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Jimisola Laursen & Anders Ludvigsson

An overview of EFB usage in Scandinavia

discrepancies between EASA's recommendations and operators' implementation

For the full report: https://lup.lub.lu.se/student-papers/search/publication/8926572

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Authors

Jimisola Laursen

- First Officer, A320
- 3 airlines with EFB
- 8 years as an airline pilot CRJ9, B737
- Software developer in perf. eng.
- MSc in Computer Science
- BSc in Aeronautical Sciences

Anders Ludvigsson

- Captain, B737
- 9 years in Flt Ops admin
- 12 years as an airline pilot, MD80
- Army officer
- BSc in Computer Science
- BSc in Aeronautical Sciences

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Outline

- Introduction
  - Purpose
  - Limitations
- Method
  - Survey
- Some interesting facts about EFB usage
- Results and discussion (main findings)
- Conclusions

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EFB Admin

The EFB administrator is responsible:

a) for **all the applications installed**, and for providing support to the EFB users on these applications;

b) to check potential **security issues** associated with the application installed;

c) for **hardware and software** configuration management and for ensuring, in particular, that no unauthorised software is installed;

d) for ensuring that **only a valid version** of the application **software** and current **data packages** are installed on the EFB system; and

e) for ensuring the **integrity of the data packages** used by the applications installed.

AMC 20-25, 7.11

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Introduction

- Authors had common perception of:
  - EFB shortcomings
  - Research scarce
  - Rules / recommended best practices not always complied with

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Introduction

- Searched for available research material
- Reached out to FAA + Scandinavian CAAs
  - Confirmed that EFBs are common
    - FAA 66%
    - Scandinavia 78%
- Did regulatory overview and background
- Had desire to map how the end users perceived the EFB

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Purpose

- Survey EFB usage
- User experience
- Identify potential discrepancies from:
  - rules
  - recommended best practices

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Limitations

- Commercial Air Transport, fixed wing, Air Operator Certificate from DK, NO and SE
- User experience
  - General, weight, size, battery
  - Performance calculations
  - Documentation
- Excluded:
  - Operational Flight Plan, differences between software / hardware etc.

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Method

- Literature study
  - LUBSearch (Google Scholar)
  - Avoiding grey material
- fatigue AND aviation – 2600
- efb AND aviation – 9 (20 but 11 non-academic)

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Method

- Survey - Quantitative
  - Large population (11 airlines, 500+ respondents)
  - End users
  - Easier to replicate + statistics
  - Based on AMC 20-25

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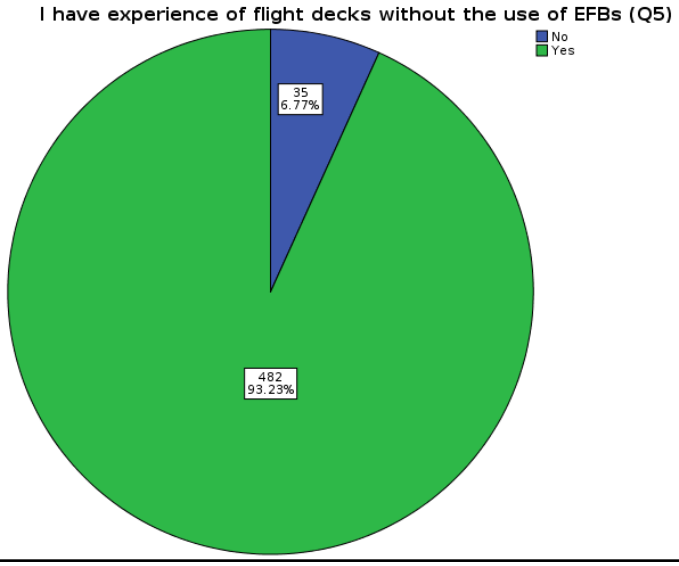
State of the ~~union~~ EFB



