Stakeholder Drivers for Cabin Interior Design

MASTER LIST: change here to update driver and factor titles used in the other sheets

D#	Driver	Description	Comments	F#	Factors	Definition	Comments	Example Criteria	References
	Top-level motivation *Based on Profitability equation at the root*	***Explanation*** *Implication of each top-level driver*	***Important additional information*** *Relevant considerations when processing the drivers*		***Mid-Level implications*** *Lower-level factors associated with each driver:* *- some factors are interdependent* *- may represent mixed technology effects*	***Mid-level effects*** *Definitions are generic; the specific implication of the constituent factors depends on the point of view: the same factor will embody different qualities if considered by a passenger, an airline, an equipment manufacturer, etc.*	***Important additional information*** *Important considerations and additional information useful for applying the defined factors to a cabin project or adopting for a revised NPDI method.* ***Note:*** *Cabin Solution = cabin product, service, technology, design feature, or any other distinct item being analysed.*	***Bottom-level design considerations (with KPI per unit time)*** *Detailed examples of the design criteria or specific requirements that may be derived to implement the presented factors. Criteria weights to be assigned based on the higher-level design factor weights (equal criteria weights within each factor), or assigned by the user based on their internal preferences and needs for the project.*	***Where is it from*** *Example sources discussing the proposed criteria*
1	**Revenue Potential**	Revenue parameters controlled by the respective stakeholder and driven by sales volume	*Revenue potential directly fed by the sales and provision of goods to users*	**a**	**Brand Image**	The effect of a cabin solution on the public perception of stakeholder's brand value and reputation.	The subjective reflection of stakeholders' brand value and reputation in public perception. Affected by the user's ability to leave service/product reviews and its differentiation. Affects stakeholder's share price. More reliable in relative terms (compared against competitors or past performance) rather than as an absolute assessment (with no comparison basis).	- User reviews in social media or other information sources (# reviews and rating pattern) - Impact on demand potential (Δ% seats) - The ability to dictate pricing (Δ% seats due to price adjustments)	[05], [30], [39], [40], [53], [73], [77], [78], [80] - [84], [87] - [89], [100] [104], [105]
				b	**Promotion Channels**	Stakeholder's capability to realise effective promotion of their own products or services using the cabin solutions implemented.	The ability of a cabin solution to facilitate, expand, diversify, and enhance the effectiveness of Stakeholders' opportunities to market their own products/services. Affects Brand Image, differentiation.	- Promotion channels available (number of individual channels) - Promotion channel effectiveness (Δ% revenue/seats sold due to given channel) - Utilisation effects: increased cabin capacity fulfilment due to new cabin solutions (avg. Δ% revenue/seats)	
				c	**Upfront Pricing**	Facilitation of effective approaches to setting the price levels for accessing the baseline products/services offered with the flight booking.	Operator's endowment to leverage baseline product/service pricing without losing demand, as enabled by a cabin solution. Reflects inherent significance of new equipment for the user.	- Baseline price effects created by new equipment (e.g. Δ% ticket revenue) - Targeted demand: attraction of the target user persona (perennial: Δ% seats sold) - Collateral demand: attraction of the non-targeted user persona created by new cabin solutions (same KPI) - Utilisation effects: increased cabin capacity fulfilment due to new cabin solutions (avg. Δ% revenue/seats)	
				d	**Access Pricing**	Facilitation of effective approaches to define on-demand product/service pricing schemes that are realised after the passenger has booker their flight.	Operator's opportunity to impose or adjust on-demand or usage-based pricing schemes after ticket sale, e.g. upgrade service level in-flight. Reflets instantaneous cabin equipment value for money to the users.	- Ancillary revenues enabled by selling on-demand cabin access to products or services available in-flight (Δ% ancillary revenue) - Targeted demand: attraction of the target user persona (transient: Δ% ancillary revenue) - Collateral demand: attraction of the non-targeted user persona created by new cabin solutions (same KPI)	
				e	**Growth Potential**	The potential for keeping the demand for the same product/service stable or increasing above the original levels in the near/mid-term future.	The state of market dynamics when near- and mid-term demand for a specific product/service in its original form will remain compatible with user trends without the need for significant development or upgrading.	- Sales dynamics for product version or its minor evolutions (Δ% sales as revenue or volume)	
				f	**Innovation Capacity**	Long-term potential for viable product/service evolution beyond the original baseline.	Long-term market ability to absorb future product/service development profitably. Offers the scope for product innovation by updating, upgrading, expanding, or otherwise changing it to align with changing user trends.	- The presence of product characteristics enabling its evolution (yes/no) - The promise of viable demand for an updated product (expected sales)	
