co-creation of value, *Journal of Destination Marketing and Management*, 4(3), pp.151–161.

26) Buhalis, D. and Leung, R. (2018). Smart hospitality—Interconnectivity and

interoperability towards an ecosystem. *International Journal of Hospitality Management*, 71, pp.41-50.

27) Buhalis, D., and Law, R. (2008). Progress in information technology and tourism management: 20 years on and 10 years after the internet: The state of eTourism research. *Tourism Management*, 29(4), pp.609-623.

28) Canhoto, A. I. and Clark, M. (2013). Customer service 140 characters at a time: The users' perspective. *Journal of Marketing Management*, 29(5-6), pp. 522–544.

29) Carib-exort.com. (2009). *Cruise Market Study*. [online] Available at: [https://www.carib-export.com/obic/documents/Cruise\\_Market\\_Study\\_FINAL.pdf](https://www.carib-export.com/obic/documents/Cruise_Market_Study_FINAL.pdf) [Accessed 2 Nov. 2018].

30) Castillo-Manzano, J., Fageda, X. and Gonzalez-Laxe, F. (2014), An analysis of the determinants of cruise traffic: An empirical application to the Spanish port system, *Transportation Research Part E*, 66(14), pp. 115-1.

31) Charlier, J.J. and McCalla, R.J. (2006). Geographical overview of the world cruise market and its seasonal complementarities. In R.K. Dowling (Ed.), *Cruise ship tourism*, pp.18-30.

32) Cheng, M., Wong, A.I. and Prideaux, B. (2016). Political travel constraint: the role of Chinese popular nationalism. *Journal Travel Tourism Marketing*, 34 (3), pp.383-397.

33) CLIA. (2016). Contribution of Cruise Tourism to the Economies of Europe 2015

34) CLIA. (2017). *Europe Statistics and Markets 2016*. [online] Available at: [https://www.cliaeuropa.eu/images/downloads/CLIA\\_Europe\\_Stats\\_and\\_marts\\_2016\\_V4.pdf](https://www.cliaeuropa.eu/images/downloads/CLIA_Europe_Stats_and_marts_2016_V4.pdf) [Accessed 17 June 2018].

35) CLIA. (2017). The Contribution of the International Cruise Industry to the Global Economy in 2016 edition.

36) CLIA. (2018). Contribution of Cruise Tourism to the Economies of Europe 2017. [online] Available at: [https://www.cliaeuropa.eu/images/Reports/2017\\_Europe\\_Economic\\_Impact\\_Report\\_-\\_20thJune.pdf](https://www.cliaeuropa.eu/images/Reports/2017_Europe_Economic_Impact_Report_-_20thJune.pdf) [Accessed 25 Dec. 2018].

37) CLIA. (2018). Cruise Industry Outlook. [online] Available at: <https://cruising.org/-/media/research-updates/research/featured/2018-clia-state-of-the-industry.pdf> [accessed 17 June 2018].

38) Cohen, B. (2012). Smart cities hub.

39) Coleman, M.T., Meyer, D.W. and Scheffman, D.T. (2003). Economic analyses of mergers at the FTC: The cruise ships mergers investigation. *Review of Industrial Organization*. 23(3), pp. 121-155.

40) Cruisecritic. (2019). *Cruise Critic*. [online] Available at: <https://www.cruisecritic.co.uk/> [Accessed 20 Nov. 2018].

