# Man/Machine Interface

## Training the Modern Airline Pilot


**DO NOT USE FOR FLIGHT**

K&S Pad

Our discussion today will apply to:

- Any *ab-initio program
- Any Air Carrier training department
- Any Flight School
- Any University flight program

But first:

Who are we?

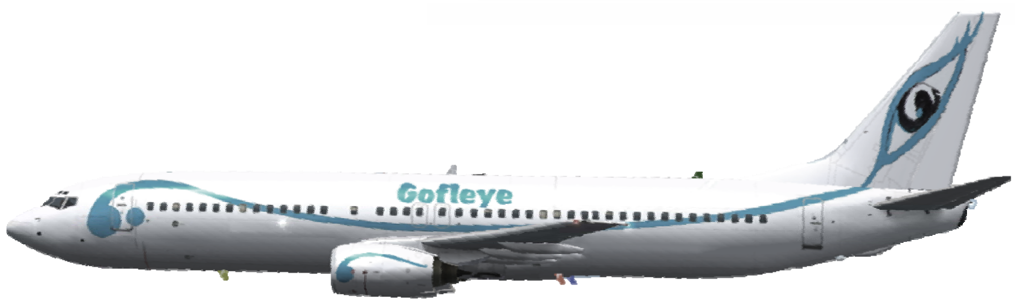
Why do we know what we know?

AIR TRANSPORT PILOT

# FAA 142 TRAINING CENTER = SIMULATORS ONLY

K & S
AVIATION
Knowledge & Safety

AIR TRANSPORT PILOT



# Boeing B-737 Classic & NG

AIR TRANSPORT PILOT


# Airbus A-320

K & S AVIATION

Knowledge & Safety

AIR TRANSPORT PILOT


# Boeing B-757/767

# K&S Aviation

## Computer Based Training

## Boeing 737 NG

## Pressurization System

The cabin pressure controllers regulate the opening of the outflow valve.

# K&S Aviation

## Computer Based Training

AIRBUS A320

Flight Controls Normal Law and Protections


FLIGHT CONTROL COMPUTERS
A side stick or an autopilot sends a message to the flight control computers demanding an aircraft maneuver.
K&SA320
Flight Controls Normal Law and Protections
3
MENU
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In flight mode, if you wish to execute a descending left turn for example, you set the required attitude and then return the side stick to neutral.
MACH
ALT
HDG
A/THR
320
300
280
260
240
255
250
245
20
10
.67
STD
31
32
33
34
K&SA320
Flight Controls Normal Law and Protections
11
MENU
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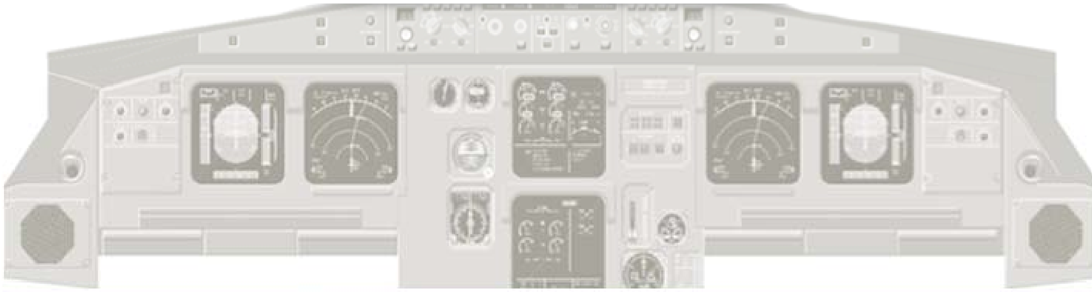
K & S
Knowledge & Safety
AVIATION

GENERAL AVIATION PILOT

# FAA 141 FLIGHT SCHOOL – SPECIALIZING IN AB-INITIO

## Jet Transport Pilot Course



The Airlines as a Career | Course Outline

Zero Flight Hours

↓

Private Pilot License

↓

Instrument Rating

↓

Commercial Pilot License/Multi-engine Rating (*190-250 hours)

↓

Jet Pilot Transition Course

↓

Boeing B-737/757/767 or Airbus A-320 Type Rating

K&S Aviation Services is a FAA approved FAR part 141 flight school and a FAR part 142 training center. FAR part 61 flight training is available. * Hours will be adapted to ICAO contracting states' requirements. Contact us for career counseling or an e-brochure.