2	**Collaborative Potential**	Revenue parameters dependent on other stakeholders and requiring collaboration	*Revenue potential enabled by collaboration among the service and goods providers*	**a**	**Distribution Channels**	Product/service distribution channels enabled by the implemented cabin solutions.	Impact that a cabin solution has on the diversity of primary stakeholder opportunities to distribute their products. Does not include in-flight retail of consumer goods from secondary stakeholders.	- Added stakeholder revenues due to newly enabled distribution channels (Δ% revenue)	[73], [100], [105]
				b	**Advertising Channels**	Stakeholders' ability to effectively advertise products/services offered by the other stakeholders enabled by the implemented cabin solutions.	The ability of a cabin solution to facilitate, expand, diversify, and enhance the effectiveness of Stakeholders' opportunities to advertise products/services on behalf of other stakeholders. Affects collaborative impacts due to B2B and B2C promotion.	- Added revenues from partner advertising through new cabin solutions (Δ% revenue)	
				c	**Co-Branding Potential**	Facilitation of productive collaboration between several cabin interior stakeholders realised through joint delivery of cabin solutions.	Stakeholder partnership opportunities for mutual amplification of capabilities and reinforcement of synergistic benefits enabled by jointly offered products/services.	- Added revenue from collaborative product/service development (Δ% revenue) - Cost-saving due to collaboration on product/service development (Δ% cost)	
				d	**Retail Channels**	Facilitation of the operator's capability to effectively sell products or services offered by other stakeholders to passengers in-flight.	Impact of cabin solutions on the diversity of stakeholder opportunities to distribute products on behalf of partner stakeholders. Includes in-flight retail of consumer goods from secondary stakeholders.	- Added revenues from newly enabled partner retail channels (Δ% revenue)	
3	**Passenger Perception**	Intrinsic qualities of the cabin elements affecting passive passenger perception.	*Revenue streams and motivators for raising profit margins conditioned by the passengers' willingness to pay, which arises from their subjective perception of the cabin and flight experience enabled by it, and may be conscious or implicit, physical or mental*	**a**	**Physical Comfort**	The alignment of cabin elements with user anthropometry affecting the perception of bodily comfort.	The sensations created across the contact area at the physical body-seat interface affected by the structures, surfaces, covers, padding, etc. Primarily relates to the extended physiological reactions created by the involved contact forces and support moments while seated, but also covers other activities. Affected by the physical features of cabin elements (texture, hardness, elasticity, temperature, etc.) and its alignment with user anthropometry (body position, angles, proportions). Affects user's physical wellbeing.	- The distribution and intensity of mechanical force points across body-seat contact surface (Pascals) - Physiological effects due to prolonged sitting (tension, compression, pains, etc.)	
				b	**Cabin Purity**	Passenger's perception of explicit cabin cleanliness and implicit hygienic quality.	Consists of: - explicit purity = cleanliness: a lack of waste; - implicit purity = hygiene: intrinsic product qualities enabling good health. Reflects cabin qualities that prevent health risks due to e.g. surface contamination. Applies to all cabin elements e.g. seating, lavatories, galleys.	- Subjective questionnaires addressing the perception of cleanliness - Embedded sensors (pressure, temperature, etc.) - Post-flight medical examination (where appropriate and relevant e.g. as a part of an R&D project provided passengers' consent)	[05], [06], [08], [75], [77], [79] - [88], [90], [101], [105]
				c	**Aesthetics**	Passengers' subjective perception of visual cabin qualities at both overall and local levels.	Visual cabin qualities creating a harmoniously ordered overall appeal. Manifested at both global (overall cabin architecture) and local (surface finish qualities affecting colour and shading distribution) scale. Affects mental wellbeing of the passengers. Includes personalisation of cabin space to individual passenger preferences and needs with no effects on other occupants.	- Subjective questionnaires addressing the perception of aesthetics - Embedded sensors (light, colour, etc.)	
				d	**Autonomy**	The effects created by cabin solutions on passenger's subjective perception of own independence, and their separation from the others and their activities.	Cabin qualities enabling privacy (seclusion from others) and autonomy (operational independence). Exhibited across all cabin spaces used by passengers and not constrained solely to the seating space; affects user's wellbeing.	- Subjective questionnaires addressing the user's perception of own autonomy and privacy	[20], [80], [82] - [85], [87], [105]
				e	**Ambience**	Objective effects created by the cabin solutions on the passengers' mental and emotional state.	Cabin element and environment qualities affecting passenger mood (emotional state). Includes audial and visual environment, which differs from Aesthetics by relying on objective, neuroscience-based effects. Also includes pre-designed cabin space effects enabling mental adjustment e.g. jetlag compensation, relaxation, concentration. Affects user's mental wellbeing.	- Subjective questionnaires addressing the user's mood and emotions in-flight and post-travel - Semi-objective assessment of cabin space views against existing baseline from other industries e.g. interior design	[05], [06], [31], [75], [80] - [84], [89], [90], [105]
				f	**Trendiness**	Passenger's subjective perception of how well the cabin aligns with popular trends.	Affects the user's self-image and subsequently mental wellbeing. Does not reflect brand image.	- Subjective questionnaires inquiring into the user's perception of: novelty, fashion, exclusivity, etc.	