- 41) Cruisemarketwatch. (2016). *Financial Breakdown of the Typical Cruiser*.
- 42) Cruisemarketwatch. (2018). *Cruise Market Watch | The Cruise Industry's destination for market share, size and marketing trends*. [online] Available at: <https://cruisemarketwatch.com> [Accessed 25 Dec. 2018].
- 43) De Cantis, S., Ferrante, M., Kahani, A. and Shoval, N. (2016). Cruise passengers' behavior at the destination: investigation using GPS technology. *Tourism Management*, 52, pp. 133-150.
- 44) De Groot, A. (2011). Plotting a course in cruise management education. In P. Gibson, A. Papathanassis, and P. Milde (Eds.), *Cruise sector challenges*, pp. 245-255.
- 45) Deloitte. (2018). *Industry insight New Zealand ports and freight yearbook 2018*. [online] Available at: <https://www2.deloitte.com/content/dam/Deloitte/nz/Documents/finance/nz-2018-ports-and-freight-report-final.pdf> [Accessed 2 Jan. 2019].
- 46) Di Vaio, A., Lepore, L. and Varriale, L. (2018). Self-organised cruiser's expenditures in a port of call: the interaction effect between city interface satisfaction and super-sized ships. *International Journal of Culture, Tourism and Hospitality Research*, 12(4), pp.385-406.
- 47) Digitaltrends. com. (2017). *Want to live in a futuristic smart city today? Take a cruise*. [online] Available at: <https://www.digitaltrends.com/features/cruise-ships-turn-to-wearable-tech-to-create-personalized-experiences/> [Accessed 10 Dec. 2019].
- 48) Domínguez, G., A. (2014). "Smart Ships": Smart Mobile Applications, Cloud and Big data on Marine Traffic for Increased Safety and Optimized Costs Operations, Second International Conference on Artificial Intelligence, Modelling and Simulation, Seville, Spain.
- 49) Douglas, N. and Douglas, N. (2004) Cruise ship passenger spending patterns in Pacific island ports. *International Journal of Tourism Research*. 6, pp.251-261.
- 50) Dowling, R. (2006). *Cruise ship tourism*. Wallingford: CABI.
- 51) Erb, Y. (2011). Some aspects about the Internet of things, the advantages and challenges: Business aspects of the Internet of things. Zurich: ETH Zurich.
- 52) Etgar, M. (2008). A Descriptive Model of the Consumer Co-Production Process. *Journal of the Academy of Marketing Science*, 36, pp.97-108.
- 53) FCCA. (2003). *Florida Caribbean Cruise Association | 2003 Cruise Industry Overview* [online] Available at: <http://www.f-cca.com/downloads/CIOfall2003.pdf> [Accessed 12 Dec. 2018].
- 54) FCCA. (2018). *Florida Caribbean Cruise Association | 2018 Cruise Industry Overview* [online] Available at: <https://www.f-cca.com/downloads/2018-Cruise-Industry-Overview-and-Statistics.pdf> [Accessed 25 Dec. 2018].
- 55) Femenia-Serra, F., Perles-Ribes, J. and Ivars-Baidal, J. (2018). Smart destinations and tech-savvy millennial tourists: hype versus reality. *Tourism Review*.

- 56) Franke, N. and Schreier, M. (2010). Why Customers Value Self-Designed Products: The Importance of Process Effort and Enjoyment. *Journal of Product Innovation Management*, 27(7), pp.1020-1031.
- 57) Franke, N., Schreier, M. and Kaiser, U. (2010). The “I Designed It Myself” Effect in Mass Customization. *Management Science*, 56, pp.125-140.
- 58) García-Haro, M., Martínez-Ruiz, M. and Martínez-Cañas, R. (2015). The Influence of Value Co-Creation on Consumer Satisfaction. *International Journal of Online Marketing*, 5(4), pp.60-83.
- 59) Geertsma, R., Negenborn, R., Visser, K. and Hopman, J. (2017). *Design and control of hybrid power and propulsion systems for smart ships: A review of developments*.
- 60) Gillham, W.E.C. (2000), Case Study Research Methods, Continuum, London.
- 61) Gretzel, U., Sigala, M., Xiang, Z. and Koo, C. (2015). Smart tourism: foundations and developments. *Electronic Markets*, 25(3), pp.179-188.
- 62) Gummesson, E. (2000). *Qualitative Methods in Management Research*, second ed., Sage, USA.
- 63) Henry, J., Hamlin, R. and Simpson, E. (2015). The local and long-haul cruise passenger market segments: What are the implications of their emergence for cruise destinations? *Tourism in Marine Environments*, 10(3-4), pp.159-175.
- 64) Henthorne, T.L. (2000). An analysis of expenditures by cruise ship passengers in Jamaica. *Journal of Travel Research*, 38, pp.246-250.
- 65) Hilty, L. M. and Aebischer, B. (2015). (Eds.), *ICT Innovations for Sustainability, Advances in Intelligent Systems and Computing*, pp. 333–349. New York: Springer.
- 66) Ho, C.I. and Lee, Y.L. (2007). The development of an e-travel service quality scale. *Tourism Management*, 28(6), pp.1434-1449.
- 67) Höjer, M. and Wangel, J. (2015). *Smart Sustainable Cities: Definition and Challenges*.
- 68) Horwathhtl (2015). *Tourism Megatrends 10 things you need to know about the future of Tourism*. [online] Available at: <http://corporate.cms-horwathhtl.com/wp-content/uploads/sites/2/2015/12/Tourism-Mega-Trends4.pdf> [Accessed 25 Dec. 2018].
- 69) Ianzito, C. (2018). *Cruise Lines Introduce Apps to Help Passengers*. [online] Available at: <https://www.aarp.org/travel/vacation-ideas/cruises/info-2018/high-tech-cruise-ships.html> [Accessed 2 Jan. 2019].
- 70) Ivars-Baidal, J., Celdrán-Bernabeu, M., Mazón, J. and Perles-Ivars, Á. (2017). Smart destinations and the evolution of ICTs: a new scenario for destination management? *Current Issues in Tourism*, pp.1-20.
- 71) Jin, J., Gubbi, J., Marusic, S., Palaniswami, M., 2014. An information framework for