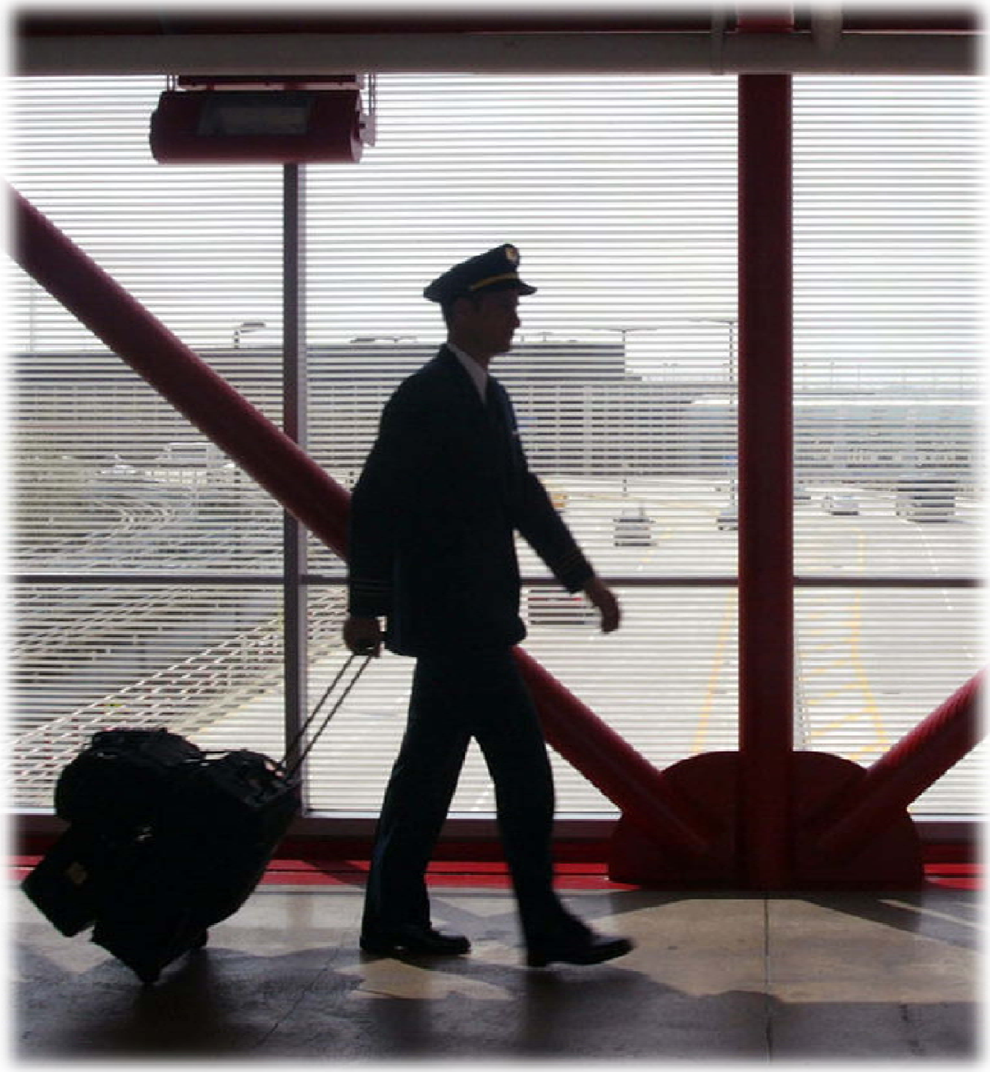
Total number of pilots trained ≈ 2000 pilots since 1998.

Who?

# Military pilots transitioning to the civilian world:

- US Air Force
- US Marines
- US Navy
- US Army

# Airline pilots wishing to enhance their resumes:



# Our specialty, the low time pilot or ab-initio:

From Theory to Practice:

What do we get for 250 hours?

# … in the US!


## …after 250 hours and $45 – 100,000 later!

# European and Asian Airline Trainee Graduates

…after 250 hours and $125,000 or more later!

# US Military Undergraduate Pilot Training Program

…after 250 hours and $1 million later!