4	**Passenger Experience**	Explicit qualities of the cabin elements affecting active passenger experience	*Revenue streams and motivators for raising profit margins conditioned by the passengers' willingness to pay arising from their factual, objective experiences with cabin, both physical and mental*	**a**	**Ergonomics**	The alignment of cabin elements with user biomechanics affecting the perception of convenience and ergonomics.	Convenience is affected by the space/room available for the user to move and operate cabin elements; reachability of cabin interfaces e.g. buttons and vents; operability of cabin elements e.g. comfortable reaction forces and pressure. Reflects the efficiency of cabin space and the architecture of structural and mechanical user interfaces. Includes ergonomics (passenger convenience) and human factors (servicing convenience), excludes boarding procedures. Affects user's physical wellbeing.	- Subjective questionnaires addressing the perception of convenience - Embedded sensors (body shapes in motion, reaction forces, etc.)	[05], [06], [08], [75], [77], [79] - [88], [90], [101], [105]
				b	**Cabin Environment**	The quality of gaseous environment filling the open volume inside cabin.	Cabin air quality measured through composition, pressure, humidity, temperature, purity, olfactory content. Includes bacteriological and viral safety; and personalisation of the environmental settings to individual passenger preferences and needs with no effects on other occupants.	- Cabin sensors measuring cabin composition, contamination, viral content, and other parameters for subsequent comparison against baseline - Subjective questionnaires addressing the effects of cabin environment on passenger's physiological comfort	[05], [75], [77], [79], [81] - [83], [85], [102], [103], [105]
				c	**Experiences**	The variety and quality of individual experiences available to passengers on-board an aircraft.	Manifested through 5 experience dimensions: - Quality: affects user satisfaction, - Variety: reflects the richness and diversity of the available experiences, - Type: mental, physical, or combined; - Mode: active (requires user's input) or passive (output to the user only, purely observational); - Theme: reflects the user's experience area e.g. sleep, rest, work, entertainment, learning, family, etc. Includes personalisation of cabin space and functionality to individual needs and preferences related to passenger experiences with no effects on other occupants. Affects the operator's revenues, cabin differentiation, and user's wellbeing.	Assessed across the 5 dimensions listed by a combination of subjective and objective means. E.g. for the variety of IFE experiences and their effectiveness in fulfilling passenger satisfaction: - assessed through subjective indicators (joy, mental rest, relaxation) - measured using a customised set of values (a 10-point scoring scale)	[05], [06], [31], [34], [75], [77], [79] - [86], [88] - [90], [105]
				d	**Useability**	Cabin solution qualities affecting passengers' ability and convenience to operate it.	Includes two purposes: - Accessibility of cabin-user interaction for the special needs users; - Useability of cabin equipment for the diverse range of user literacy levels and their capabilities in using technology. Includes personalisation of cabin space and functionality to individual passenger preferences and needs with no effects on other occupants.	Assessed by evaluating how simple it is to understand and operate cabin equipment, the presence of intuitive qualities for new technology, and other subjective qualities based on some nominal (e.g. 10-point) scale. E.g. for the IFE systems: - Useability for the special needs users (e.g. visually impaired) - Intuitivity of the operational interface (e.g. the ability to understand menu navigation disregarding of the language skills) - Sufficient capability for using the equipment in a variety of conditions (lights off, turbulence, noise)	[09], [31]
				e	**Interfaces**	The operational qualities of active cabin equipment interfaces.	Functionality and operability of active cabin interfaces: mechanical, electrical, and electronic. Includes PED integration and interfaces. Affects user's ability to use cabin equipment, subsequently impacting operator's revenues and user's mental wellbeing.	Functionality can be assessed using a combination of subjective scoring and sensor-enabled measurements e.g., per type: - Mechanical: surface texture affecting the grip, button pressure/reaction forces affecting its operation; - Electrical: power level and stability, button or other interface responsiveness; - Electronic: response delay, input processing speed, control precision.	[06], [80], [81], [83], [85], [90], [105]
5	**Outside Interfaces**	Qualities of cabin interfaces with the outside world	*Revenue streams and motivators for raising profit margins conditioned by the passengers' ability to connect to the world outside in a one-way or two-way mode*	**a**	**Outside View**	The impacts created by cabin solutions on passenger experiences related to viewing outside of the aircraft.	Facilitating the exploration of the views outside the cabin through baseline viewing means (cabin windows) and by integrating novel solutions (e.g. extended reality, outside cameras, added functionality). Affects users' mental wellbeing.	- The quality and variety of experiences involving outside views - Subjective evaluation of user satisfaction e.g. using a custom scale	[105]
				b	**In-Flight Information**	The impacts created by cabin solutions on passenger experiences that involve one-way information flow.	Solely focuses on unilateral information flow used for passenger information services e.g.: flight information, airport wayfinding, operator's route and transfer planning, transport at the destination. Not constrained to any specific means of delivering information (audio, video, and other CDS). Affects journey continuity and subsequently, passenger's mental and physical wellbeing.	Assessed by measuring the quality and content richness of the inward information flow from the ANSP, Airport, DMO, weather services, urban transport infrastructure, etc.	[05], [75], [85]
