SATISFACTION OF PASSENGERS – PROCESS COMPARISON BETWEEN TWO CRUISE SHIP CLASSES

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ABSTRACT

In cruise ship design, a ship designer often focuses on the ship's function, while a cruise operator's focus is on the creation of a comfortable and enjoyable cruise experience for passengers. Today, these two viewpoints are strongly connected, and thus, the way the inside of a ship is designed can impact how satisfied passengers are on their cruise journey. Thus, we need to figure out the best way to design a passenger ship from the perspective of the passengers themselves. In this paper, we analyse the differences in the combination passenger ship environmental elements and overall consumer satisfaction in two different cruise ship classes from the same ship operator, but from different eras. First, we present a theoretical framework and model for the cruise ship environment that consist of ambient, layout/design, social, product/service and onboard enjoyment factors. Then, by using data collected from the public domain, we compare two types of cruise ships using open-source data (N=755). This allows us to identify the factors contributing to the discrepancy in expectations across cruise guests. Based on this limited data, we create several linear regression models which indicates a favourable and statistically significant link between environmental elements and passengers' conduct while on board. Information processed this manner can be utilised to make informed decisions on cruise ship layout and amenities. In addition, the developed innovative KPI proved instrumental in influencing decision-making processes related to cruise ship designs and operations. Therefore, the findings from our research show a positive link between the onboard environment and the overall happiness of passengers.

KEY WORDS

Cruise class comparison; Process comparison; Onboard environmental factors; Customer Satisfaction; Cruise experience.

INTRODUCTION

Ships design is determined by their intended purpose or mission. Levander (2004) says that we start making a passenger ship by first understanding the customer's needs or the ship mission. When putting together a ship, different people might focus on different aspects. For instance, a naval architect might concentrate on the cost and how the ship works, while an interior designer might want to make the inside of the ship as pleasant as possible. Thus, we need to fully understand how best to design a passenger ship from a passenger's viewpoint.

Cruise ships are complex and their performance is not measured only by technical key-performance indicators (KPI), but also by cruise travellers' experience. The technical KPIs for cruise ships are well-documented; for example, in the chapter by Levander (2004) in the Ship Design and Construction. These include factors like GT/pax and crew/pax, which directly indicate the quality in terms of volume of the ship per passenger and service per passenger. However, this information is often

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too general to provide a descriptive understanding of cruise experience itself and the effect of ship and cruise designs on the overall satisfaction of the passengers.

In recent tourism studies, tourist satisfaction has become the core concept of tourist behavioural studies (Huang et al., 2015). Therefore, cruise passengers, who are a pivotal group in the cruise industry, play a crucial role in the cruise purchasing cycle and thus their behaviour must be better understood. They make purchasing decisions periodically, but from the cruise industry's perspective, it is challenging to track and understand these decision-making processes and identify which aspects no longer satisfy the passengers' needs and expectations. On the other hand, building and maintaining clear lines of communication and transparency within the organization is pivotal to spotting and solving potential problems before they escalate. Routine reporting is advocated to promptly identify and correct performance issues, increasing visibility and accountability throughout project management. Collaboration between experts and customers is crucial for enhancing project outcomes. Ongoing customer feedback is instrumental in refining product quality and meeting customer expectations.

Individuals responsible for decision-making often tend to favour certain evaluative criteria over others. This bias is generally represented through the differential weighting assigned to each criterion. Upon deriving an initial ranking of decisions, these individuals might find it necessary to re-evaluate and adjust their original preferences. The discipline of multiple-criteria decision-making primarily deals with identifying and selecting the best possible choices (Gou et al., 2016). Businesses employ data mining, regression analysis and KPI techniques to discern consumer purchasing behaviours, enabling them to tailor their sales strategies and provide personalised customer services. Data-driven clustering methods are used to truly understand customer behaviour or tendencies. A significant obstacle in this area is the obfuscation of critical information due to its dispersal across the Internet and elsewhere. The exhaustive search for pertinent data is not only time-intensive and resource-consuming but is also frequently unsuccessful due to the vast amounts of irrelevant information. In many advanced organisations, the current strategic focus is on enabling dynamic decision-making. This requires consideration of several key aspects: acquiring and analysing real-time data, understanding the interconnectedness of data sets, and engaging users with data-driven strategic approaches. Analysing consumer behaviour is critical for generating system-driven recommendations in consumer-centric decisions.

Executives must quickly interpret this data, as timely and updated insights are crucial for adapting organizational strategies to meet market demands. Multi-attribute decision-making (MADM) involves selecting the most satisfying option from a range of alternatives, each characterised by specific attributes, a process inherent in human activities (Xu & Zhang, 2013). Therefore, ineffective data communication can lead to an organization's inability to fulfil customer expectations. Sustaining an organization in the contemporary market requires continual evolution and adaptation aimed at customer satisfaction, which necessitates a thorough assessment of organizational processes for effectiveness and efficiency. The present process is highlighted due to its complexity and propensity for errors. Simplifying and streamlining these processes is essential so all stakeholders understand the required actions clearly. An optimised process is anticipated to enhance efficiency, reduce customer complaints, and increase satisfaction for both customers and executives.

The cruise industry requires a systematic approach for continuous improvement, especially concerning passenger decision-making processes and the onboard environment including layout, ambience, service, and social features (see Akter et al. 2021 a and b), see Figure 1. In Figure 1, the entire circle represents overall satisfaction, which is essentially the overall rating of the cruise. The individual segments of the circle represent different aspects of the onboard experience, including ambient conditions, layout and design, social interactions, quality of products and services, and the overall enjoyment. These factors are regarded as independent variables that can influence overall satisfaction, which is considered the dependent variable in this context. Furthermore, it's important to note that the independent variables may vary in their impact based on different scenarios and circumstances (Tsiotsou, R. H., & Wirtz, J. 2015; Akter et al., 2021 a).