# Different Voices in Training

FAA Commercial Pilot

Multi-Crew Pilot License

Joint? Aviation Authorities License

Wee need more simulator training…

Wee need more real aircraft training…

Wee need more upset training…

Less computers…more humans

More computers …less humans

It is not the machine… It's the humans…

No common denominator

Except…

a pilot has to be trained…

…It is the law!

# The industry is trying to jump this gap.

?


Theory → Practice

Holy Grail or el Santo Grial

From Theory to Practice:

Key elements of a training program


Gofleye
ATR 72

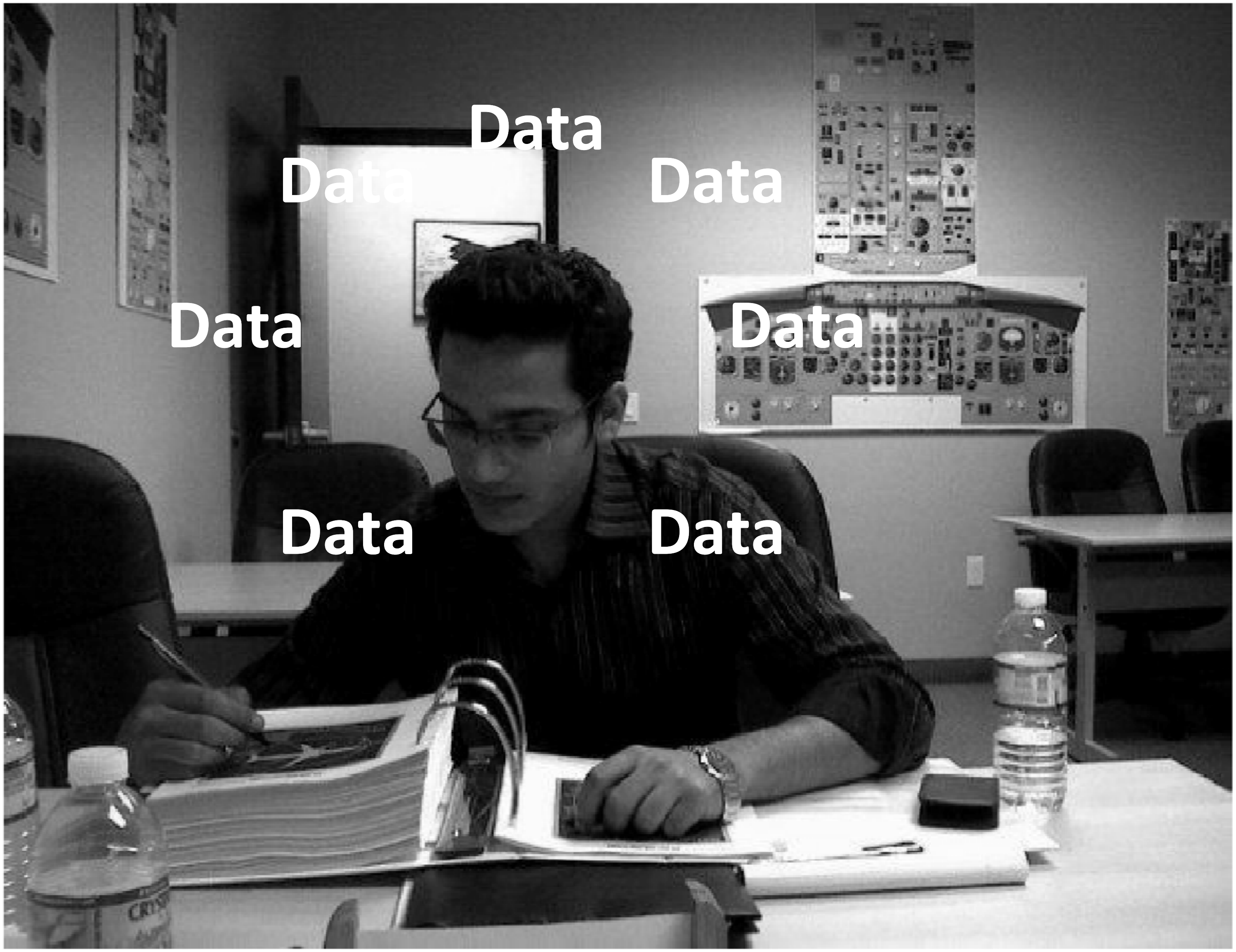

Student

Instructor


Evaluator

From Theory to Practice:

Processing data…




A student must process a lot of theory

## Manuals – B-737 NG

Aircraft Systems: 1255 pages

Aircraft Procedures: 963 pages

Aircraft Emergency Procedures: 642 pages – The ones we can foresee!!

