Opening Doors

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PHASE 1 – FEASIBILITY - PROOF OF CONCEPT

The Airbus A320 & A320 NEO

Improving the seat configuration, safety and passenger comfort

Section 1 - Research & Analysis

Section 2 - Design & Technology Adoption

Section 1

Research & Analysis

Airbus A320 Seat Plan

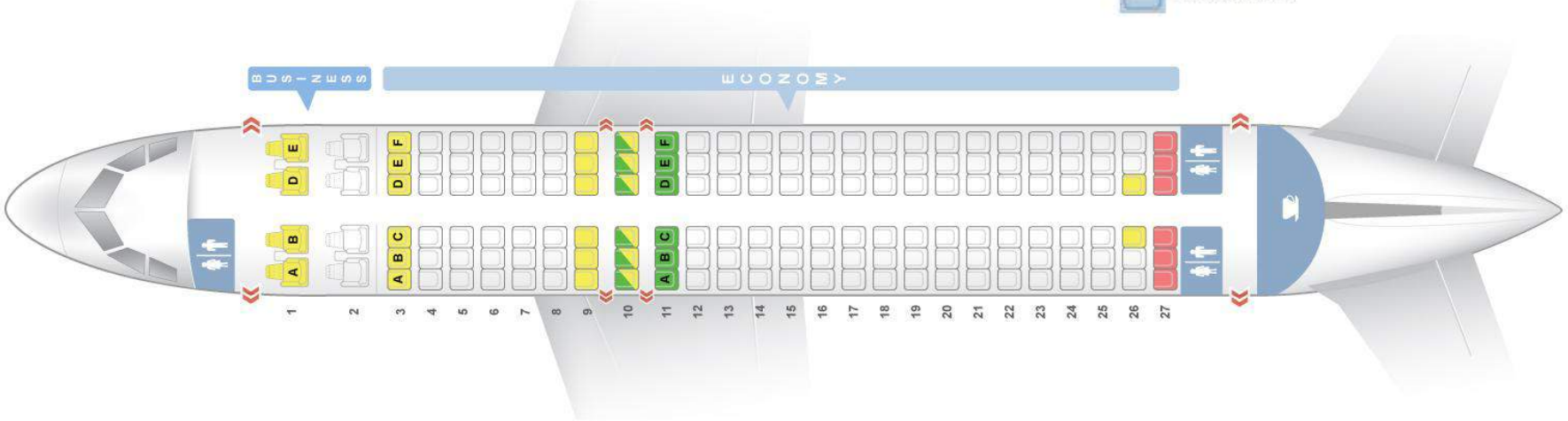
Seating details

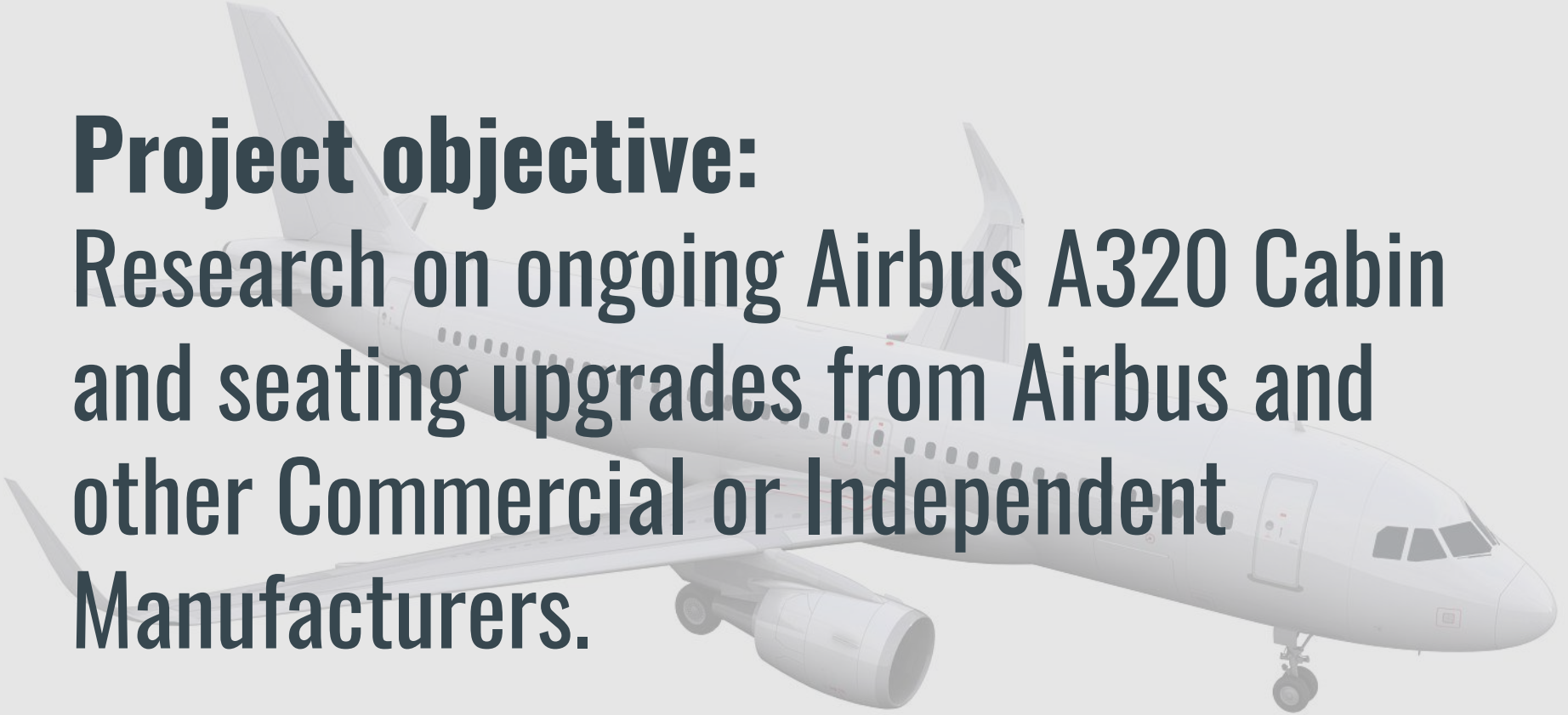
Seat map key

	Pitch	Width	Seating details
Business	32-38	17-21	8 recliner seats
Economy	30-33	17-18	150 standard seats

Seat map key

- Good seat
- Be Aware - See comments
- Bad seat
- Mixed Review
- Standard seat
- Blocked seat
- Premium seat
- Crew seat
- Power port
- Emergency exit
- Galley
- Lavatory
- Closet
- Bassinet





Project objective:

Research on ongoing Airbus A320 Cabin and seating upgrades from Airbus and other Commercial or Independent Manufacturers.

Upgrades to Seating by Airbus in recent years

Airbus has introduced a new "Space-Flex" optional cabin configuration which increases space-efficiency by a new rear galley configuration and a "Smart-Lav" modular lavatory design – allowing an in-flight change of two lavatories into one accessible toilet. With larger, "Cabin-Flex" relocated exit doors, it allows up to 20 more passengers for the A321neo without "pushing the limits", and up to 9 more passengers for the A320neo.

For the A321neo, the additional passenger count is enabled through a rearrangement of the exits. While initial A321neo examples share the same exit door configuration as the A321ceo (four exit doors on each side), future examples will permanently delete doors R2 and L2 (forward of the wings) to permit a maximum configuration of 240 seats with two overwing exits replacing doors R2 and L2, and