Currently, the cruise industry heavily relies on the knowledge and skills of senior coordinators of ship design and building, and cruise operations, who process the information, make decisions, and pass on information and expertise to less experienced staff. The cruise experience environmental performance metrics are neither measured nor communicated between the stakeholders and real-time monitoring systems for establishing necessary Key Performance Indicators (KPIs) are not in place. Customer feedback, irregular and potentially biased, serves as the sole source of performance data, offering a view that may be disproportionately positive, neutral, or negative. Identifying customer issues is essential for continuous improvement of the cruise ships. Thus, this study introduces the cruise environment model proposed by Akter et al. (2021 a and b), which encompasses critical components such as ambient, layout/design, social engagement, product/service quality, and onboard enjoyment factors. This paper specifically emphasises the explanation of various environmental elements and the correlation between onboard environmental factors and an evolved Key Performance Indicator (KPI) is determined based on the absolute net score of the customer feedback measured with Likert scale. The computation of the KPI is automated using a standard procedure that processes customer reviews.
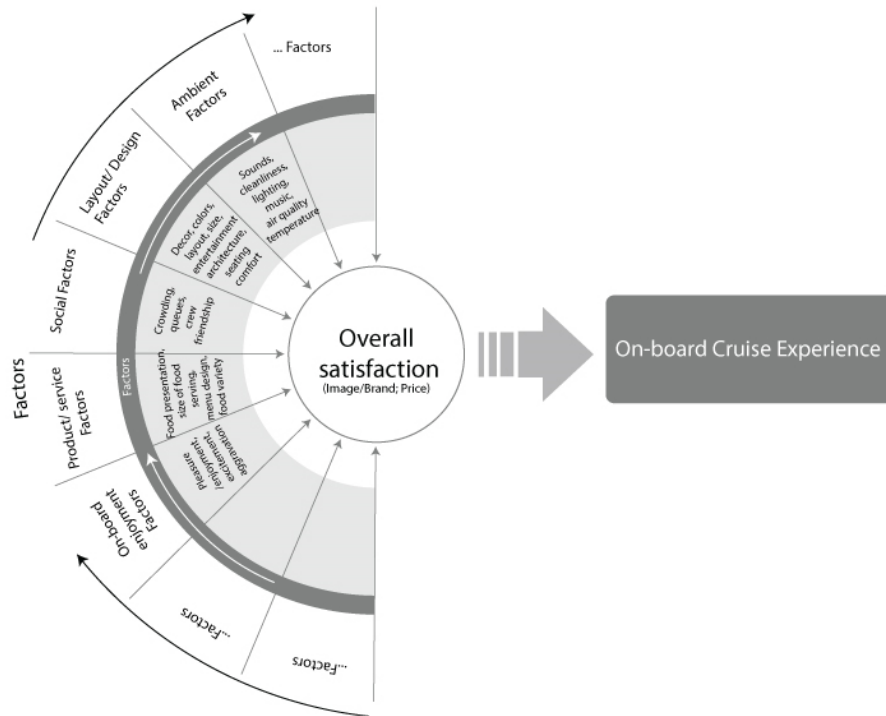
Figure 1: approach to describe onboard environmental factors affecting the onboard experience of cruise passengers'(Akter et al., 2021 a)

THEORETICAL BACKGROUND

Process and Key Performance Indicators (KPIs)

Key Performance Indicators (KPIs) are set to track and measure the performance of any advanced system. Establishing robust communication and transparency within the organization addresses the challenge of poor information flow, facilitating early problem detection. It is advisable to utilise daily reports to identify and address performance discrepancies quickly. This practice enhances visibility and accountability throughout project implementation. Establishing solid collaboration between experts and customers is crucial. In an organization such as the cruise industry, it is practical for supervisors to regularly update or auto-update projects. A steady flow of customer updates can improve production quality and meet customer demands effectively. Employing Key Performance Indicators (KPIs) is essential for tracking performance metrics. The challenge in cruise ship application is that the performance in service can be changed during and between the cruises, while issues related to the layout can be only significantly changed during ship conversions or dockings. Thus, the KPI developed must account for this bias in implementing corrective measures.

Services should be viewed as processes rather than mere outputs. The three-stage service usage model suggests that customers experience three key phases when using services: pre-purchase, service encounter, and post-encounter (Lovelock and Wirtz 2011; Tsiotsou and Wirtz 2012; Tsiotsou and Wirtz, 2015). Studies have explored each stage to understand their key factors, influences (both direct and indirect), processes, and results (Tsiotsou and Wirtz, 2015).

The pre-purchase stage: The pre-purchase phase in service decision-making is notably more intricate than that for products due to a broader range of factors and actions (Fisk 1981; Tsiotsou and Wirtz, 2015). Consumers are active participants in creating the service, so their decision-making process is longer and more complex. Consumer expertise, knowledge, and perceived risk are significant during this initial phase (Tsiotsou and Wirtz, 2015). Services, characterised by their experiential and credence attributes, are typically more challenging for consumers to evaluate before purchase (Mattila and Wirtz 2002; Zeithaml 1981; Tsiotsou and Wirtz, 2015).

The service encounter stage: Customers interact with the service provider during the service encounter stage. At this point, customers are not just buyers but active participants, helping to shape their own experiences and the final service delivered while assessing the service quality (Tsiotsou and Wirtz, 2015). Consumer engagement involves actions that show support or criticism of a service, such as giving positive feedback, recommending services to others, assisting fellow customers, blogging, posting reviews, or even taking legal actions (van Doorn et al. 2010). Recent studies highlight that consumer engagement is multifaceted, involving thinking (like being fully absorbed), feeling (such as commitment), and doing (such as energetic participation and interactions) (Brodie et al. 2011; Tsiotsou and Wirtz, 2015). Service encounters offer opportunities

for customers to develop and either positively or negatively enhance their engagement with a service provider (Tsiotsou and Wirtz, 2015). These encounters are intricate, involving customer interactions and the setting influencing consumer expectations, contentment, loyalty, intentions to repurchase, and the likelihood of recommending the service to others (Tsiotsou and Wirtz, 2015).