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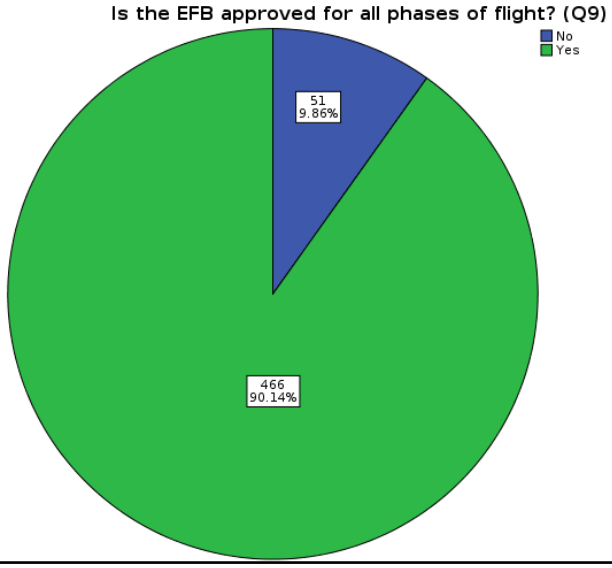
All phases of flight



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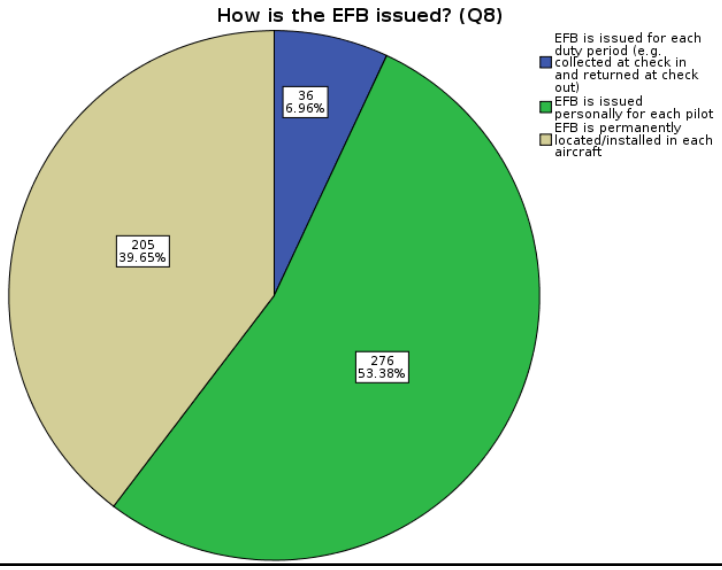
Issued – how?



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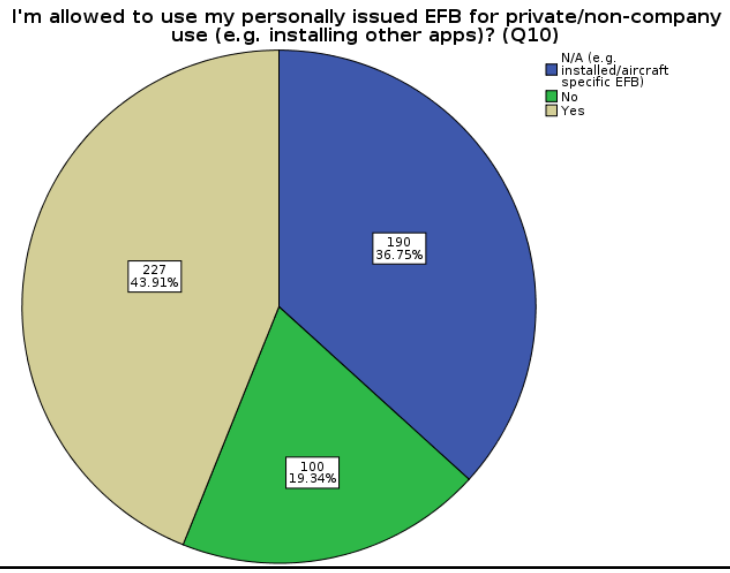
Open / Locked