a relocation of doors R3 and L3 (aft of the wings) four frames back. Less dense configurations will also permit the deactivation of either doors R3 and L3 (replaced with a plug; maximum 195 seat configuration) or both doors R3 and L3 and one overwing exit (replaced with plugs; maximum 165 seat configuration).

Fuel efficiency per seat is increased by 6% with this option, in total exceeding 20% together with the new engines and the sharklets. The moved and enlarged exit doors are estimated to add 100 kg empty weight.

SOURCE: https://en.wikipedia.org/wiki/Airbus_A320_family

Independent “Competitors” Ideas

Thompson Aero

Thompson Aero Seating proposes staggering every seat in a row, eliminating the undesirability of the middle seat, giving every passenger their own space.

Thompson Aero New Seating Proposal

SOURCE: http://www.thompsonaero.com/

Zodiac 4

A new seating configuration that removes that middle seat in favor of one that faces the rear has been proposed by Zodiac Seats France. It is called “Economy Class Cabin Hexagon,” and is based on a honeycomb layout, which puts your neighbor looking directly at you – for hours!

Zodiac 4 New Seating Proposal

SOURCE: http://www.businessinsider.com/this-new-airplane-seat-by-zodiac-could-bring-awkwardness-to-a-whole-new-level-2015-7

Air Lair

The Air Lair is a personal cocoon for each passenger in a double-decker configuration. Within this enclosed environment, the passenger can control their own personal space without disturbing other passengers. Strategically placed lighting is used to set the mood, while an over-head projector provides the entertainment, and ergonomically designed lay-flat seat provides the comfort. Factory design have made the “Air Lair” really look like the future of travel.