creating a smart city through internet of things. *IEEE Internet Things J.* 1(2), pp.112–121.

72) Johnson, D. (2002). Environmentally sustainable cruise tourism: A reality check. *Marine Policy.* 26(2), pp.261-270.

73) Karlsson, M. and Andersen, T. (2017). The PortCDM concept in application. *The Global Language of Business.* [online] Available at [https://www.gs1.org/sites/default/files/22\\_-\\_portcdm\\_at\\_gs1\\_ver6\\_-\\_as\\_run.pdf](https://www.gs1.org/sites/default/files/22_-_portcdm_at_gs1_ver6_-_as_run.pdf) [Accessed 7 Jan. 2019].

74) Kwortnik, R. J. (2008). *Shipscape influence on the leisure cruise experience* [online] Available at: <https://scholarship.sha.cornell.edu/cgi/viewcontent.cgi?article=1929&context=articles> [Accessed 20 Dec. 2018].

75) Kwortnik, R.J. (2008). Shipscape influence on the leisure cruise experience. *International Journal of Culture, Tourism and Hospitality Research* 2(4), pp.289-311.

76) Lamsfus, C., Martín, D., Alzua-Sorzabal, A. and Torres-Manzanera, E. (2015). Smart Tourism Destinations: An Extended Conception of Smart Cities Focusing on Human Mobility. *Information and Communication Technologies in Tourism*, Springer, pp. 363-375.

77) Lester, J. and Weeden, C. (2004). Stakeholders, the natural environment and the future of Caribbean cruise tourism. *International Journal of Tourism Research*, 6, pp.39-50.

78) Lind, M., Haraldson, S., Karlsson, M. and Watson, R. (2017) *Port Collaborative Decision Making – Closing the Loop in Sea Traffic Management.* [online] Available at: <https://pdfs.semanticscholar.org/ce1b/4e555d67e957e407944c6fbb7e69c6c4f5bb.pdf> [Accessed 10 Dec. 2018].

79) Locker, M. (2017). *Inside Royal Caribbean's Wild, Tech-Filled Cruise Of The Future.* [online] Available at: <https://www.fastcompany.com/40495733/inside-royal-caribbeans-wild-tech-filled-cruise-of-the-future> [Accessed 10 Dec. 2018].

80) Lusch, R. F., Vargo, S. and Wessels, G. (2008). Toward a conceptual foundation for service science: Contributions from service-dominant logic. *IBM Systems Journal*, 47, no 1.

81) Maheshwari, D. and Janssen, M. (2014). Reconceptualizing measuring, benchmarking for improving interoperability in smart ecosystems: the effect of ubiquitous data and crowdsourcing. *Gov. Inf. Q.* 31 (Suppl. 1), pp.84–92.

82) Mantel, L. and Papathanassis, A. (2016). Cruise passengers' willingness to pay for sustainable cruises. In A.Papathanassis (Ed.), *Cruise Business Development: Safety, Product Design and Human Capital.* Heidelberg: Springer Verlag. pp.191-213.