				c	**In-Flight Communication**	The impacts created by cabin solutions on passenger experiences that involve two-way communication exchanges.	Focuses on bilateral information flow used for passenger communication services and enabling passenger's engagement with the outside world during flight e.g.: internet browsing, ground communication (text, voice, video), shopping for ground-based goods and services, leaving reviews on-the-go. Affected by the communications technology more than CDS. Includes personalisation of cabin communication functionality to individual passenger preferences and needs with no effects on other occupants.	Assessed by measuring content quality and richness, and the effectiveness of technical means enabling the communication flow between cabin occupants and a variety of ground-based service and content providers.	[06], [81], [105]
				d	**Journey Continuity**	The impacts created by cabin solutions on facilitating a seamless journey for the passengers.	Consists of the physical, information (mostly digital), and mental continuity. Facilitates the Aerotropolis model by streamlining passenger activities and processes across the aircraft as a part of the wider airport, inter-city, and urban transport infrastructure. Affected by turnaround processes; affects passenger's wellbeing as well as brand image and revenues for most stakeholders.	- Average journey time reduction (minutes/city pair) - Added stakeholder revenues enabled by the collaboration across the user's journey steps	[75], [78], [83], [86], [105]
6	**Operational Cabin Qualities**	Cabin solution qualities that affect cabin operations and the related revenues	*Flexible cabin qualities independent of the passengers' perspective that affect operational revenues and costs; include passenger services delivered or enabled by the Flight and Ground Crews.*	**a**	**Passenger Capacity**	The impacts created by cabin solutions on the number of passengers that a given cabin can fit inside it.	The effects that a cabin solution has on the overall passenger capacity.	- The difference in the number of seats available as counted before and after implementing a cabin solution.	[78]
				b	**Configuration**	The impacts created by cabin solutions on the diversity of possible passenger accommodation layouts (LOPA) attainable within given cabin.	The available variety of possible versions for the overall cabin layout (holistic scale) and constituent equipment configuration (localised scale e.g. passenger equipment versions and options) that a cabin solution enables.	- The efficiency of cabin traffic flow (passengers and crew walking around the cabin, e.g. the average travel time between cabin locations) - The alignment with passenger categories and their needs. For example, if a cabin is split into several classes (traditional - by service level, or innovative - by activity/function type) then a "good" configuration would have all cabin classes/zones equally filled with high occupancy rate.	[105]
				c	**Luggage Storage**	The impacts created by cabin solutions on the diversity of possible passenger luggage storage attainable within given cabin.	Facilitation of sufficient storage for passenger belongings (checked-in and carry-on), its effective and efficient management from cabin. Includes storage capacity and convenience; also includes non-passenger cargo capacity.	- Available luggage weight and items per passenger (checked-in and carry-on) - Total available luggage weight per flight - Passenger satisfaction specific to carry-on luggage storage and retrieval procedures	[05], [06], [77], [80] - [85], [88], [90], [105]
				d	**Turnaround Efficiency**	The impacts created by cabin solutions on the efficiency of passenger ingress/egress procedures both to/from the individual seat and the whole cabin.	The effect of a cabin solution on the procedures between flights: - convenience: clear and simple process, - ergonomics: adjusted to human biomechanics, - efficiency: the speed and smoothness of the process Includes GHP activities to replace the consumables and clean the cabin between flights; and cabin evacuation in emergencies.	- Turnaround time effects (Δ minutes) - Emergency evacuation time (Δ seconds) - Inter-flight cabin servicing (number of GHP staff per cabin)	[05], [75], [78], [80], [81], [84] - [86], [89], [90], [105]
				e	**Service Capabilities**	The impacts created by cabin solutions on cabin crew capabilities to offer passenger services.	The quality and variety of the in-flight services enabled by cabin equipment. Includes the capabilities to deliver goods to passengers, and to resolve passenger difficulties and in-flight issues.	- the number of specific services and service types available	[06], [07], [82], [86] - [88]
				f	**Crew Information**	The impacts created by cabin solutions on the quality and effectiveness of passenger services delivery by the cabin crew.	The exhibition of interpersonal qualities by the cabin crew as enabled by a cabin solution. Relies on the available capabilities to: - equip the crew with the knowledge of passengers' implicit and explicit needs, preferences, and perceptions; - align the crew's attitude, understanding, and intentions with passenger expectations of appropriate custom (cultural fit). May include cabin crew appearance and behaviours, wearable technology, passenger data access, language and translation capabilities.	- Changes in ticket demand and ancillary revenues as a reflection of cabin service quality; - Using a variety of sensors and processing capabilities to measure passenger's response e.g., by the application of emotional technologies to scan facial expressions and process physiological response before, during, and after cabin service requesting and provisioning.	[05], [75], [77], [78], [80], [82] - [88]
				g	**Crew Operations**	Cabin solution qualities that help streamlining, optimising, and improving the efficiency of crew operations.	The convenience and ergonomics offered by a cabin service solution to the cabin crew. Affects crew workload, working intensity, conditions, motivation, productivity, efficiency etc. when delivering passenger services. Includes autonomous operational capabilities i.e. independent from the crew and not requiring their involvement, which primarily relates to automation of whole or part of the cabin services.	- Time savings per cabin service operation for a particular service type - The number of passenger requests served per flight - Productivity per cabin service operation: the ratio of valuable output produced (profitability, passenger satisfaction) to supplied inputs (labour, expenditure, consumable materials, etc.)	[05], [06], [77], [80] - [82], [84], [86] - [89]