Air Lair New Seating Proposal

SOURCE: https://airnation.com/blog/air-lairs-passenger-personal-cocoon-concept-design/

Jacob Innovations

Another innovative seating design comes from Jacob-Innovations. The "step seat principle" involves elevating alternate rows of seats, from one to five steps above the cabin floor, to give economy class passengers room to lean back by up to a 45-degree and enough space in business class to lie down completely.

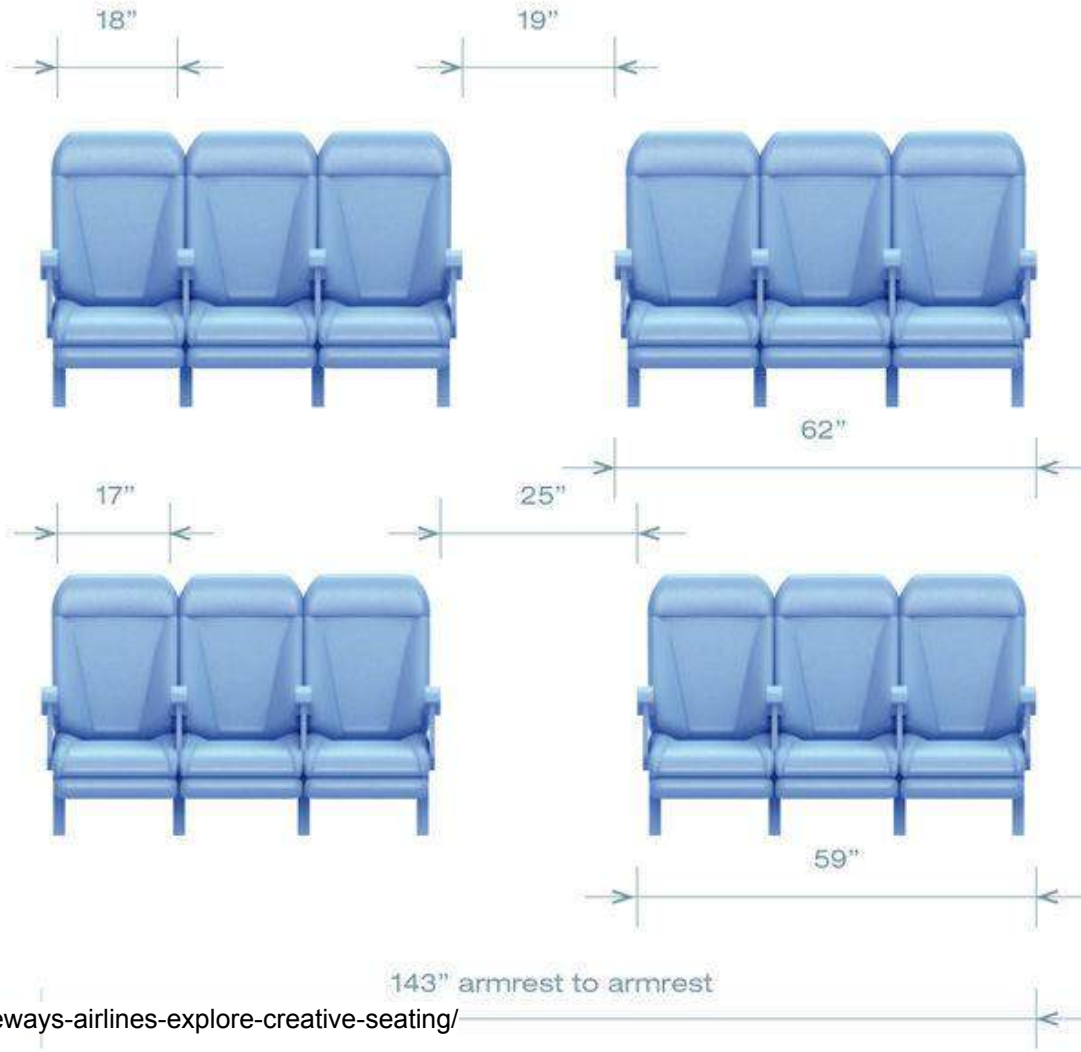
Jacob Innovations Seating Proposal

SOURCE: https://www.wired.com/2009/10/step-up-lie-down-sit-sideways-airlines-explore-creative-seating/

