DESIGN FOR CABIN SAFETY

CESAR ALBERTO SILVA – EMBRAER/UNESP
LUÍS GONZAGA TRABASSO - ITA
MAURO HUGO MATHIAS - UNESP
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unesp UNIVERSIDADE ESTADUAL PAULISTA
"JÚLIO DE MESQUITA FILHO"
CAMPUS DE GUARATINGUETÁ

ITA INSTITUTO TECNOLÓGICO DE AERONÁUTICA

CONTENTS:

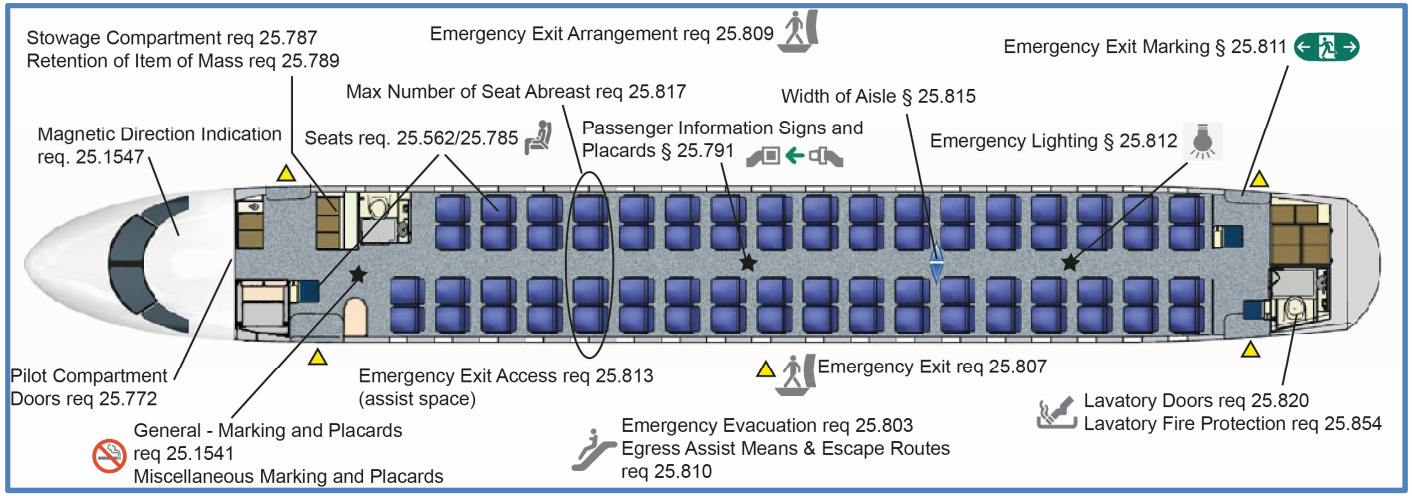
INTRODUCTION

The overall objective of this work is to develop a method for **integrating** cabin safety requirements into aircraft interior design

Thus the following specific objectives have been identified:

1. Map the cabin safety requirements;
2. Develop the Design for Cabin Safety (DF_CS) method;
3. Apply the DF_CS method in real cases and discuss the results;

CONTENTS:



INTERIOR REQUIREMENTS

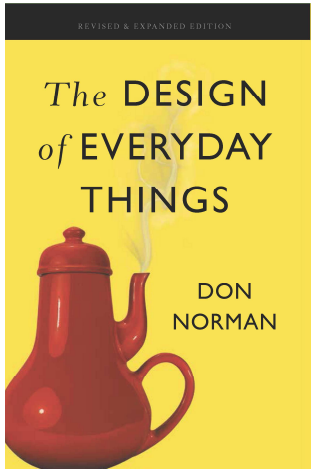
ERGONOMICS

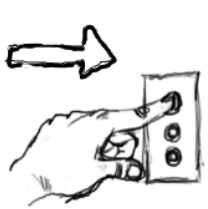
CABIN SAFETY ORIGIN

User
EXPERIENCE

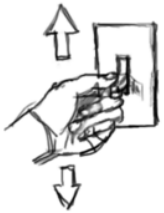
“ No product is an island. A product is more than the product. It is a cohesive, integrated set of experiences. ”