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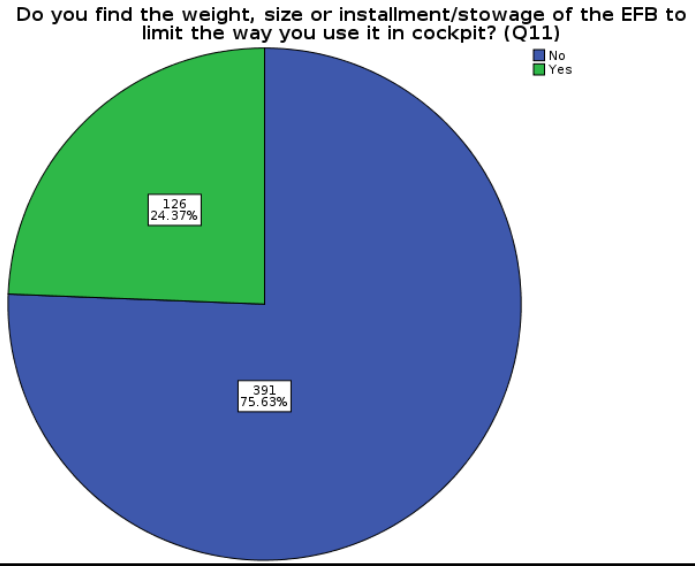
Ergonomics



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Results / discussion

- 20 accidents and incidents 1989-2009
- *Take-off performance calculation and entry errors: A global perspective* by the Australian Transport Safety Bureau (ATSB), 2011
- A number of case studies
- *Flight Crew Computer Errors (FMS, EFB) - Case Studies (1st ed)* by IATA, 2011

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Results / discussion

Case Study	Aircraft Type	Date	Location	Phase of Flight			Error Details			Consequence
				Take Off	Cruise	Approach	Error Category	Performance Parameter[1]	Device[2]	
1	B757-223	20 Dec 1995	Cali, Colombia			X	Select and Data Entry: Navigational Error		FMC	Collision with Terrain
2	B777-300	23 Dec 2006	North Atlantic		X		Incorrect Position Inserted: Navigational Error		FMC, ACARS and OFP (Documentation)	
3	B767-300ER	13 Dec 2008	Manchester, England	X			Data Entry	Take Off Weight	Laptop Computer	Tailstrike
4	B777-300ER	22 Mar 2007	Auckland, New Zealand	X			Data Entry	Take Off Weight	Take off data card	Tailstrike
5	A330-243	28 Oct 2008	Montego Bay, Jamaica	X			Unknown	Take Off Weight	Unknown	Reduced take off performance
6	A340-642	12 Dec 2009	London, England	X			Data Entry	Take Off Weight	Loadsheet and performance procedure being completed out of sequence.	The aircraft was slow to rotate and initial climb performance
7	B747-300	2 Jun 2007	Changai, Singapore	X			Data Entry	Take Off Weight	Documentation	Collision With Obstacle
8	B747-400	10 Dec 2006	Orly, France	X			Data Entry	Take Off Weight	Laptop	Tailstrike
9	B747-400	13 Oct 2004	Halifax, Canada	X			Calculation	Take Off Weight	Laptop	Collision With Terrain

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Flight Crew Training

Flight crew should be given **specific training** on the use of the EFB system **before** it is operationally used.
Training should **include at least** the following:

a) An overview of the system architecture;

b) Pre-flight checks of the system;

c) Limitations of the system;

d) Specific training on the use of each application and the conditions under which the EFB may and may not be used;

e) Restrictions on the use of the system, including where some or the entire system is not available;

AMC 20-25, 7.13

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Flight Crew Training

f) Procedures for normal operations, **including cross-checking of data entry and computed information**;

g) Procedures to handle abnormal situations, such as a late runway change or diversion to an alternate aerodrome;

h) Procedures to handle emergency situations;

i) Phases of the flight when the EFB system may and may not be used;

j) CRM and human factor considerations on the use of the EFB; and

k) Additional training for new applications or changes to the hardware configuration.