- 83) Maritimejournal. (2017). *Human error accounts for 75% of marine liability losses*. [online] Available at: <https://www.maritimejournal.com/news101/insurance,-legal-and-finance/human-error-accounts-for-75-of-marine-liability-losses> [Accessed 7 Jan. 2019].
- 84) Martimo, P. (2017). *Disruptive Innovation and Maritime Sector - Discovering smart-shipping's potential to disrupt shipping*. Report Turku School of Economics.
- 85) McCarthy, J. (2006). *The cruise industry and port city regeneration: The case of Valetta*. *European Planning Studies*, 11(3), pp.341-352.
- 86) McCrindle. E. and Mark. Wolfinger, Emily (2014). *The ABC of XYZ: Understanding the Global Generations*. McCrindle Research.
- 87) MedCruise. (2017) *Cruise activities in MedCruise ports – statistics 2016*.
- 88) Medcruise.(2015). *MedCruise News*. [online] Available at: [http://www.medcruise.com/sites/default/files/medcruise\\_newsletter\\_issue\\_47\\_mar\\_2015\\_lr.pdf](http://www.medcruise.com/sites/default/files/medcruise_newsletter_issue_47_mar_2015_lr.pdf) [Accessed 2 Jan. 2019].
- 89) Meriteollisuus Finnish Marine Industries (2016). *Smart Maritime Technology Solutions. An Update: A strategic research agenda for the Finnish maritime cluster 2017–2025*. [online] Available at: [https://www.turku.fi/sites/default/files/atoms/files/mety\\_sra\\_2016.pdf](https://www.turku.fi/sites/default/files/atoms/files/mety_sra_2016.pdf) [Accessed 6 Jan. 2019].
- 90) Minghetti, V. and Buhalis, D. (2010). *Digital Divide in Tourism*. *Journal of Travel Research*,49(3), pp.267-281.
- 91) Mizik, N. and Jacobson, R. (2003). *Trading Off Between Value Creation and Value Appropriation: The Financial Implications of Shifts in Strategic Emphasis*. *Journal of Marketing*, 67(1), pp. 63-76.
- 92) Morabito, V. (2015). *Big data and analytics: strategic and organizational impacts*. Springer.
- 93) Negenborn, R., Duinkerken, M., L. Chen, A. D., Cappelle, L., B. Kuipers, M. S.J. and Harmsen, A. J. (2018). *Autonomous Ships in the Port of Rotterdam*. Report of Smart Port, project TET-SP, 49 pp.
- 94) Neuhofer, B., Buhalis, D. and Ladkin, A. (2012). *Conceptualising Technology Enhanced Destination Experiences*, *Journal of Destination Marketing and Management*, 1(1-2), pp.36-46.
- 95) Neuhofer, B., Buhalis, D. and Ladkin, A. (2015). *Smart technologies for personalized experiences: a case study in the hospitality domain*. *Electronic Markets*, 25(3), pp.243-254.
- 96) Newsroom.accenture.com. (2017). *Accenture to Help Carnival Corporation Transform the Guest Experience Through Intelligent Personalization*. [online] Available at:



<https://newsroom.accenture.com/news/accenture-to-help-carnival-corporation-transform-the-guest-experience-through-intelligent-personalization.htm> [Accessed 2 Jan. 2019].

97) Papathanassis, A. (2014). Cruise sector & 'Glocal' corporate citizenship: The 5th International Cruise Conference, Bremerhaven, Germany. *International Journal of Tourism Research*, pp.24–26.

98) Papathanassis, A. (2016), *Cruise Business Development Safety, Product Design and Human Capital*.

99) Papathanassis, A. (2016). High hopes and high seas: the role and impact of cruise tourism in destination development, paper presented in the International Tourism Studies Association (ITSA) Biennial Conference, Greenwich, 19 August.

100) Papathanassis, A. (2016). Stranded at sea: exploring passengers' reactions during incidents at sea, in Papathanassis, A. (Ed.), *Cruise Business Development: Safety, Product Design and Human Capital*, Springer, Heidelberg, pp. 29-49.

101) Papathanassis, A. (2017). Cruise tourism management: state of the art. *Tourism Review*, 72(1), pp.104-119.

102) Papathanassis, A. (2017). R-Tourism: Introducing the Potential Impact of Robotics and Service Automation in Tourism. *Ovidius University Annals, Series Economic Sciences*, 17(1), pp. 211-216.

103) Papathanassis, A. and Beckmann, I. (2011). Assessing the "poverty of cruise theory" hypothesis. *Annals of Tourism Research*, 38(1), pp.153-174.

104) Papathanassis, A. and Bunda, N.R. (2016). Action research for sustainable cruise tourism development: the Black Sea region case study. *Tourism in Marine Environments*, 11, pp.161-180.

105) Papathanassis, A. and Klein, R. (2015). "Long-tail' or 'fairy tale': the case for scientific publishing in cruise tourism. *Tourism in Marine Environments*, 10 (3–4), pp. 144-149.