- Don Norman,
Former User Experience Architect, Apple



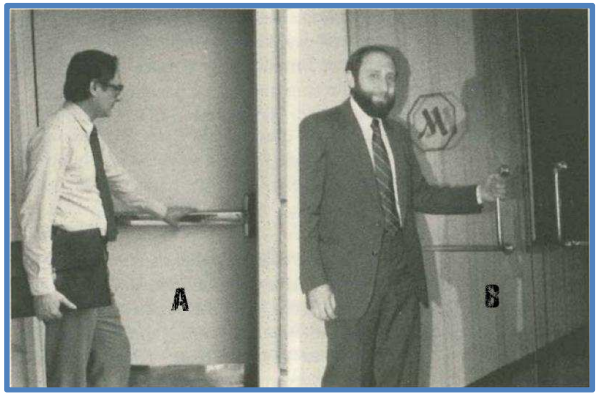


Button - Push



Switch - Flip

Knob - Rotate



DESIGN CONCEPTION AFFORDANCE

BIBLIOGRAPHIC REVIEW

Title	Author (s)	Perspective
Psychology and design process	Bernhard Wilpert (2007)	Psychologist
The contribution of design to accidents	Steve Kinnersley & Alfred Roelen (2007)	System Safety
Ergonomics in product design: safety factor	Jean-Claude Sagot, Valérie Gouin and Samuel Gomes (2003)	Ergonomic
Statistics of design error in the process industries	J.Robert Taylor (2007)	Designer
Safe by design: where are we now?	Andrew Hale, Barry Kirwan and Urban Kjellén (2007)	Safety specialists
What we have learned about learning from accidents? Post-disasters reflections	Jean Christophe Le Coze (2013)	Safety specialists

(Safety Science 45 - 2007)

RELATED WORK

CONTENTS:

DF_CS METHOD FOUNDATION

Design for X is applicable in different areas of the product development:
Ex: Design for Manufacturing (DFM), Assembly (DFA), Automation (DFAut) etc.

DFX methods integrates the requirements of area X
into the conceptual design phase of the product