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Do we need training?

https://www.youtube.com/watch?v=RRy_73ivcms&t=3s

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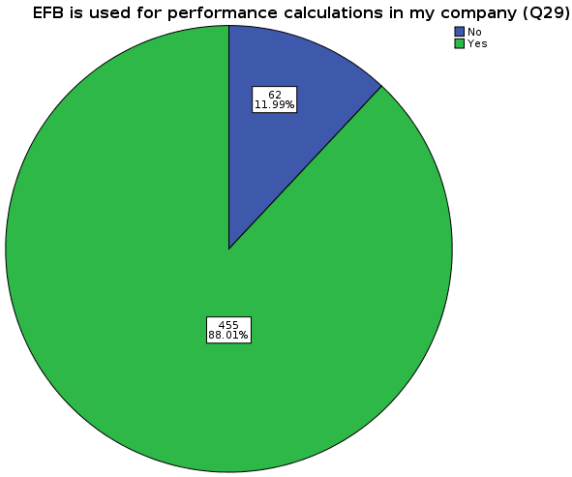
Mission Critical?



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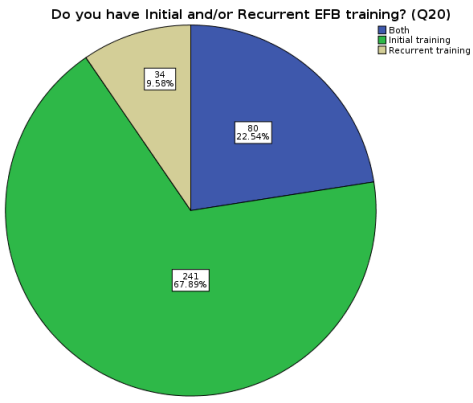
Training: Yes/No?



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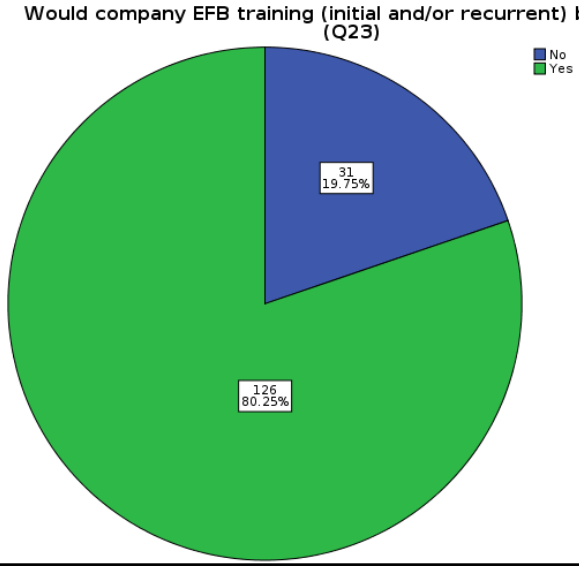
Training useful?



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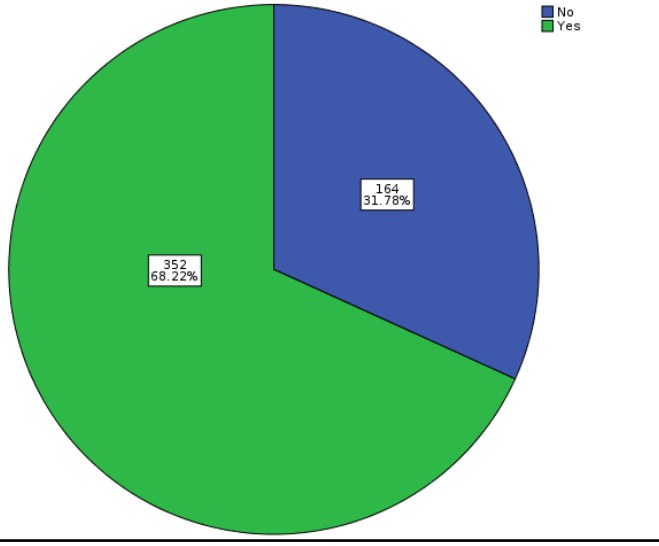
Assessing correct use?