Understanding the market

Airbus A320 Standard Seat Measurements

Economy Class



SOURCE: https://www.wired.com/2009/10/step-up-lie-down-sit-sideways-airlines-explore-creative-seating/

Top American Carriers

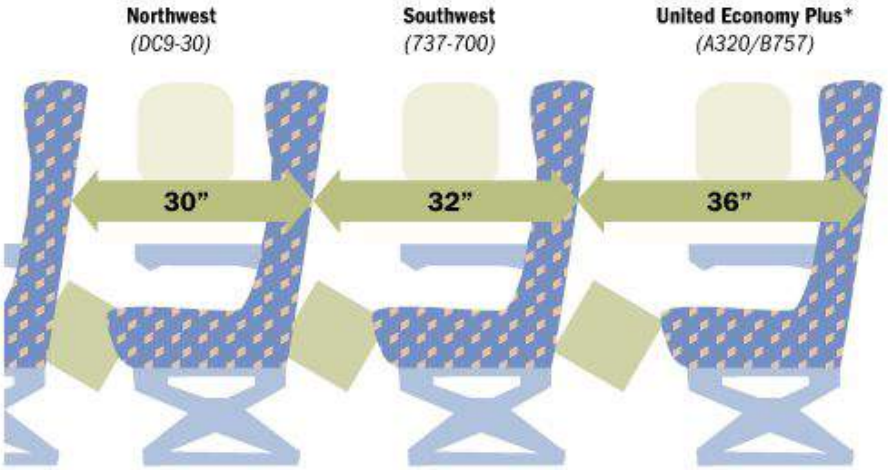
Economy Class

SOURCE: http://www.suddenlysenior.com/airlinelegroomwars.html

Leg-to-Leg Combat

Airlines are battling over legroom. Below a listing of major airlines and their legroom in terms of "seat pitch," a standard measurement representing the distance from one point on a seat to the same point on the seat in front of it.

Below, three examples of seat pitch:



AIRLINE (AIRCRAFT)	SEAT PITCH
United Economy Plus (A320/B757)	36"
JetBlue-rear rows (A320)	34"
Delta Song (757)	33"
Frontier (A319)	33"
Midwest (717)	33"
Southwest (737-700)	32"

AIRLINE (AIRCRAFT)	SEAT PITCH
JetBlue-front rows (A320)	32"
United-regular coach (A320/B757)	31"
AirTran (717)	31"
Alaska (737-400)	31"
American (MD80)	31"

AIRLINE (AIRCRAFT)	SEAT PITCH
America West (A320)	31"
Continental (737-800)	31"
Delta (757-200)	31"
US Airways (737-300)	31"
Northwest (DC9-30)	30"

*Economy Plus is a category of roomier coach seats with limited availability.

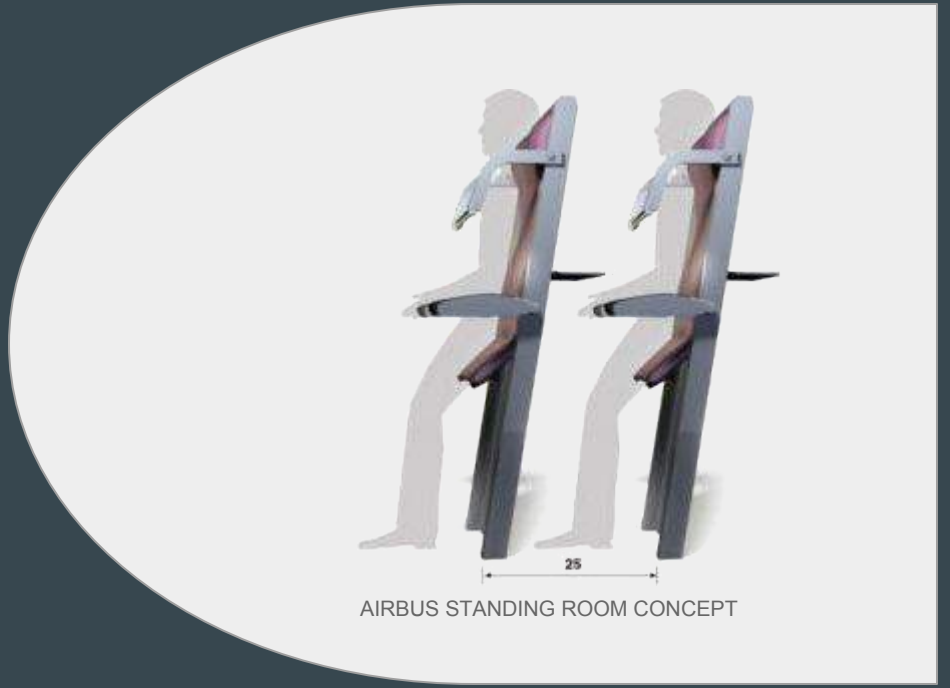
Notes: Minimum seat pitch in inches; Aircraft selected were most numerous in fleet.