       The post-encounter stage: The final phase of service consumption is the post-encounter stage, which encompasses consumers' behavioural and attitudinal reactions to the service experience. Research in this stage has predominantly focused on consumer satisfaction and perceived service quality due to their significant impact on business performance (Brady and Robertson 2001; Tsiotsou and Wirtz, 2015). However, satisfied consumers with high perceptions of service quality may only sometimes become repeat customers or continue using the same service provider (Keiningham and Vavra 2001; Tsiotsou and Wirtz, 2015). Therefore, recent consumer research has shifted its focus to other crucial post-purchase outcomes, including perceived service value, consumer delight, how consumers respond to service failures (e.g., complaints and switching behaviour), and how they react to service recovery efforts. This perspective is supported by Tsiotsou and Wirtz (2015).

Onboard Environment Factors

The servicescape of a cruise company encompasses a range of physical and social factors. As Bitner (1992) identified, the physical dimensions include ambient conditions, spatial layout, and functionalities, all enriched by various signs, symbols, and artistic elements. Beyond the tangible aspects, the social environment and the sense of enjoyment on board, generated by the interactions of those present on the ship, also play a vital role. Akter et al. (2021 a and b) proposed a categorization that expands this concept to include ambiance, layout/design, social dynamics, product/service quality, onboard enjoyment factors, and the overall satisfaction. These aspects are detailed in Table 1. The ambient conditions, highlighted by Jeon and Jeong (2009), consist of sensory elements such as temperature, colour, lighting, noise, music, and scent. These elements shape customers' perceptions of the cruise service environment.

       Functional components such as architectural design, spatial layout, and functionality are essential in-service environments. They dictate the placement and interrelation of items like furniture, equipment, and service areas crucial for exhibitors to deliver services effectively. Such arrangements directly impact customer comfort and their emotional reactions. The physical environment's design, including ambiance, layout, and functionality, significantly influences consumer behaviour toward a service or business. Functionality specifically pertains to the enhancement of the service process and customer experience. Creating a user-friendly setting is crucial for customer satisfaction, as detailed by Rosenbaum and Massiah (2011).

       In addition to the physical environment, a customer's decision-making process is also swayed by social elements and the service or product quality (Andersson, 2013). The servicescape model posits that the collective emotions within a service setting are mirrored by the interactions among employees, customers, and the venue's social density (Dad et al., 2016). It has been observed that several product and service dimensions, namely the culinary experience, presentation of dishes, size of servings, menu creativity, diversity of cuisine, and calibre of service, are critical to customer satisfaction (Akter et al., 2021a and b). The factors contributing to pleasure while onboard are linked to emotional states such as happiness, joy, excitement, and overall engagement. It has been further noted that a customer's comprehensive satisfaction correlates with aspects including the nation of service, the establishment's brand image, pricing, symbolic elements, artefacts, and the experience of value for money (Akter et al., 2021a and b), see Table 1.

Table 1: Attributes of onboard environmental factors and overall satisfaction (extended from Akter et al., 2021a and b)

Ambient Factors		
	Dimensions	**Attributes**
	sounds	music /sound effects; audio (music, noise); favourite sounds; auditory cues /elements. (e.g. music, noise; non-musical sound; music/sound effects; background music; both a quiet and loud disco, piano music acoustics, noise/ noise (level, pitch)
	cleanliness	cleanliness (scent, air quality, fragrance); cleanliness: coins, ashtrays, ceiling, machine screens, employees appearance, overall cleanliness; aesthetic cleanliness
	lighting/ light	visual aesthetic (lighting)
	air quality	air quality e.g. temperature, humidity, circulation /ventilation; ambient (temperature)
	odour	aroma/scents; olfactory cues (scent, air quality, fragrance)
	taste/smells	sensory component: seeing, hearing, smelling, touching, tasting; textures
	comfort and discomfort	seating comfort, seating comfort: seat back, elbow room, distance from table, overall comfortableness, easy in and out, comfortable furniture uncomfortable chairs, comfortable workspace
	color	colors used; color schemes; visual aesthetic
	atmosphere	atmosphere refers specifically to relaxing, having fun, home- and country-specific
	visual attractiveness	quality photos, animation effects, virtual tour; visual (e.g. lighting, colors, brightness, shapes visual aesthetic (shapes); materials sensory elements e.g. color, light, texture; variety, uniqueness, quality
Layout/design factors		
	Dimensions	**Attributes**
	style of décor	interior décor; design; interior design e.g. layout/ store layout/layout accessibility/overall structure/layout; design characteristics e.g. form, size, texture, animation; décor e.g., furniture, fixtures, artifact; the design of the outdoor areas, and a calm experience; separate design area for all age groups; classical and stylish restaurants; interior (design, equipment, furniture, layout); design factors: floor and carpet, aisle width, wall composition, paint and wallpaper, ceiling composition, merchandise, layout, drink placement, bar placement, cash register placement, waiting areas, waiting rooms, dance floor locations, traffic flow, queues, furniture, point of purchase displays, signs and cards, wall decoration, license and certificates, artwork, product displays, price displays, entrances; furniture; arrangement of furniture equipment; interior décor: background colors, electric signs design, wall treatment design, floor treatment design, overall design attractiveness; the design of the outdoor areas, and a calm experience; exterior factors: exterior signs, display windows, surrounding stores, address and location, architectural style, surrounding area, parking, exterior walls; luxuriously styled areas such as large windows provide a unique and beautiful panoramic view of the sea; ocean-view balconies; perceived services cape for exterior (external) variables e.g. entrance, parking, architecture, design, exterior design, surrounding area location and so on; landscape, architecture, parking; design and arrangement of buildings
	colours/ style of décor (incl. colour)	architecture, color; aesthetic e.g. color, style; aesthetic e.g.materials décor
	scale/size	shape, room/cabin size, spacious, modern and comfortable cabins; aesthetic e.g. scale shape: spacious, modern and comfortable cabins; space/function; shapes, symbols; signs, symbols and artefacts e.g. signage/ directional signage; informational signage, interpretational signage; personal artifacts
	architectural entertainment	product/service: room, restaurant, ball room, fitness center, kids center, uniqueness/hotel, resort, boutiques, and galleries; bathroom: bath, shower; basic amenities; considerations: non-smoking, swimming pool, high speed internet, fitness center, pet