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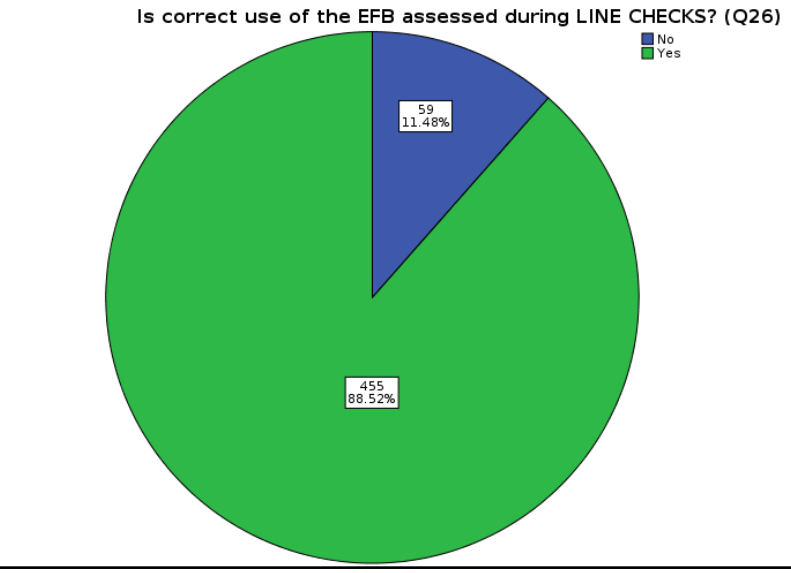
Assessing correct use?



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Performance

In addition to the provisions of chapter 7.6, **specific care is needed** regarding the crew procedures concerning **performance** or mass and balance applications:

a) Crew procedures should ensure that **calculations** are conducted **independently by each crew member** before data outputs are accepted for use.

b) Crew procedures should ensure that a **formal cross-check** is made before data outputs are accepted for use. Such cross-checks should utilise the independent calculations described above, together with the output of the same data from other sources on the aircraft.

c) Crew procedures should ensure that a **gross-error check** is conducted before data outputs are accepted for use. Such a gross-error check may use either a 'rule of thumb' or the output of the same data from other sources on the aircraft.

d) Crew procedures should ensure that, in the event of loss of functionality by an EFB through either the loss of a single application, or the failure of the device hosting the application, an equivalent level of safety can be maintained . Consistency with the EFB Risk Assessment assumptions should be confirmed.

AMC 20-25, F.1.3 Procedures

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Data Entry Error and Detection

- Humans have rather high accuracy when inputting data
  - **>99,5%**
- Significantly lower error detection rate
  - **40-70%**

Panko, 2008

- Swapping between apps?

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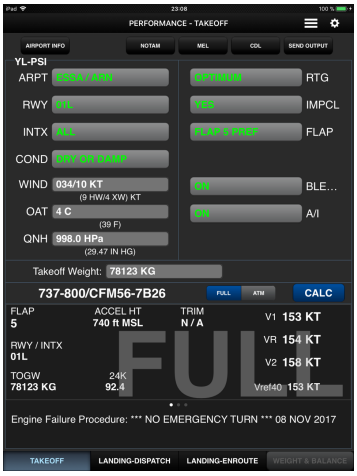
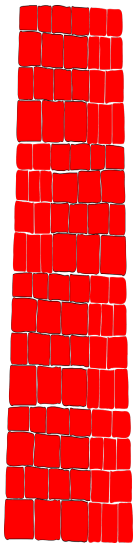
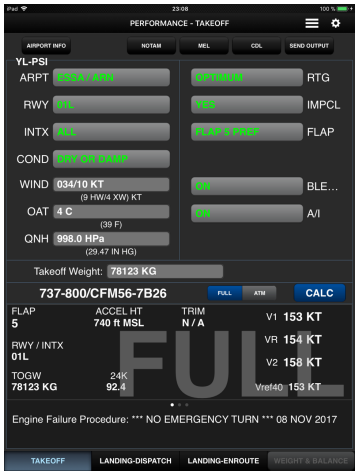
Independent + crosscheck