7	**Integrated Cabin Quality**	Qualities of a fixed design solution that remain constant across all flights of the cabin product embodying it	*Fixed cabin qualities that are independent of the passengers' perspective, which affect both operational revenues and costs*	**a**	**Fuel Burn**	Fixed physical qualities of the cabin equipment directly affecting the overall fuel burn.	Represents the fuel burn effects incurred by the presence of a specific product in the cabin at all times (i.e. disregarding of whether it is operated and for how long). Manifested as cumulative fuel burn effect due to equipment weight (primary) and electrical power consumption (secondary).	- The fixed weight of cabin equipment and variable weight of its replaceable and consumable materials (kg) - Cabin equipment power consumption (kWh) - Total fuel burn impact (kg/PSK, kg/nm, or other technical units)	[100], [110]
				b	**Adaptability**	The level of cabin equipment adaptability for different needs.	The ability of a cabin solution to be adjusted to fit with project specification and requirements (excludes the Certification Requirements), operator's needs (corporate culture, preferred cabin layout and equipment configuration, route specifics); cabin sectoring (classing by function or service level). Excludes customisation to passenger's needs (reflected in other factors).	- Effort required to adapt a cabin solution to a specific need / requirement / constraint (measured in monetary terms as cost or FTE; number of people/teams involved, etc.)	[20]
				c	**Applicability**	The inherent ability of the cabin equipment to be standardised across the different configurations.	The ability of a cabin solution to be standardised across the CEM's interior projects, cabin products, classes, and aircraft platforms. May transpire at various product levels: individual technologies and/or components, product assemblies.	Effort required across all stakeholders to adopt a solution to different projects or platforms; less = better: - FTE or cost impacts due to work performed and other related activities e.g. testing, inspection, documentation updates; - Differences in component count, material volume, related procedures e.g. installation time, maintenance time, number of activities	[105]
				d	**Safety**	The inherent qualities of cabin equipment that enable the prevention, aversion, or mitigation of various risks and hazards.	Cabin solution effects across 4 pairs of dimensions related to flight safety and security: 1A - Safety: protection from abnormal events or its consequences 1B - Security: protection from malicious intent 2A - External: caused by the hazards outside the cabin e.g. crashworthiness safety, cyberattack security 2B - Internal: caused by the hazards inside the cabin e.g. equipment malfunction proofing, protection from deliberate equipment misuse 3A - Passive protection: the inherent ability of cabin equipment to protect its occupants from the potential risk or danger e.g. non-toxicity 3B - Active protection: cabin equipment capabilities to withstand, deter, or safely absorb extraordinary circumstances as they unfold and afterwards e.g. impact resistance, FST performance. 4A - Perceived Safety: cabin qualities creating the feeling of safety and security in the mind of passengers, affects mental wellbeing 4B - Factual Safety: actual cabin safety features, which may not be visible to passengers to have a direct effect on their perception.	Protection areas included but not limited to: viral and bacteriological, physical e.g. crashworthiness, passenger data, electric, electronic, radiomagnetic interference. Also reflects the potential for improvement or expansion of the safety and security measures. A large variety of approaches may be applied to measure safety and security, which will depend on the specific equipment and its capabilities. The majority of this will be covered by the Airworthiness Certification requirements from e.g. EASA CS-25, SAE ARP documents, FST and RoHS guidelines, industry-specific safety regulations and best practices outside of the aerospace domain (e.g. electronic equipment),	[05], [06], [77], [81], [83], [86] - [89], [106], [108]
8	**Sustainability**	Sustainable quality of cabin equipment	*Large-scale, indirect cabin solution effects that do not directly impact profitability but may affect passenger perception, loyalty, or legal fees. Some stakeholders are facilitators, others assure quality.*	**a**	**Environmental**	Cabin solution qualities associated with the environmental impacts.	The cumulative environmental impact of a cabin solution on the wider environment throughout its entire life cycle.	Evaluation approaches and metrics are defined by the accepted Life Cycle Assessment methods of sustainability impacts, for example: - ReCiPe (e.g. particulate matter emissions, ozone formation effects, ecotoxicity) - Global Warming Potential (cumulative radiative forcing)	[51], [57], [58], [81], [100], [109], [110], [111], [113]
				b	**Economic**	The impact of cabin solutions on the local state of economy and its development.	Cabin solution impacts on the local economic growth by engaging the airport, transport, and other urban infrastructure: - Direct impacts: effects directly produced by the cabin solution e.g. operator's revenue, government tax; - Indirect impacts: effects produced in the wider economic landscape in some way due to the implementation of the considered cabin solution e.g. increased passenger spending at the airport.	May be expressed through: - Financial efficiency (revenue to investment ratio in monetary terms) - Financial effectiveness (absolute revenue or profit to stakeholders in monetary terms) on a variety of stakeholders or economic segments e.g.: - Infrastructure (e.g. airport) - Government (e.g. budget influx) - Local vendors e.g. technology, education	[111]