Source: Company reports

Market Trends

Seat-To-Seat

- Since 1978 the average space between economy-class has lost three inches
- Newer thinner seats could have increased the legroom but many airlines choose to use the space to add more seats
- Airbus has recently proposed a “standing-room” concept.

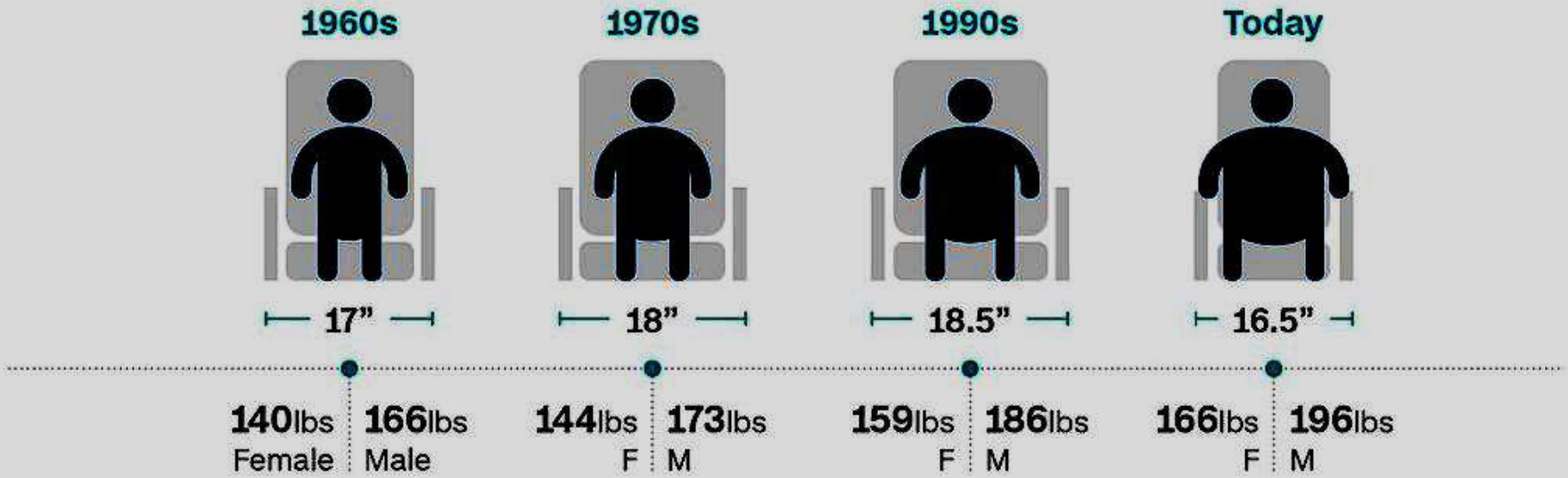


AIRBUS STANDING ROOM CONCEPT

SOURCE: http://www.aviationexplorer.com/aircraft_airline_seating_charts.html

Size matters

Airline seats are getting thinner while passengers are getting wider. The result? Airlines can't help but feel overcrowded.



Source: CDC, SeatGuru

Seat Changes Over the Years

Airlines

- AA - American Airlines
- DL - Delta
- UA - United
- WN - Southwest

Seat Pitch, (inches)

Seat Width, (inches)