		allowance, promenade and comfort; object-based authenticity: architecture impression, peculiarities of interior design, attractive historical town, heritage information; architecture; aesthetic e.g. architecture
	comfort or arrangement of seating	uncomfortable chairs, comfortable workspace
	space/function/layout and quality	layout e.g. easy to move, convenience; overall structure; traffic flow; way finding; quality of product: form, quality of performance, durability, design; assortment e.g. variety, uniqueness, quality; more single seating, more group seating , separate design area for all age groups; aesthetic e.g. texture, pattern; product display; overall structure/layout, navigation, way finding, the nine-story atrium, direct access to the spa, ocean-view balconies; use of space, space/function; need enough workspace; alternative space solutions; space/function consists of layout, equipment and furnishing; accessories-functional e.g., layout, comfort, signage, accessories
	product/furniture/displays	product display; furnishings; product assortment; amenities (tools, IT, equipment); equipment/ electric equipment and display/dining equipment; equipment, space/function: lounge (socializing), kitchen, toilet/shower, equipment (XX); furnishings, spatial crowding

Social factors

	Dimensions	Attributes
	crowding	the level of crowd, the type of crowd; lack of privacy
	queues	front desk/check in
	friendliness of the crew	staff: attitude, enthusiasm, politeness, courteous, commitment, friendliness, staff quality; staff behaviour: customer orientation credibility; suitable behaviour; friendly staff, helpful staff, personalized, always there employee response: enjoy working and helping guests, feel happy; the nature of interactions; personal service; crew members' language skills and communication
	embarkation experience (employee-customer support, customer-to-customer interaction)	crew members' communication; friendly, helpful, happy, always look happy, cozy and welcoming atmosphere, homelike, security; privacy; personal service; crew members' language skills and communication; customer: being friendly with other guests; number, type and behaviour of customers and employees; customers: customer types, number, appearance; employees: service, personal, number, appearance, uniforms; customers' image, employees' image; social interactions between and among customers and employees; employees, customers, social density, displayed emotions of others; verbal interaction; interaction with others; reference groups, reviews ; seeing others as motivation, others as distraction ; social scape: social relationship; displayed emotions of others (emotional contagion); service relationship ; in between salespeople relationship quality, salespeople store manager relationship quality; surroundings: couple-friendly, children-friendly; maintenance standard; employees' good/bad lookin; employees: service, personal, number, appearance, uniforms , physical appearance, both casual and formal attire with some preferring more casual dress; staff image: competence physical attractiveness, in addition, personal service: both casual and formal attire with some preferring more casual dress

Product/service factors

	Dimensions	Attributes
	food quality	food and service experience refer specifically to food quality: delicious food and beverages
	food variety	food variety: in culinary terms such as offering many choices, cuisine offering almost all tastes, offering a '50s-style diner, American fast food, serving a variety of coffees, offering Italian food with five different restaurants, 12-13 bars with a wide variety of beverages
	food presentation	food presentation: providing different possibilities for enjoying food, providing the panoramic views through the meter-high glass; the size of food servings, menu design, the variety of food, food experience, variety, uniqueness,
	service experience	offers personal, friendly, professional and 24-hour free cabin service, etc. ;service interface: service person (customer room service), technological support, call center, service guarantee, facility, security; service experience of expenses on-board refer specifically to the cost of a bottle of wine around 22 USD and above ; passengers need to pay 11 and 12 USD as a service charge per day ; additional charge for a table reservation, private experience, and private chef facilities ; a service charge added to the

		drink prices ; whereas no additional charge for a pizzeria or sea view café ; an extra charge for breakfast in the cabin, and so on ; product/product characteristics: convenience vs. specialty, durable vs. nondurable; mattress, pillow comfort; complementary product, material; price (expensive, discounted, or affordable); additional charge; Environment -approval, others e.g. customer service, window display
	serviceability factor	convenience in layout, privacy, communication, w/staff wayfinding, cleanliness.
	Service encounter	service encounter- product quality e.g. variety /choice; value for money
	perceived serviceability	way finding, privacy protection, comfortable furniture, conduciveness to communication with staff, convenient layout
On-board enjoyment factors		
	Dimensions	**Attributes**
	pleasure or enjoyment; entertainment/emotional experience	entertainment experience activity includes a surf simulator; a romp in the aqua park; bathing in two whirlpools that hang XX metres above the sea; a sky pad virtual reality experience; a glow-in-the-dark laser tag facility; the "perfect storm" waterslide trio for all water lovers aboard; wall climbing; swimming pool; long water slide; sauna; mini-golf; enjoying fascinating shows; a 4d cinema; escape room; musical evenings, musical evenings; musical evenings; big casino; a disco; many bars; art auctions and has around XX paintings and sculptures; classic bingo games and lectures; various shops to avoid boredom, and so on; excitement, aggravation; consumer attitudes: innovativeness; variety, uniqueness, quality
	sports, fitness, and wellness	entertainment experience activity includes sports, fitness, and wellness refer specifically to sports and leisure activities for people of all age groups, or mostly focuses on younger groups of people; inside and outside the sports court; fitness gyms; a spa offering many different treatments for fees; a spacious fitness area with a splendid ocean view; a pool with a relaxation area; fitness centre and courses, XX square metres of facilities for wellness and relaxation; a large samsara spa and treatments, and so on
Overall satisfaction		
	Dimensions	**Attributes**
	country image or brand	cruise brands (an American or an Italian or other); includes a brand with an incredible history; the image of the country of its builders (Finland, German, Italy, other etc.); preferably focusing on all age groups or a mostly younger group of people; family-friendly ships; largest cruise ship; utility: market value brand, term and conditions, location convenience, price range, reputation, overall quality, risk management, trust, security
	price/ cost experience	price: discount, price conformity to product quality; cost experience; such as a good return on value for money, ticket price; choice: comparison, star-ratings, pictures, sorting facility, reviews, offers; in details, price e.g. loyalty program, member card, events program, advertisement; in details, promotion e.g. advertisement, sales promotion, personal selling, public relation; customer relationship: loyalty program, previous usage experience; consumer attitudes (e.g., price sensitivity, involvement, innovativeness)
	sign, symbol and artefacts	such as a slow cruise, a real adventure; often feeling as if the passengers are on board a floating city; physical clues; maps and painting; search aids & slogans: keywords, meta-tag, slogans
	approach/avoidance	switching behaviour, switching intent; customers e.g. individual response - approach e.g. affiliation, exploration, stay longer, commitment, carry out plan avoid