				c	**Social**	Localised social and governance impacts created by the cabin solutions.	Cabin solution effects against the CSR metrics, primarily its Community Involvement & Development principle at the local and global levels, internal stakeholder staff and the external community. Involves the impacts on culture, talent development and human resource, working environment and opportunities, human rights, justice and equality, education, human rights, globalization, etc.	The specific assessment may use a wide range of CSR metrics selected based on importance to involved stakeholders e.g.: - Ethical sourcing of cabin components and materials - Forecasted expansion of specific talent/skill per industry/domain (number of people with a particular skill)	
				d	**Circularity**	The recycling potential of the physical and digital cabin equipment.	The possibility of the cabin equipment constituents to be recycled for repeated use: - Internal: recycling the materials or components for repeating the same function within the cabin interiors industry (e.g. aluminium seat frame into another seat frame), requires comparable material properties; - External: relinquishing the materials or components for repeated use in other industries (e.g. aluminium seat frame into automotive parts), may accept materials with properties altered by the recycling processes.	- Recyclability (percent) - Recycled quality (composition, properties)	[58] [100] [113]

9	**Implementation NRC**	The NRC required to implement the new technology into a cabin project	*Each factor includes an associated testing programme. Applied on a per-project basis: includes all shipsets that have a given cabin version installed.*	**a**	**Availability**	The level of technology readiness to be applied as a part of a cabin solution.	The effort required to develop the core technology enabling a particular cabin solution from its current maturity level to integration readiness. Involves the activities that are typically performed jointly by the interested parties (cabin supply chain) and the original technology source (R&D institutions, private companies, etc.): - Market research - Technology R&D - Definition of a functional cabin solution and application scenario planning - Derivation of the development strategy, roadmapping	Assessed using a pre-defined 9-point scale to reflect the top-level Technology Readiness Level within key parameter categories e.g.: - Engineering & Integration - Industrialisation & Manufacturing - Operational Performance - Value & Risk Detailed bottom-level assessment is performed using the metrics most appropriate to a particular parameter. The required effort is measured for all involved stakeholders using e.g.: FTE costs for the involved staff to scope, prepare, conduct, and post-process qualification testing, etc.	[105]
				b	**Designability**	The ability of the considered technology to be adopted as a part of a cabin design solution.	The effort required within cabin interior supply chain to design a concept cabin solution that uses the core technology considered (e.g. a piece of cabin equipment using a novel technology for disruptive IFE experience). Includes the following activities: - develop conceptual designs and virtual/digital mock-ups, - market alignment through concept testing (focus groups, user & customer surveys), - identify and engage with preferred partner stakeholders (in line with Design Factors Map sheet) and collaborative design agreements ("co-creation"), etc. - Derive product requirement specification	- Design effort required from across the stakeholders (FTE costs) - Resource required (software licenses, patent fees, etc.) - Concept testing e.g. focus groups, user surveys etc. (FTE costs)	[29]
				c	**Integrability**	The ability of the considered technology-based design solution to be integrated into the targeted cabin envelope.	The effort required within cabin interior supply chain to develop the concept technology-based cabin solution into an integrated product. Involves the following activities (not an exhaustive list): - Engineer the related piece of cabin equipment (includes CAD, FEM) - Engineer the integration of cabin equipment into the aircraft cabin envelope (e.g. may require amending the airframe structure or systems, add interfaces, etc.) - Engage the interfacing stakeholders e.g. the Airframer, Certification Authorities, etc. - Produce/update product documentation (e.g. bill of materials, stress sheets, service & operation manuals, configuration and version tracking, etc.), drawings & LOPA - Manage product requirements, verify product design against the specification, identify the applicable Certification Requirements and prepare a testing programme - Prepare visual demonstrator mock-ups and samples for customer inspection, alignment, and usability testing	- Engineering effort required from across the stakeholders (FTE costs) - Resource required (software licenses, patent fees) - Customer inspection (FTE costs, materials) - Costs of product changes (e.g. post-inspection update to product requirements)	[20]
				d	**Manufacturability**	The ability of the considered technology-based cabin design solution to be produced or integrated into existing equipment.	The effort required to implement a concept design solution into a cabin product, which involves: - industrialisation: develop the manufacturing processes to build the product - supplier engagement: liaise with suppliers to align the conceptual manufacturing setup - trial: test out the conceptual production approaches and update as required to optimise, de-risk, and resolve inconsistencies - launch: install the physical production equipment (jigs and tools) and launch the production process - Future-proofing: gathering and formalising the lessons learnt, best practices, and other suggestive records	The time (FTE) and cost of internal industrial development work (labour, tools, materials, utilities, facilities, training, etc.) to produce new equipment: - Documentation: preparation and amendment of production manuals, technical publications, configuration tracking, etc. - Licensing: training and access to software and process - Manufacturing: Physical production/software programming of the approved product - Materials: constituents and consumables, facility expenses and utilities - Scrap: the cost of repeated production due to manufacturing errors, supplier quality issues, production process or tooling updates following client-driven design changes, production QA inspection, etc. - Envelope fit: updating airframe production tools/processes to support the integration of agreed out-of-envelope cabin elements	[105]