1985

AA	DL	UA	WN
31-33	31-33	32-36	31-35
19-20	19.5-20	19-20	19-20

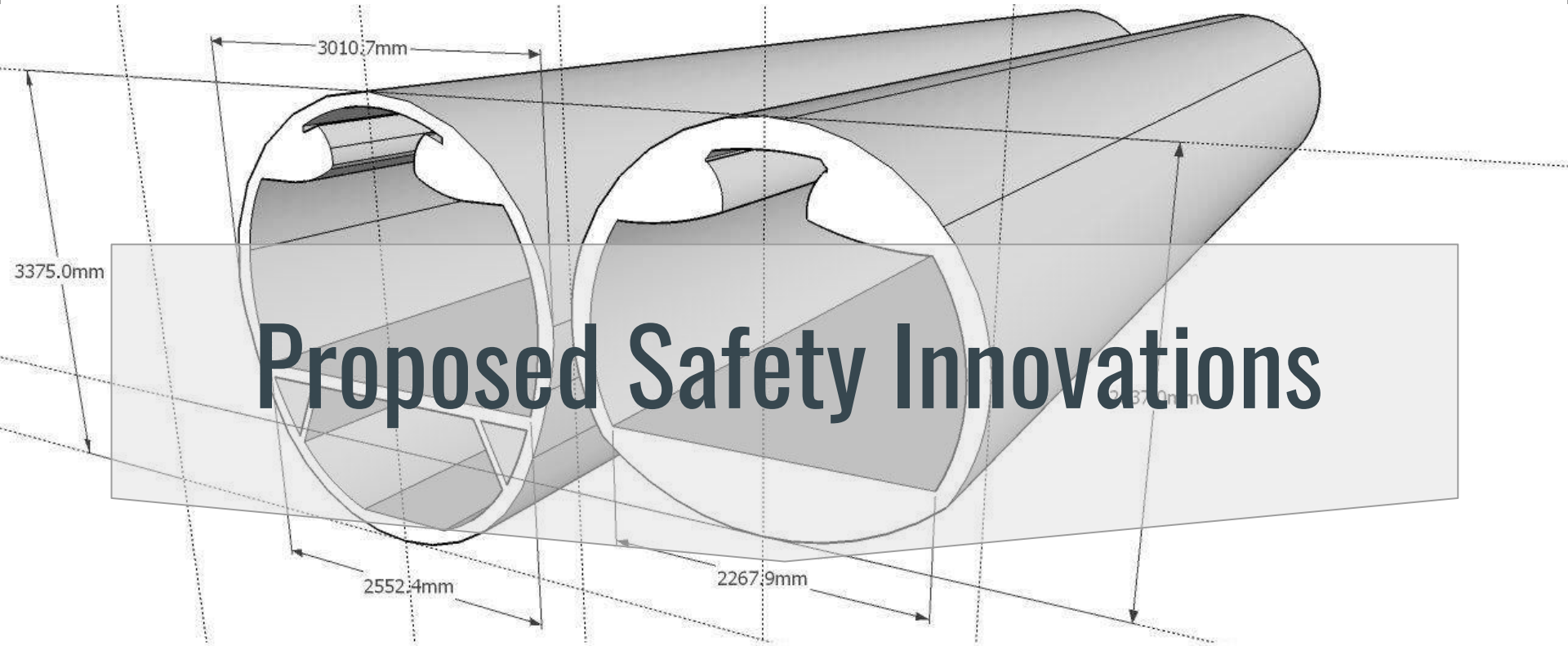
1995

AA	DL	UA	WN
31-33	32-33	31-34	31-32
18.5-23	18.5-23	18.5-23	18.5-23

2014

AA	DL	UA	WN
30-32	30-33	30-31	31-33
17.2-18.5	17.2-18.3	17-18.3	17

SOURCE: http://maphappy.org/2015/07/this-is-how-small-airplane-seats-have-shrunk-over-the-years/



Proposed Safety Innovations

Opening Doors Proposed Seat Design

Rear Facing Seating

- According to experts, rear-facing seats provide better protection for the back, neck and head in the event of sudden deceleration and hard impact.

SOURCE: http://www.aviationexplorer.com/aircraft_airline_seating_charts.html
https://www.smartertravel.com/2017/06/19/safer-sit-backward-plane/
http://www.telegraph.co.uk/travel/news/San-Francisco-plane-crash-rear-facing-aircraft-seats-safer/
https://aviation.stackexchange.com/questions/11476/why-are-passenger-seats-not-facing-backward-on-an-airplane

Opening Doors Proposed Seat Design

Rear Facing Seating

Proposed Comfort Innovations

Opening Doors Proposed Berth Slippers Design

Long Haul
Bert Slippers

- The idea of creating sleeper planes by adding tiers in a passenger cabin dates back almost to the beginnings of commercial aviation: back in the 1930s. Believe it or not, you could have had that in an airliner 80 years ago.

SOURCE: https://www.quora.com/Why-arent-there-any-planes-with-beds-instead-of-seats-for-all-passengers
http://www.airliners.net/forum/viewtopic.php?t=1353763
http://www.core77.com/posts/27476/The-Part-of-the-Plane-You-Never-Get-to-See-What-Do-Cabin-Crews-Chillaxation-Spots-Look-Like

Opening Doors Proposed Over the Head Berth Slippers Design

- Eliminating the Overhead luggage compartment and substituting with berth slippers.