MODEL AND RESEARCH METHODOLOGY

To examine the environmental factors affecting the onboard customer experience, Akter et al., (2021a and b) have identified following key factors: ambient, layout/design, social, product/service, and onboard enjoyment factors that result in overall satisfaction. To connect the passenger overall satisfaction to these elements of design, we have sorted the questions of one openly available website Cruisecritic according to these dimensions. The questions used on the website are about cabin quality, public rooms, family, embarkation, dining, service, value for money, entertainment, fitness and recreation and overall satisfaction. The questionnaire is divided into six sections. The questions of the first factor are related to *ambient factors* such as sounds, cleanliness, lighting, music, temperature, air quality, odour, etc., which impact the question related to, for instance, the cabin and public rooms. On the other hand, the *layout/design* factors of the cruise consisted of interior design, entertainment architecture, etc., which in turn impact questions about cabin, public rooms, family. Moreover, the *social factors* of the cruise consist of crowding, queues, crew friendship, embarkation experience, etc., influence questions about embarkation procedures and family interactions. *Product/service* factors of the cruise involve food experience, service experience, etc., which refer to questions regarding dining, service, and value for money. *Onboard enjoyment* factors of the cruise lie in pleasure or enjoyment, excitement, aggravation, entertainment experience, etc., referring to the questions regarding entertainment and fitness and recreation. In addition, factors contributing to *overall customer* satisfaction include the country image or brand and price, etc., impacting questions regarding questions about overall satisfaction and value for money. Respondents were requested to provide their agreement level of each item on a five-point Likert scale, where 1 is considered "strongly disagree," and 5 is "strongly agree. The answers were weighted as arithmetic means of the scores of the sub questions." The overall passengers' satisfaction is modelled with a regression model:

$$Ys = \beta o + \beta 1 X1 + \beta 2 X2 + \beta 3 X3 + \beta 4 X4 + \beta 5 X5 + e \qquad [1]$$

where Ys = tourists' overall level of satisfaction, βo = constant (coefficient of intercept), X1 = ambient; X2 = layout/design; X3 = social; X4 = product/service and X5 = onboard enjoyment factors; $\beta 1$,..., $\beta 5$ = regression coefficients and e = error term. We use the data from two ship classes from Royal Caribbean Cruise Lines: Freedom (3 ships, built 2006-2008) and Radiance class ships (4 ships, built 2001-2004). The ships present different eras of design and sizes, see for technical details and KPI's (crew to passenger, GT to passenger and stateroom to passenger -ratio) Table 3.

Table 2: Onboard environmental factors for cruise- Freedom and Radiance class effects on the onboard cruise experience

Factors	Dimensions	Case company's elements	Questions number
Ambient Factors	Sounds, cleanliness, lighting, music, temperature, air quality, odour, and so on	cabin, public rooms	1A, 1B
Layout/ design Factors	Style of décor, colours, size, architectural entertainment, the comfort or the arrangement of seating	cabin, public rooms, family	2A, 2B, 2C
Social Factors	Crowding, queues, the friendliness of the crew, embarkation experience	embarkation, family	3A, 3B
Product/ service Factors	Food presentation, the size of food servings, menu design, food variety, food experience and food quality; service, service experience provided by companies	dining, service, value for money	4A, 4B, 4C
Onboard enjoyment Factors	Pleasure or enjoyment, excitement, aggravation, emotional response, emotional experience, entertainment experience	entertainment, fitness and recreation	5A, 5B
Overall satisfaction	Country image or brand, sign, symbol and artefacts; price, cost experience	overall, value for money	6A, 6B

Table 3: Ship Facts

Ship Facts	**Royal Caribbean International - Freedom-class cruise ships**			**Royal Caribbean International - Radiance- class cruise ships**			
	• The Freedom of the Seas • The Liberty of the Seas • The Independence of the Seas			• The Radiance of the Seas • The Brilliance of the Seas • The Serenade of the Seas • The Jewel of the Seas			
Cruise name	**The Freedom of the Seas Facts**	**The Liberty of the Seas Facts**	**The Independence of the Seas Facts**	**The Radiance of the Seas Facts**	**The Brilliance of the Seas Facts**	**The Serenade of the Seas Facts**	**The Jewel of the Seas Facts**
Built in	2006; renovated 2015	2007	2008; renovated 2018	2001; last renovated 2016	2002; last renovated 2013	2003; last renovated 2012	2004; last renovated 2016
Builder	Kvaerner Masa-yards, Turku Finland			Meyer Werft yard, Papenburg, Germany			
Tonnage	156,271 GT	154,407 GT		90,090 GT			
Length	1,112 ft			962 ft		965 ft	962 ft
Wide/ beam/width	185 ft	185 ft	185 ft	106 ft	106 ft	106 ft	106 ft
Draft/ draught	29.5 ft	28 ft	28 ft	28 ft	28 ft	28 ft	28 ft
Speed	21.6 knots	21 knots	21.6 knots	25 knots			
Guest capacity	3,934 (double occupancy); 4,553 (total)	3,798 (double occupancy), 4,960 (total)	3,858 (double occupancy), 4,560 (total)	2,143 (double occupancy), 2,466 (total)	2,142 (double occupancy), 2,543 (total)	2,146 (double occupancy), 2,476 (total)	2,191 (double occupancy); 2,702 (total)
Decks	14 guest, 15 total, 14 passenger elevators			12 guest, 13 total, 9 guest elevators			
Crew	1,447 (internationa)	1,360 (internationa)	1,440 (internationa)	894 (international)	848 (international)	848 (international)	852 (international)
Staterooms	1,967	1,899	1,929	1,071	1,070	1,073	1,097
GT/pax	34.32	31.13	33.86	36.53	35.43	36.39	33.34
Crew/pax	0.32	0.27	0.32	0.36	0.33	0.34	0.32
Stateroom/pax	0.43	0.38	0.42	0.43	0.42	0.43	0.41