				e	**Certifiability**	The ability to attain airworthiness certification for new cabin equipment.	The ability to validate a cabin product (physical, digital, or mixed) against product specification as delivered by the cabin supply chain and integrated by the CEM. Involves various testing activities: - Tests to confirm compliance with airworthiness requirements: structural integrity, fatigue and damage tolerance, operational & FST performance, Particular Risk Analysis validation (e.g. lightning strike protection, engine failure effects), etc. - Tests to confirm compliance with product requirements expressed by the customer, CEM, airframer, or other parties as captured in RS: functional and usability testing, product quality and cabin integration testing (clashes and tolerances), etc. May involve the administrative work and physical testing required to extend the certification basis with new requirements and AMC e.g. for the technologies that use newly discovered physical principles to offer functionality that has not been considered for airworthiness certification before. Does not include technology or material qualification testing, which are covered at the earlier maturity stages.	The impacts due to product certification effort are conveniently assessed using time (FTE) and monetary cost metrics driven by testing scope and complexity: - testing equipment and supplies - labour involved in conducting the testing programme (e.g. contracting external testing service providers) - labour involved in controlling product specification compliance (e.g. fulfilling or updating compliance tracking in the RS with the help of internal or contracted monitoring staff) - CA fees (e.g. contracting CA ambassadors to observe testing and approve compliance)	Same as Protection factor references

10	**Implementation RC**	The RC incurred by implementing the new technology into a cabin project	*Per-shipset basis: RC are calculated per given aircraft or fleet*	**a**	**Procurement**	Cabin equipment component sourcing arrangements available.	Sourcing arrangements for cabin product constituents - software and hardware, both conventional and belonging to novel cabin solution features.	The costs involved in provisioning novel cabin equipment, such as: - Supplier engagement contracts to deliver the required technology/components - User's price to buy the components/products (Operator, CEM, Airframer), includes the fees to add new SFE or purchase/rent BFE, pricing schemes, economies of scale effects e.g. discounts - The cost of logistics: both to deliver components to the integrator, and the assembled product to the customer. Depends on geography and transport modes, includes the possible effects of product logistics on its quality and reliability (e.g. scrap % due to transportation damage)	[30], [39], [40], [57] [112]
				b	**Installation**	The effort required to implement the delivered cabin equipment onto an aircraft.	The effort going into shipset installation onto the customer's aircraft. Affected by the level of product complexity and serviceability (e.g. tools reach), and the extent/scale of installation (partial or entire cabin).	The cost of product installation onto the customer aircraft in monetary terms: - Labour required and the effects of product design on it (e.g. complexity, modularity, serviceability), which affects installation speed and the required skillset, ultimately driving the FTE and other human resource costs - Non-human resource involved in the installation process: equipment, consumables, utilities - Service provider (normally the MRO) fees to install the new shipset (above pure labour costs) - Refitability: the ability/effort (FTE cost) to refit/retrofit a cabin product into an existing aircraft - Checking compliance of the installed shipset to confirm project delivery - Inspection expenditure due to novel equipment requiring extended testing and checking	[30], [39], [105]
				c	**Phasing Out**	The end-of-life scenarios available for cabin equipment.	Effects of cabin equipment end-of-life processes due to both linear and circular scenario.	The cost of equipment phasing-out or recycling at its end-of-life: - the cost of labour, consumables, tools and equipment, and utilities involved in cabin product utilisation or recycling (typically paid to the Dismantler) - the legal/government fees associated with product utilisation (landfill, incineration, etc.) - costs recovered due to recycling suitable components/materials e.g. from subsequent profitable reselling	[58], [100], [113]
				d	**Depreciation**	The loss of cabin equipment value over its use period.	The loss of investment incurred over cabin equipment life due to NPV and ageing-induced devaluation. Product value decreases constantly towards its end-of-life if it receives no updates or upgrades. The residual value after phasing out differs depending on the specific product characteristics. The devaluation may be slowed down by better resistance to wear & tear to some extent, but cannot be prevented altogether in most cases.	The depreciation effects are measured by the direct and indirect means: - Direct: the absolute reduction in cabin product value expressed as the difference between its purchase price and the price of onward selling of the product to the next user or its components after dismantling. - Indirect: the effects due to alignment between cabin equipment design life and cabin interior life, e.g. a product with a 3-year design life will have a lower relative value than a 7-year design life product when assessed as part of a cabin used for 5 years.	[30], [39]