DF_CS is associated with Survivability

X = x + bility

<x=design (with affordance)> and <bility=survivability>

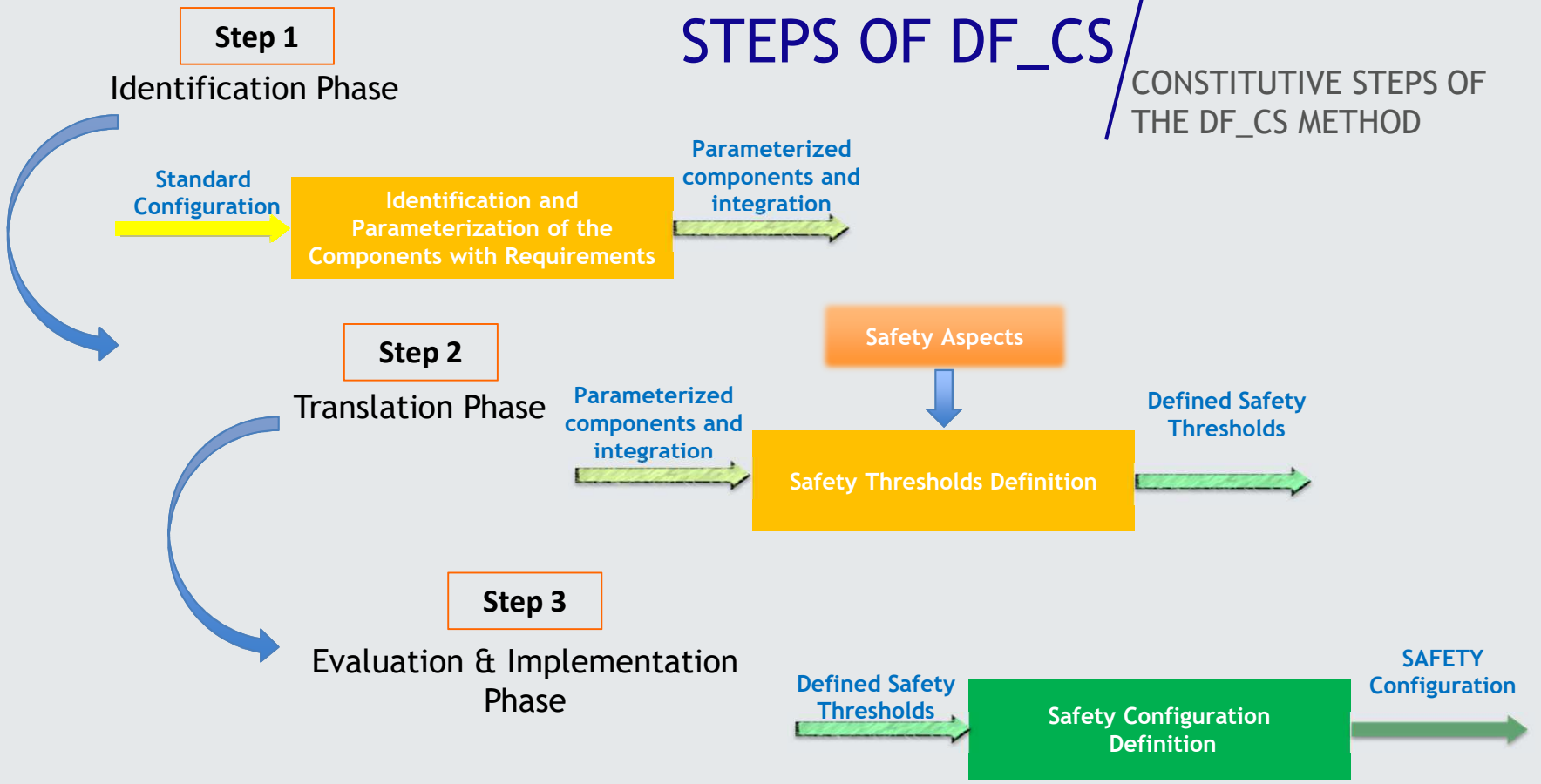
thus <design for *survivability>

***that represents the main objective of Cabin Safety**

DESIGN FOR EXCELENCE DFX

STEPS OF DF_CS

CONSTITUTIVE STEPS OF THE DF_CS METHOD



SAFETY DEFINITION

SEMANTIC TRANSLATOR

CRASHWORTHINESS TO DESIGN REQUIREMENTS

For example considering requirement applicable for Safety Equipment §25.1411:

<readily accessible>

<you may not move any other item to get access to the emergency equipment>

A guide to "operate" this semantic translator engine are the follow questions:

What do you mean by <SafeTD>?;
<readily accessible>

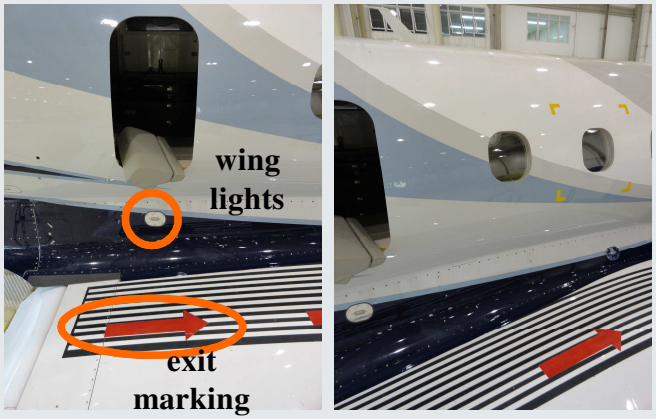
Why the <SafeTD> is needed?;
<readily accessible>

What are the goals of <SafeTD>?
<readily accessible>

How to achieve <SafeTD>?
<readily accessible>

CONTENTS:

TEST CASE: OVERWING EXIT MARKING EFFECTIVENESS TEST



Test Conditions

Dark ambient condition with the airplane interior and exterior emergency lighting powered on.

Group Size

13 volunteers

Age (years)	below 50	50 and above	Total
Male	4	3	7
Female	4	2	6
Total	8	5	13

Pass Fail Criteria

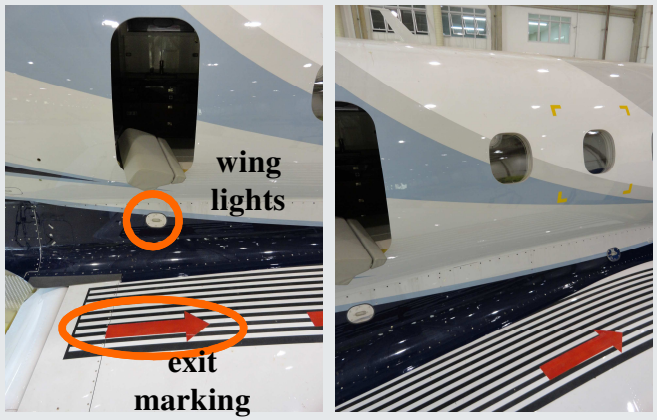
For a group of 13 volunteers, no more than 2 failures is acceptable (85%).