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Performance calculations

Independent performance calculations and cross-check of result	64.6%
FO performs calculation, Captain cross-checks result	15.2%
PF performs calculation, PNF/PM cross-checks result	13.0%
PNF/PM performs calculation, PF cross-checks result	4.8%
Other option	1.5%
Captain performs calculation, FO cross-checks result	0.9%

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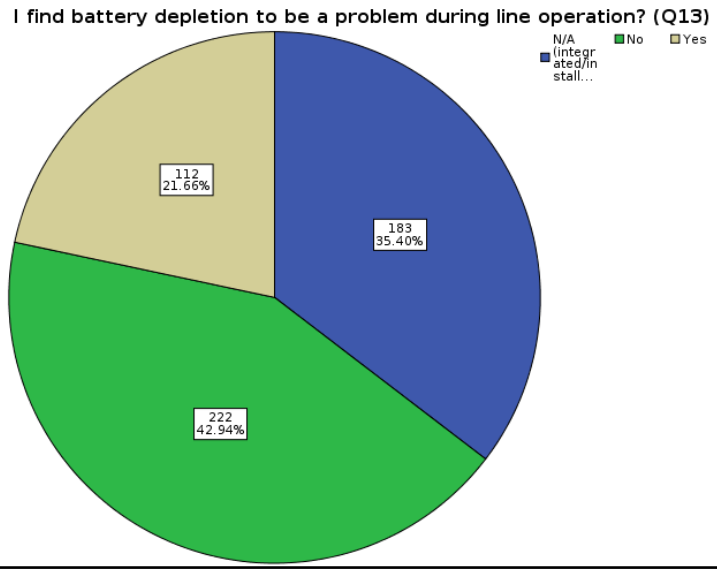
Battery



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Information distribution

- Number of manuals?
- Total number of pages?
- Channels?

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Information overload

- EFBs have enabled operators to disseminate information in an unsurpassed way.
- Information shall be structured and made available for its users:
  - **based on the needs and abilities of the user groups or individuals;**
  - **not based solely on available software features.**
- Else there is risk for information overload and adaptation resistance.
- Operators have opportunity to improve abilities through training and can limit number of communication channels.

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Conclusions

- Large majority of the pilots used their EFB for mission critical purposes, e.g. 88% for performance calculations
- Yet 77% of the pilots received no training or only initial training
- Operators are used to various mandatory recurrent training for their pilots, both theoretical and practical.
- It should be standardized to perform EFB training to ensure safe and efficient use.

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Conclusions

- To perform independent performance calculations with cross check of result is well supported by research.
- 35% of the pilots did not follow the recommendations.
- Operators are directly responsible and need to ensure recommended best practices are implemented.

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All on-board

https://www.youtube.com/watch?v=pQHX-SjgQvQ

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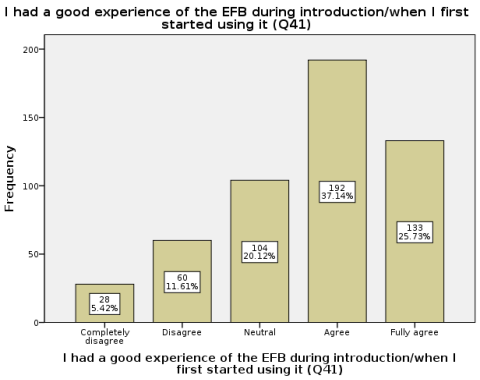
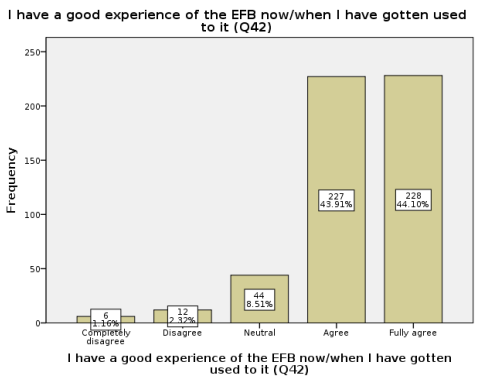
Perception of EFB





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Questions / thoughts?