106) Papathanassis, A., Breitner, M.H. and DeGroot, A. (2014). *Cruise Tourism & Innovation: Improving Passengers' Experiences and Safety*. Berlin: Logos Verlag.

107) Papathanassis, A., Lukovic, T. and Vogel, M. (2012). *Cruise Tourism and Society*.

108) Porter, M.E. and Heppelmann, J.E. (2014). *How Smart, Connected Products Are Transforming Competition*. [online] Harvard Business Review. Available at: <https://hbr.org/2014/11/how-smart-connected-products-are-transforming-competition> [Accessed 14 Nov. 2018].

109) Presscenter. (2017). *Sea Beyond: Experience the New the Next and the Never Before with Royal Caribbean*. [online] Available at: <https://presscenter.rclcorporate.com/video/5/sea-beyond-experience-the-new-the-next-and-the-never-before-with-royal-caribbean/> [Accessed 5 Jan. 2019].

- 110) Rezaei, R., Chiew, T.K. and Lee, S.P. (2014). A review on E-business interoperability frameworks. *J. Syst.* 93, pp.199–216.
- 111) Rihova, I., Buhalis, D., Moital, M. and Gouthro, M. (2014). Conceptualising Customer-to-customer Value Co-creation in Tourism. *International Journal of Tourism Research*, 17(4), pp.356-363.
- 112) Rolls-Royce. (2017). *A world first. We demonstrate the first remotely operated commercial vessel.* [online] Available at: <https://www.rolls-royce.com/media/our-stories/discover/2017/rolls-royce-and-svitzer.aspx> [Accessed 7 Jan. 2019].
- 113) Sciozzi, D., Jugović T.P. and Jugović, A. (2015). Structural analysis of cruise passenger traffic in the world and in the Republic of Croatia. *Scientific Journal of Maritime Research*, 29, pp.8-15.
- 114) Seatrade-cruise. (2019). *Seatrade Cruise News.* [online] Available at: <http://www.seatrade-cruise.com/> [Accessed 2 Jan. 2019].
- 115) Sheffield, J. (2016). The Ultimate Travel Bot List. 30 Seconds to Fly Homepage. [online] Available at: <https://www.30secondstofly.com/ai-software/ultimate-travel-bot-list> [Accessed 17 June 2018]
- 116) Siddaway, A. (2014). What is a systematic literature review and how do I do one? *University of Stirling*, (2), pp.1-13.
- 117) Sigala, M. (2015). From demand elasticity to market plasticity: A market approach for developing revenue management strategies in tourism. *Journal of Travel and Tourism Marketing*, 32(7), pp.1-23
- 118) Sigala, M. and Marinidis, D. (2012). Web Map Services in Tourism: A framework exploring the organisational transformations and implications on business operations and models. *International Journal of Business Information Systems*, 9(4), pp.415-434.
- 119) Sigala, M., Christou, E. and Gretzel, U. (2012). *Web2.0 in travel, tourism and hospitality. Theory, practice and cases.* Ashgate Publishers.
- 120) Sohns, K., Breitner, M. and Papathanassis, A. (2011). Online Content Mining Technologies for the Cruise Industry: State-of-the-Art and Acceptance, *European Journal of Tourism, Hospitality and Recreation*. 2(3), pp.55-77.
- 121) Srdjevic, Z., Bajcetic, R. and Srdjevic, B. (2012). Identifying the Criteria Set for Multicriteria Decision Making Based on SWOT/PESTLE Analysis: A Case Study of Reconstructing A Water Intake Structure. *Water Resources Management*, 26(12), pp.3379-3393.
- 122) Sun, X., Jiao, Y. and Tian, P. (2011). Marketing research and revenue optimization for the cruise industry: A concise review. *International Journal of Hospitality Management*, 30(11), pp.746-755.