Test Procedure

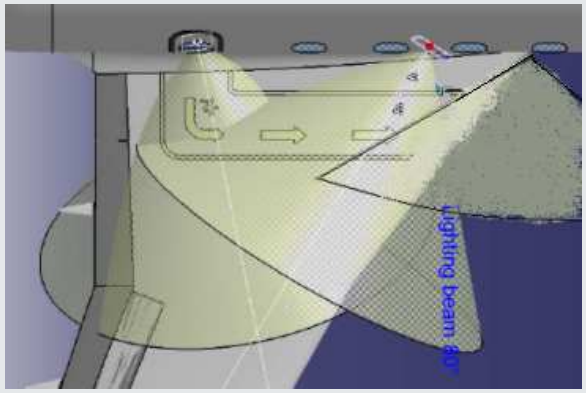
Hi! Please, pay attention and strictly follow the instructions, signals and markings to reach the ground.
Are you ready? 1, 2, 3, Go!"

METHOD APPLICATION – TEST CASE:
OVERWING EXIT MARKING EFFECTIVENESS TEST

OWE ORIGINAL DESIGN prior DF_CS



OWE REDESIGN after use DF_CS



Lighting Beam redesign

METHOD APPLICATION

PHASE 1 - 2 - 3

CONFIGURATION COMPONENTS:

- ✓ Overwing exit marking
- ✓ External illumination

Components aspects related with factors influencing survival:

- ✓ Configuration
- ✓ Procedure
- ✓ Environment
- ✓ Behavior

	COMPONENT	PARAMETERS (input)	SAFETY ASPECTS (output)
COMPONENTS & PARAMETERS	OVERWING EXIT MARKING	(i) must be at least 42 inches wide; that from any other passenger emergency exit must be at least 24 inches wide; (ii) must have a reflectance of at least 80 percent, and must be defined by markings with a surface-to-marking contrast ratio of at least 5:1	The exit marking shall "tell" the user what to do just by looking.
			The exit marking painted on the upper wing, close to the emergency exit, shall be effective to let passengers to decide to move towards the wing leading edge, i.e. take left after "escape" from the overwing exit.
	EMERGENCY WING LIGHTS SYSTEM	(i)Not less than 0.03 foot-candle (measured normal to the direction of the incident light) on a 2-square-foot area where an evacuee is likely to make his first step outside the cabin; (ii) Not less than 0.05 foot-candle (measured normal to the direction of the incident light) for a minimum width of 42 inches for a Type A overwing emergency exit and two feet for all other overwing emergency exits along the 30 percent of the slip-resistant portion of the escape route required in §25.810(c) that is farthest from the exit; and (iii) Not less than 0.03 foot-candle on the ground surface with the landing gear extended (measured normal to the direction of the incident light) where an evacuee using the established escape route would normally make first contact with the ground.	Light shall illuminate passenger first step outside the cabin, the passenger route in the wing and passenger first ground contact.
			Light focus shall not illuminate other areas that may contribute to the passenger misinterpreted the exit marking and let s/he to take inappropriate direction to get the group.

CONTENTS:

CONCLUSION

The results achieved demonstrate the feasibility of the DF_CS method satisfying the proposal of this work to be able to deal with cabin safety requirements and through an appropriate analysis to incorporate in the design solutions (considering the airworthiness requirements, human factors requirements and the affordance concept);

DF_CS brings the benefit to deeply analyze a complex system or range of variables, attributing to each variables a specific value related with specific **X** technology (for DF_CS is Survivability) and contributing with the method user with the decision process to select the most adherent solution with the **X** technology;

The method demonstrated its practicality and simplicity of use in the interior engineering.
Daily interior engineering analyze airworthiness requirements that certain project needs to fulfill and go to a blank sheet to draw a solution that comply with this / these requirements – DF_CS will contribute with the designer to be adherent to cabin safety requirements in the design phase definition.

CONTENTS:

FUTURE RESEARCH PROPOSALS

- ✓ Integration of the DF_CS method with other tools: for example -> include “eyes track system” that is being use as an appropriate tool for user experience diagnostic.
- ✓ Improvement of the proposed method with proper document templates that formalize the deliveries of each step.
- ✓ Detailing and cataloguing of the semantic translator – safety guideline (airworthiness requirement to design requirement) based in lessons learned

QUESTIONS?

OBRIGADO

CESAR ALBERTO SILVA

THANK YOU

cesar.alberto@embraer.com.br

embraer.com