Identified Issues

Opening Door Innovative Design

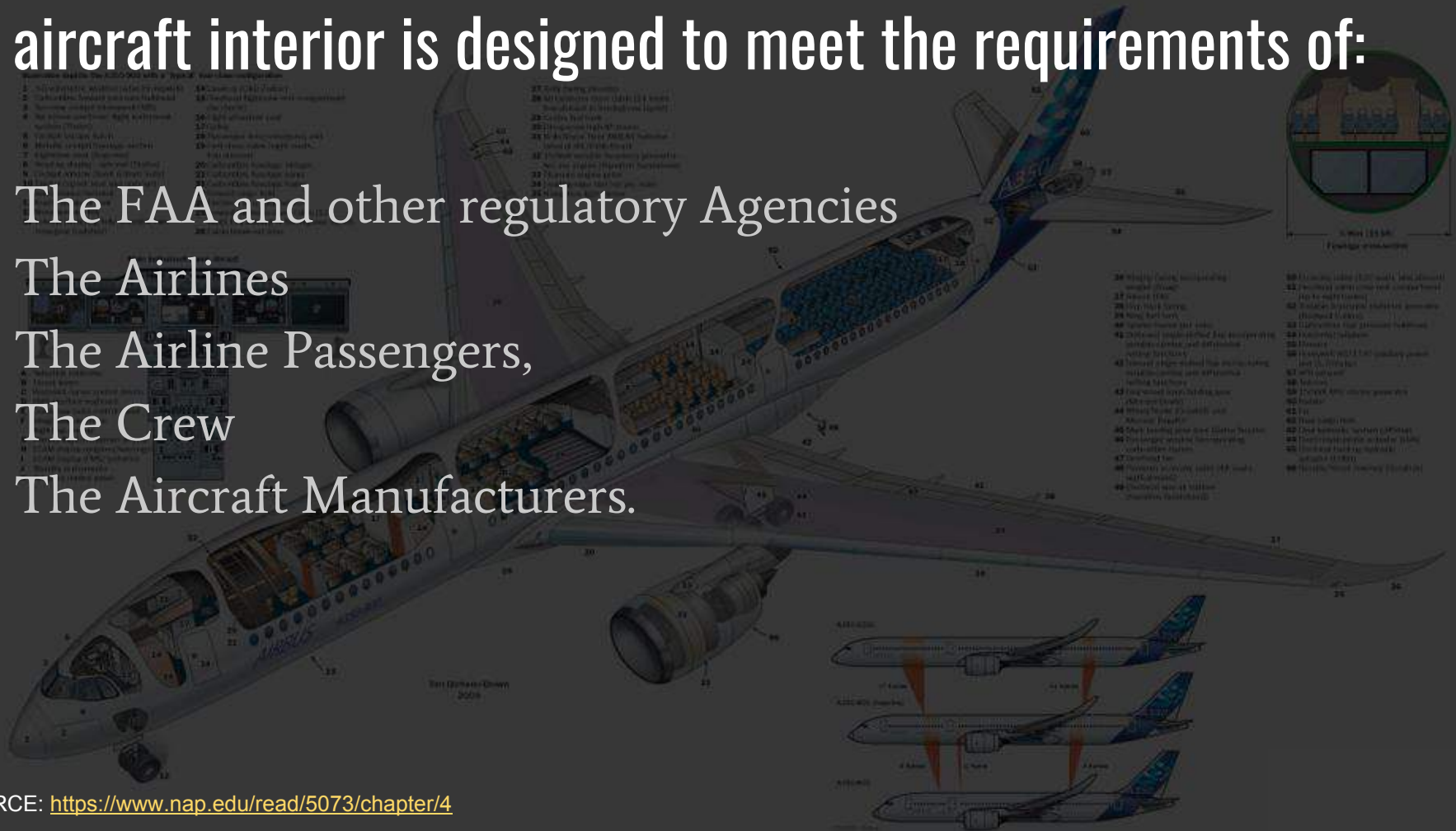
IDENTIFIED ISSUES	
Rear Facing Seats	Could be cause of sickness
	Would have to be bulkier to support body
	Tickets could be difficult to sale
Sleeping Berths	Expensive to refurbish current planes
	Will carry less passengers
	A 320 is used for short haul services

Section 2

Design & Technology Adoption

An aircraft interior is designed to meet the requirements of:

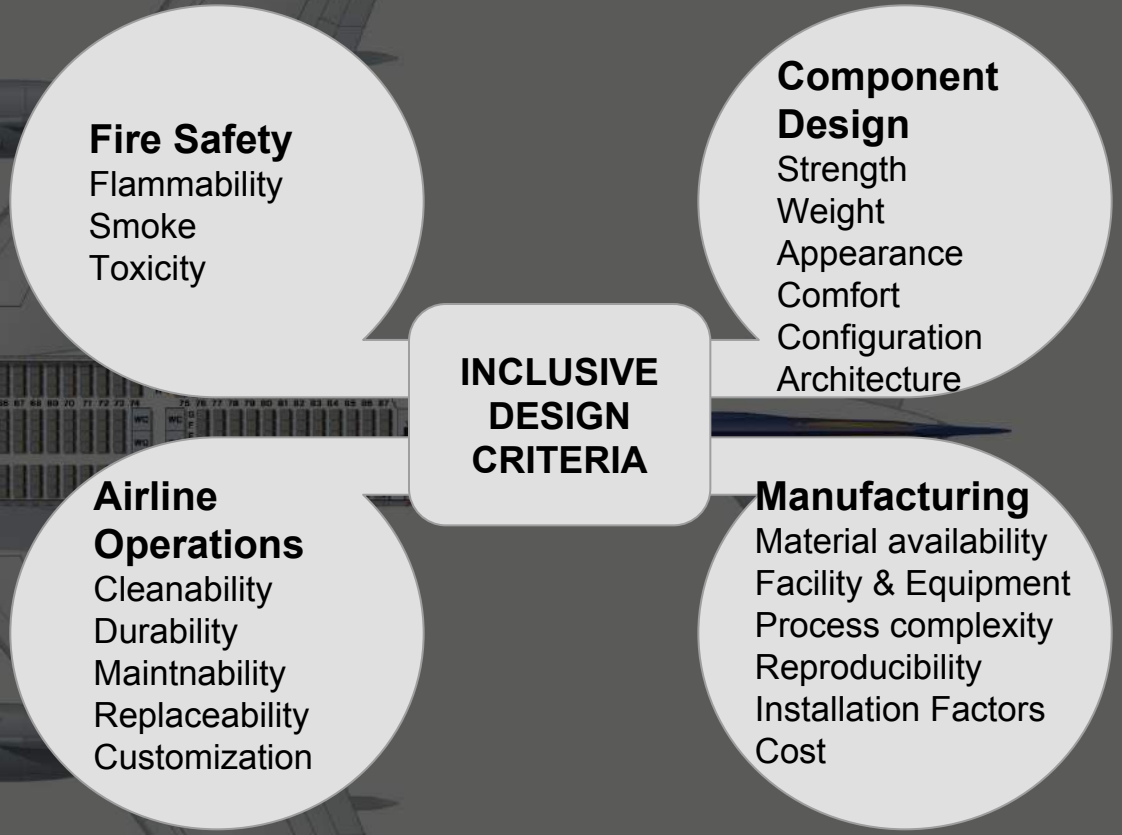
- The FAA and other regulatory Agencies
- The Airlines
- The Airline Passengers,
- The Crew
- The Aircraft Manufacturers.



SOURCE: https://www.nap.edu/read/5073/chapter/4

Design Criteria

The current state of the art for materials used to make parts that satisfy the design criteria and other requirements fall into several main categories or families.



SOURCE: https://www.nap.edu/read/5073/chapter/4

Aircraft Safety Concerns

The criteria for interior safety requirements were developed for normal operation (which includes all non-crash-related incidents) and for several survivable crash-related scenarios (crashworthiness). Although there are many types of criteria, the major ones are:

- Structural strength and stiffness
- Fire resistance (includes control of smoke generation)
- Interior configuration and emergency evacuation
- Emergency oxygen systems

SOURCE: https://www.nap.edu/read/5073/chapter/4

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SOURCE: https://www.nap.edu/read/5073/chapter/4

Fire Resistance

Although there are regulations concerning physical and mechanical properties as well as configuration and layout requirements, the FAA regulatory requirements for interior furnishings are based, in large part, on flammability.

Ceilings	Glass or carbon Phenolic
Partitions	Nomex honeycomb thermoplastic laminate
Closets	wool/Nomex
Floor Panels	textile or leather

SOURCE: https://www.nap.edu/read/5073/chapter/4

Image and Branding

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END OF PART ONE

Digital Design