Sources: (Extended from Akter et al., 2021b)

DATA ANALYSIS AND DISCUSSION

Freedom class had 385 respondents (Freedom of the Seas 105, Liberty of the Seas 127, Independence of the Seas 153), and Radiance class, 370 respondents (Radiance of the Seas 62, Brilliance of the Seas 72, Serenade of the Seas 115, Jewel of the Seas 121), from the Cruisecritic website covering the period from January 1st 2019 to October 26th 2022 (total 773 respondents). The cruise company pays close attention to various aspects of the onboard cruise experience, such as cabin quality, public rooms, family, embarkation, dining, service, value for money, entertainment, fitness and recreation, and overall satisfaction. While some of questions may be related and interconnected, they are crucial for evaluating different aspects of the cruise experience and the overall process satisfaction. The post-travel experience per onboard environmental factors is summarised in Appendix and Figure 2. The regression model parameters are summarised in see Table 4.
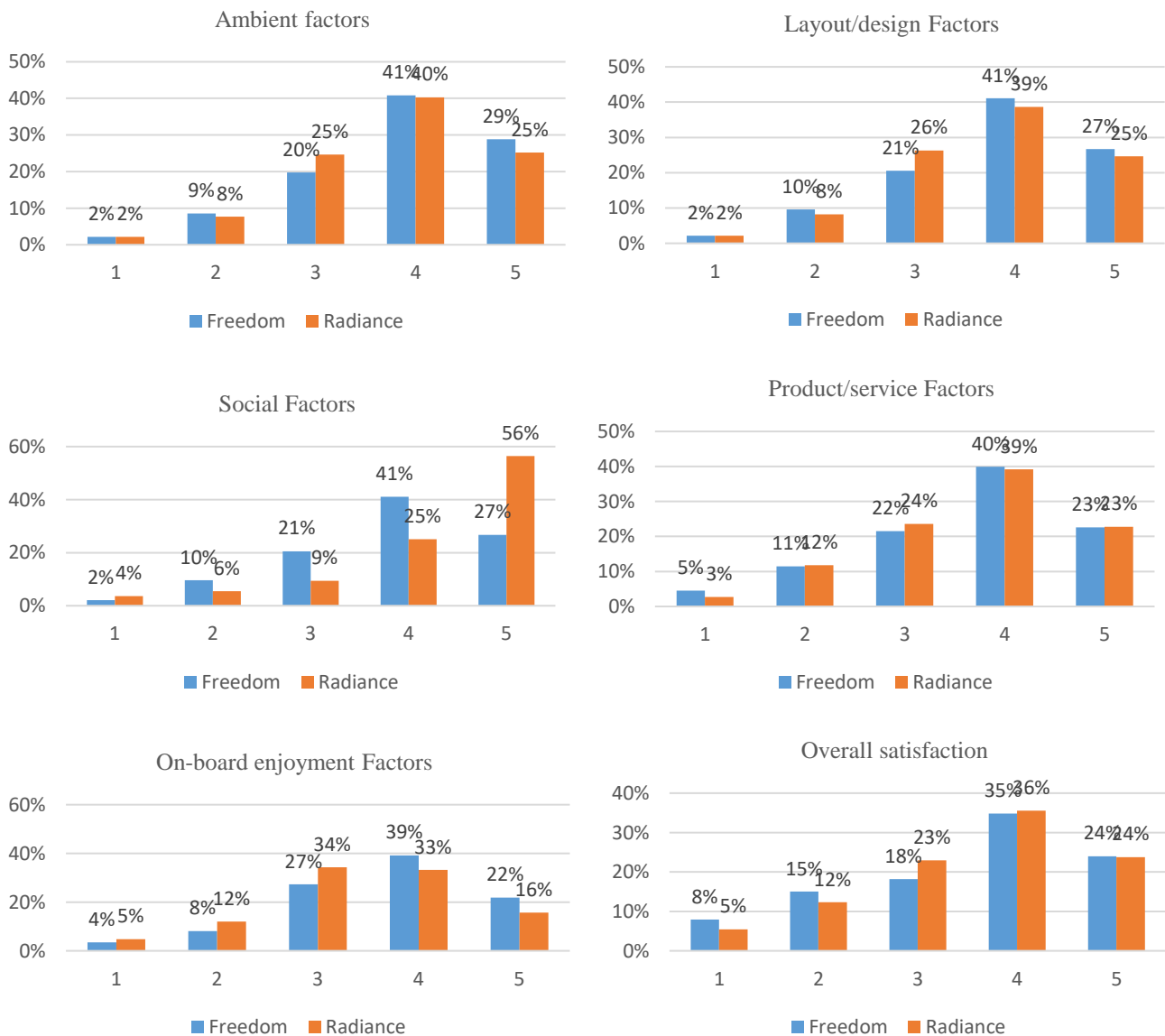

Figure 2: summary the post-cruise experience data observed in the two case ships' classes

In the category of **"ambient factors,"** it is apparent that the, older and in terms of size smaller, Radiance class ships received slightly lower customer satisfaction scores than those of the Freedom class at the scale of between 5 and 4. Notably,

the number of passengers rating their satisfaction at the higher end of the scale (5) increased for both the Freedom and Radiance classes, with a larger concentration of Radiance class customers assigning a rating of 3 compared to Freedom class. Conversely, both ship classes recorded a substantial tally of lower-end scores, between 1 and 2, signalling customer dissatisfaction.

The newer Freedom class ships outperformed, with a notable 41% of respondents rating their satisfaction with **"layout/design"** at level 4. The Radiance class, while also receiving a significant positive response, peaked at 39% respondents giving a score of 4. However, the Freedom class ships were marked by a larger proportion, 10%, of responses at the lower satisfaction level 2, signifying a measure of discontent. Across both classes, there was a pronounced trend of passenger opinions favouring the higher end of the satisfaction scale (5).