- 123) Tapscott, A. and Tapscott, D. (2016). *Blockchain Revolution*. [online] Available at: <http://blockchain-revolution.com/> [Accessed 20 Nov. 2018].
- 124) Team GTP. (2018). *MSC Bellissima Introduces First Digital Cruise Personal Assistant: Zoe*. [online] Available at: <https://news.gtp.gr/2018/12/14/msc-bellissima-introduces-first-digital-cruise-personal-assistant-zoe/> [Accessed 5 Jan. 2019].
- 125) Terry, V. (2018). *How to Create a Seamless Integration From Shoreside to the Stateroom*. [online] Samsung Business Insights. Available at: <https://insights.samsung.com/2018/02/16/technology-partnerships-help-create-a-seamless-cruise-line-customer-experience/> [Accessed 7 Jan. 2019].
- 126) Tiago, F., Couto, J.P., Faria, S.D. and Borges-Tiago, T. (2018). Cruise tourism: social media content and network structures. *Tourism Review*, 73(4), pp.433-447.
- 127) TravelPulse. (2016). *Discussing Cruise Guest Experience Technologies with UI Evolution*. [online] Available at: <https://www.travelpulse.com/news/cruise/discussing-cruise-guest-experience-technologies-with-ui-evolution.html> [Accessed 6 Jan. 2019].
- 128) Travolution. (2017). *Guest Post: How technology has revolutionised the travel industry over the last decade*. [online] Available at: <http://www.travolution.com/articles/104021/guest-post-how-technology-has-revolutionised-the-travel-industry-over-the-last-decade> [Accessed 26 Dec. 2018].
- 129) Tussyadiah, I. P. and Zach, F. J. (2012). The role of geo-based technology in place experiences. *Annals of Tourism Research*, 39(2), pp.780–800.
- 130) Uhlemann, T., Lehmann, C. and Steinhilper, R. (2017). The Digital Twin: Realizing the Cyber-Physical Production System for Industry 4.0. *Procedia CIRP* 61, pp. 335-340.
- 131) United Nations World Tourism Organization. (2007). *A Practical Guide to Tourism Destination Management*.
- 132) United Nations. (2010). *International recommendations for tourism statistics 2008*. [online] Available at: [http://unstats.un.org/unsd/publication/Seriesm/SeriesM\\_83rev1e.pdf](http://unstats.un.org/unsd/publication/Seriesm/SeriesM_83rev1e.pdf) [Accessed 13 Nov. 2018].
- 133) Utrippro (2017). *The Future of Cruising According to 3 Industry Veterans*. [online] Available at: <https://www.utripbro.com/blog/future-of-cruising> [Accessed 25 Dec. 2018].
- 134) Van Dijk, T., Moonen, H., Van Dorseer, H., Van den Berg, R. and Negenborn, R. (2018) Smart ships and the changing maritime ecosystem. [online] Available at <http://smartport.nl/wp-content/uploads/2018/09/SmartPort-whitepaper-SmartShipping.pdf> [accessed 25 Dec. 2018]
- 135) Wang, D., Li, X. and Li, Y. (2013). China's smart tourism destination initiative: A taste of the service-dominant logic. *Journal of Destination Marketing and Management*, 2(2), pp.59–

61.

136) Wang, K., Wang, S., Zhen, L., and Xiaobo Qu, X. (2016). Cruise shipping review: operations planning and research opportunities, *Maritime Business Review*, 1(2), pp.133-148.

137) Wartsila. (2017). *Wärtsilä introduces its Smart Marine Ecosystem vision*. [online] Available at: <https://www.wartsila.com/media/news/24-11-2017-wartsila-introduces-its-smart-marine-ecosystem-vision> [Accessed 20 Nov. 2018].

138) Watson, R.T. and Boudreau, M.C. (2011). *Energy Informatics*. Athens, GA: Green ePress.

139) Watson, R.T., Lind, M. and Haraldson, S. (2017). Physical and Digital Innovation in Shipping: Seeding, Standardizing, and Sequencing. *Proceedings of the 50th Hawaii International Conference on System Sciences*.

140) Whyte, L. J. (2016). *Cruise tourists' perceptions of destination: Exploring push and pull motivational factors in the decision to take a cruise vacation*. A thesis submitted for the degree of Doctor of Philosophy at The University of Queensland in 2016, UQ Business School.

141) World Economic Forum. (2017). Digital Transformation Initiative Aviation, Travel and Tourism Industry. World Economic Forum White Paper. [online] Available at: <http://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/wef-dti-aviation-travel-and-tourism-white-paper.pdf> [Accessed 25 Dec. 2018].

142) Worldwide cruise ship activity. (2003). Madrid: World Tourism Organization.

143) Xevo. (2018). [online] Available at: <https://www.xevo.com/> [Accessed 10 Nov. 2018].

144) Xiang, Z. and Fesenmaier, D. (2017). *Analytics in Smart Tourism Design*.

145) Yin, R. (2009). *Qualitative research from start to finish*.

146) Zsarnoczky, M., David, L., Mukayev, Z. and Baiburiev, R. (2016). Silver Tourism in the European Union.