11	**In-Service RC**	The RC incurred by operating the new technology	*Per-shipset basis: RC are calculated per given aircraft or fleet*	**a**	**Operational Needs**	The cost of consumable or replaceable materials involved in operating cabin solutions.	Operator's expenditure incurred by providing for cabin equipment operations. Governed by the cost and volume of supplies required e.g.: fluids, food, replaceable components, etc.	- The purchase or rental/lease cost of consumable materials: toiletries and galley materials, some cabin amenities e.g. headsets used with the new equipment, etc. - Servicing costs between flights e.g. cabin cleaning and visual checks by the GHP - Operational costs e.g. crew training and licenses (if required to operate a novel cabin product); insurance, taxes, and legal fees if incurred by the operation of a specific cabin product	[30], [39], [40], [51], [72]
				b	**Maintenance**	The cost of ordinary cabin equipment servicing imposed by the maintenance schedule.	Relates to regular MRO activities and not between flights e.g.: NDT, cleaning, replacing short-life components, etc.. Typically can be forecasted in advance based on the service manual scope and MRO agreements. May be affected by cabin product design quality (e.g. lower complexity resulting in the reduction of maintenance operations scope).	- Added MRO fees for regular servicing activities of new equipment to keep it operational - Servicing labour costs: direct FTE costs to disassemble, deep clean, test, restore, tighten bolts etc.; training and license costs if required by the new equipment. - Service enablement costs: the provisioning of tools, consumable materials, utilities etc. - Cost effects due to enablement or automation of some servicing functions e.g.: disinfection	
				c	**Data Management**	The cost of managing the data flow related to a specific cabin solution.	The cost of enabling data-driven cabin experience enabled by the new cabin equipment and informing the associated RM strategies e.g. to optimise its access pricing schemes, track passenger preference patterns, or monitor the condition of equipment or passengers. Excludes data security (a separate driver).	- The cost of data flow management: collection, storage, processing, and interpretation of passenger, crew, equipment, and other relevant in-flight data - The cost of fixed data management: any processes related to fixed cabin data e.g. product material passport, configuration traceability, electronic marking hardware and software - The cost of hiring a vendor to manage and process the involved data, or renting the equipment to process it internally - The cost effects enabled by engaging with the MRO in advance of the maintenance slot by providing product data to inform maintenance activities - The cost of data post-processing in line with relevant regulation s(e.g. GDPR) e.g. secure storage and deletion of data. (Differs from Data Security, which reflects the inherent data breach protection provided)	[105]
12	**In-Service NRC**	The NRC incurred by operating the new technology	*Per-project basis: includes all shipsets that have a given cabin version installed*	**a**	**Reliability**	Susceptibility of cabin equipment to damage incurred by its use over time.	Reflects cabin product quality affecting repair possibility, frequency, and the required resource. Affected by the design life, structural integrity, architectural complexity (number of components and optimised build), operational complexity (ease of use).	For a given cabin product, may assess the average or total: - probability and criticality of the possible equipment failure events - number of repairs per time unit (e.g. repairs/year) - number of components typically repaired - cost of repair per component - number of components repaired of each type (to inform service planning and upgrading)	[05], [20], [72], [77], [82], [83], [87], [88]
				b	**Repairability**	The susceptibility of cabin equipment to being repaired in extraordinary events.	Reflects irregular repairs due to equipment damage, malfunction, wear & tear, etc. Forecasted statistically but cannot be reliably foreseen. Irregular repairs are not defined by the standard maintenance schedule, but could be identified during a scheduled inspection. Affected by Reliability. Different from Maintenance (regular servicing). Revenue effects will differ between stakeholders e.g. a loss to the Operator (repair fees) may be the Revenue for the CEM (spares sales, in-service repairs). Note: serious damage to cabin equipment is resolved by replacement and not repairs.	The effort going into arranging a repair where it is possible: - Labour (FTE costs, licensing, etc.) involved in repairing cabin equipment. Note that the time required for a repair will differ for different products and repair/replacement scopes. - Repair materials: new parts/components, fixes require non-regular time or material. - Restoring/checking aircraft airworthiness in cases when it is void - Revenue effects due to unforeseen AOG duration - If the Airframe repair is involved due to cabin equipment damage/malfunction: engineering repairs to cabin envelope, provisioning airframe spare parts, providing guidance and oversight	[51], [72], [107]
				c	**Modifications**	The cost of cabin equipment modification activities.	The impact of updating or upgrading cabin equipment to a new standard e.g. modernising the existing cabin content with newer versions for a given customer due to its outdated status in relation to passenger needs, competitor trends, differentiation strategy, safety and airworthiness (e.g. a constituent material becoming banned), etc. Affected by the modification extent, complexity of its installation, equipment cost.	The fees and costs related to: - Cabin modification supply, delivery, installation, and inspection - aircraft airworthiness status renewal - updating service manuals, processes, and other relevant documentation	
				d	**Opportunity Losses**	The potential loss of revenue due to giving up alternative cabin solutions in favour of the ones selected for installation/implementation.	A loss of hypothetical revenue due to not using cabin equipment that would have been used instead of the solutions selected. Includes both: - full opportunity loss: replacing one solution with another completely, and - partial opportunity loss: reducing the capabilities of one cabin solution due to implementing another one (e.g. luggage space loss due to IFE modules installed in the overhead structure)	- Revenue/cost balance e.g. new equipment may save significant fuel costs but incur a loss of passenger revenue - Potential contractual losses e.g. due to ceasing discounted servicing offers	[30], [39], [40]