From the gathered data, it is evident that **"social aspects"** were highly rated, with the Radiance class receiving a peak of 56% responses at the highest satisfaction level 5, followed by the Freedom-class with 27% respondents also giving a score of 5. Moreover, the distribution of responses shows a noticeable number of low-end ratings, suggesting some passengers experienced dissatisfaction. Notably, when considering the mid-range satisfaction level 3, passengers in the Freedom class exhibited a marginally higher contentment than those in the Radiance class.

Regarding **"product/service"** factors, the scores are more equal, with 40% and 39% passengers rating their experience at the satisfaction level 4 and equal scores of 23% at the highest level of 5. This indicates that the crew operations are almost equal and thus the age and size of the ship seems not to correlate with the ratings. Despite this, the Freedom class ships observed a larger share of lower ratings, specifically level 1, suggesting higher dissatisfaction among its passengers than those on the Radiance class ships.

In terms of **"onboard enjoyment"** factors, analysis reveals that the Freedom class ships receive, as a newer ship, many positive responses, with 39% of guests rating their satisfaction at level 4 and 22% on the level 5. The Radiance class also attained a robust satisfaction score, with 33% of guests granting a level 4 rating. Additionally, the Freedom class ships recorded fewer low-end ratings, between 1 and 2, indicating a generally satisfactory experience among its passengers.

Finally, the element of "**overall satisfaction**": Regarding "overall satisfaction," the figures reveal that the Radiance class notched up 36% high-level satisfaction responses (scores of 4), while the Freedom class had a corresponding value of 35%. Both classes recorded a notable cluster of responses at the satisfactory level of 5, which amounted 24%. Comparatively, the Radiance class had fewer low-end ratings, indicative of a more satisfying passenger experience than the Freedom class, which displayed greater dissatisfaction overall (see Appendix).

Table 4: Implementation of the Equations

|	
Freedom class, Model: Overall satisfaction = -1.114 + 0.42 Layout/design factors +0.59 product/service factors +0.21 onboard enjoyment factors +error.	Shares of Contributing Environmental Factors +59%, in product/service factors (e.g., dining, service) +42% layout/design factors (e.g., cabin, public rooms) +21%, onboard enjoyment factors (e.g., entertainment)
Radiance class, Model: Overall satisfaction = -0.758 + 0.32 Layout/design factors +0.68 product/service factors +0.16 onboard enjoyment factors +error.	+68%, in product/service factors (e.g., dining, service) +32% layout/design factors (e.g., cabin, public rooms) +16%, onboard enjoyment factors (e.g., entertainment)
Freedom and Radiance class together, Model: Overall satisfaction = -1,005 + 0.35 Layout/design factors + 0.06 social factors + 0.61product/service factors + 0.19 onboard enjoyment factors +error.	+61%, in product/service factors (e.g., dining, service) +35% layout/design factors (e.g., cabin, public rooms) +19%, onboard enjoyment factors (e.g., entertainment) +6%, social factors (e.g., embarkation, family)
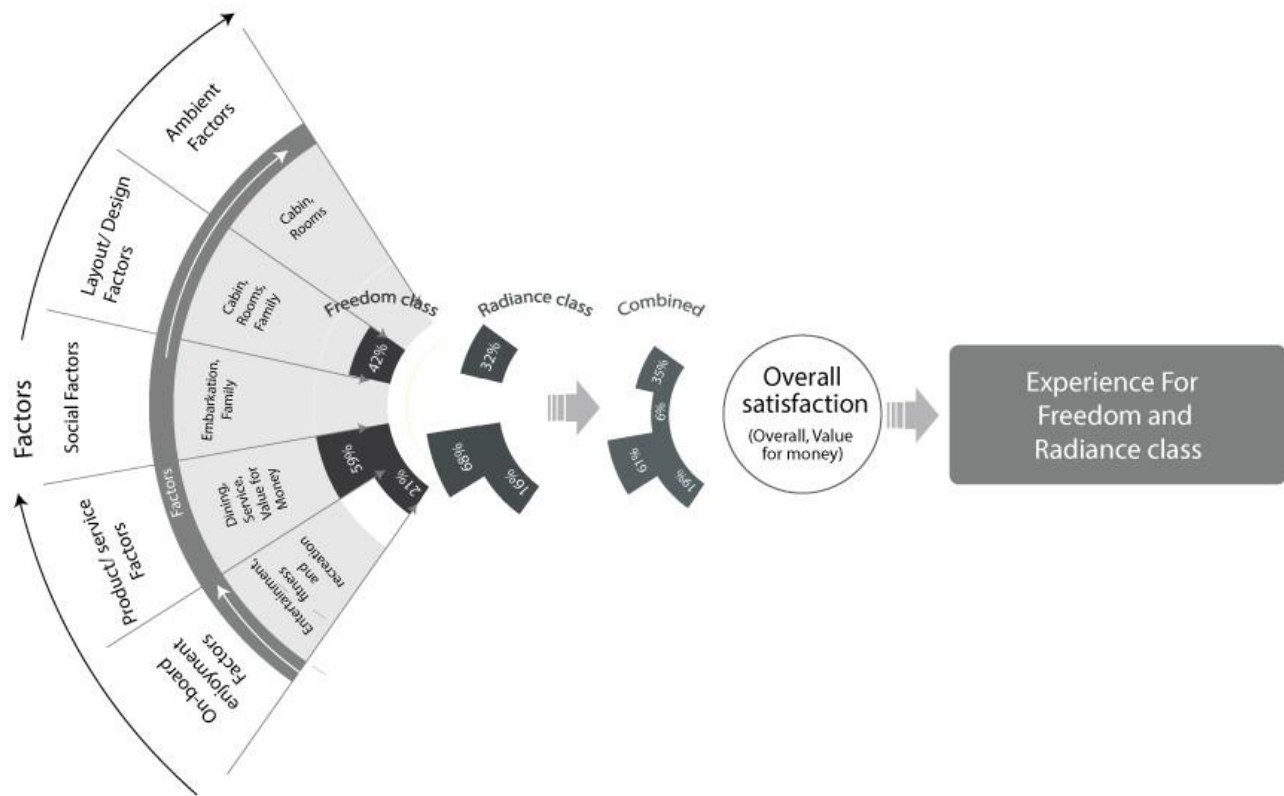
Figure 3: A proposed model of user motion to describe factors affecting the onboard experience in "Freedom and Radiance class".

As Table 4 indicates, the proposed environmental framework, and resulting regression model can be used to describe the ratio of ambient, layout/design, social, product/service, and onboard enjoyment factors on the overall satisfaction, see Figure 3 for Freedom and Radiance class separately and together. In Freedom class, 59% is the factor for the product/service factors, 42% for the layout/design factors, and 21% for the onboard enjoyment factors respectively; neglecting the effects of ambience and social factors completely. On the other hand, in Radiance class 68% is the factor for the product/service factors, 32% for the layout/design factors, and 16% for the onboard enjoyment factors; again neglecting the effects of ambience and social factors. In contrast, when the two ship classes, Freedom and Radiance are considered together, the resulting factors are 61% in product/service factors, 35% in layout/design factors, 19% in onboard enjoyment factors, and 6% in social factors respectively; this time only ambience neglected in the regression model. When using the model, comparing performance before and after making improvements and conversion in the layout, service etc is essential to evaluate how effective these improvements are in practice. Thus, the regression model proposed needs updates and new data after improvements. Here, Key Performance Indicators (KPIs) Tables 1 and 2 are set up for the purpose of continuous enhancement and commitment to quality. Employing KPIs is crucial for tracking performance, increasing productivity, and ensuring that operations align with the organization's larger goals. Based on these critical success factors' affected ratio, decision-makers can focus on further development and acquiring more information, continuing this analysis to determine areas for improvement.

CONCLUSIONS

There has been a growing need for data mining and knowledge management (KPI) techniques to uncover and utilise the insights hidden within large volumes of stored data. This study investigated how different onboard environmental factors, including the ambient, layout/design, social elements, products/services, and entertainment, relate to overall passenger satisfaction after the cruise. The Key Performance Indicators (KPIs) were derived based on these elements. Based on the data from a public website, a simple regression model was derived for two cruise ship classes from the same operator. The resulting regression models were found to be different when ship classes were treated separately or together. In the newer ship class, the layout/design and onboard enjoyment factors dominated the overall satisfaction, while in the older ship class, product/service factors dominated. This indicates that the operators should change their strategy in securing customers' overall satisfaction as new ship classes enter their fleet. In both cases, the ambient and social factors were less significant contributors to overall satisfaction; in the

case where the ship classes were combined social factors became somewhat important. When the data changes, this conclusion can naturally change.

To discover customer behaviour or tendencies, data-driven regression methods should be exposed to large data sets from public and company databases. However, the data set used in this paper shows the potential of the proposed model in helping the decision-makers plan their actions related to the ship design, conversions/maintenance, and operations. Implementing the proposed model to larger data sets is left for future work, which should be done in the industry rather than academia due to sensitive source information.

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APPENDIX

The research utilised SPSS software for a five-step data analysis process involving reliability testing, exploratory factor analysis for data validity, correlation, and regression analysis. The basic information is given in Tables 5 to 7.

Table 5: Overall satisfaction coefficient regression model. Freedom Class (N=360).

Predictor variable	Outcome variable	Global F (p-value)	Intercept / Constant	Unstandardized Coefficients B	R^2	Adjusted R^2	Result
Ambient factors	Overall satisfaction	>0.001		-0.212	0.788	0.787	Not Supported
Layout/design factors	**Overall satisfaction**	**<0.001**	**-1.114**	**0.417**	**0.788**	**0.787**	**Supported**
Social factors	Overall satisfaction	>0.001		0.050	0.788	0.787	Not Supported
Product/Service factors	**Overall satisfaction**	**<0.001**	**-1.114**	**0.594**	**0.788**	**0.787**	**Supported**
On-board enjoyment factors	**Overall satisfaction**	**<0.001**	**-1.114**	**0.210**	**0.788**	**0.787**	**Supported**

Table 6: Overall satisfaction coefficient regression model. Radiance Class (N=337).

Predictor variable	Outcome variable	Global F (p-value)	Intercept / Constant	Unstandardized Coefficients B	R^2	Adjusted R^2	Result
Ambient factors	Overall satisfaction	>0.001		-0.034	0.830	0.828	Not Supported
Layout/design factors	**Overall satisfaction**	**<0.001**	**-0.758**	**0.316**	**0.830**	**0.828**	**Supported**
Social factors	Overall satisfaction	>0.001		0.024	0.830	0.828	Not Supported
Product/Service factors	**Overall satisfaction**	**<0.001**	**-0.758**	**0.683**	**0.830**	**0.828**	**Supported**
On-board enjoyment factors	**Overall satisfaction**	**<0.001**	**-0.758**	**0.159**	**0.830**	**0.828**	**Supported**

Table 7: Overall satisfaction coefficient regression model. Freedom and Radiance Class (Together N=716).

Predictor variable	Outcome variable	Global F (p-value)	Intercept / Constant	Unstandardized Coefficients B	R^2	Adjusted R^2	Result
Ambient factors	Overall satisfaction	>0.001		-0.161	0.806	0.805	Not Supported
Layout/design factors	**Overall satisfaction**	**<0.001**	**-1,005**	**0.348**	**0.806**	**0.805**	**Supported**
Social factors	**Overall satisfaction**	**>0.001**	**-1,005**	**0.061**	**0.806**	**0.805**	**Supported**
Product/Service factors	**Overall satisfaction**	**<0.001**	**-1,005**	**0.609**	**0.806**	**0.805**	**Supported**
On-board enjoyment factors	**Overall satisfaction**	**<0.001**	**-1,005**	**0.188**	**0.806**	**0.805**	**Supported**