# Procedures – B-737 NG

Before Engine Start:

External Items - 85 Procedural Steps

Cockpit Items – 400 Individual Steps/Warnings/Status

How to effectively absorb it?


How to effectively instruct it?

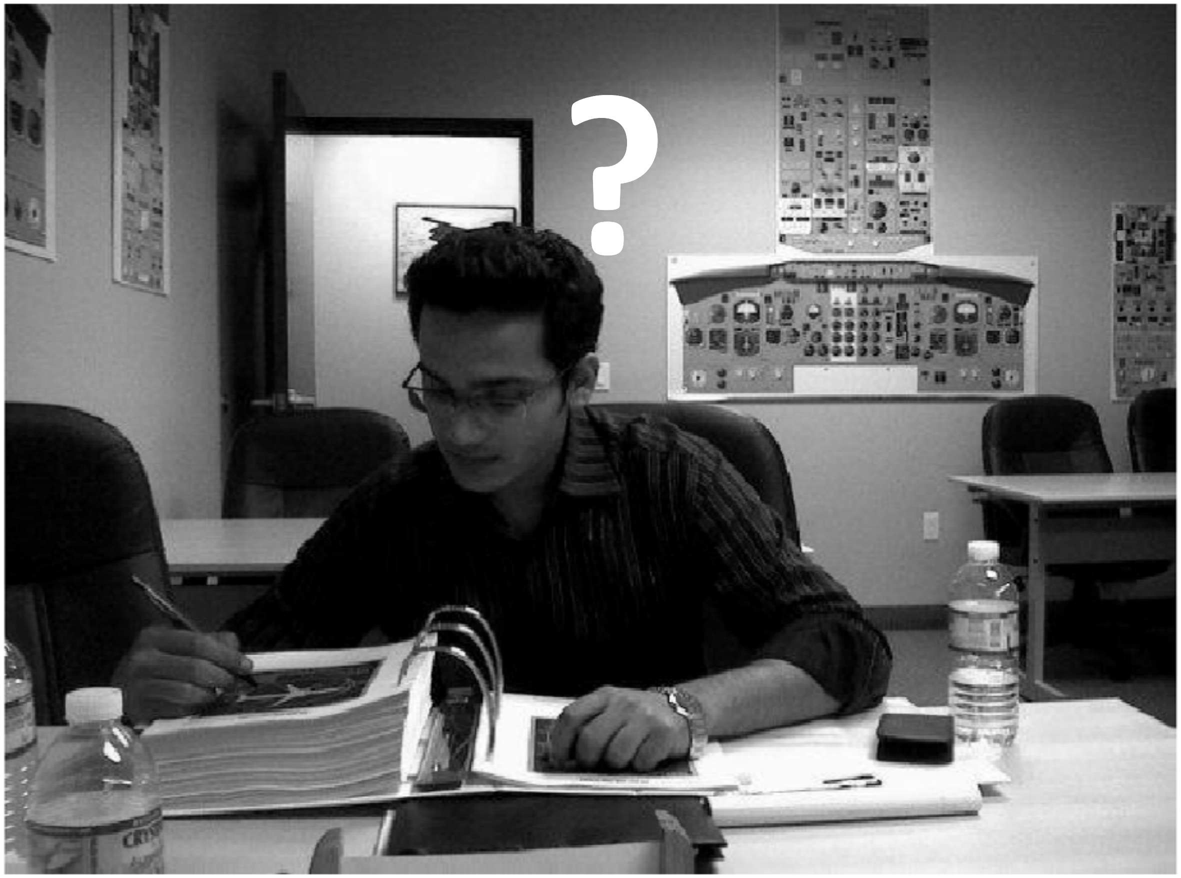

How to effectively evaluate it?

From Theory to Practice:

The **key** denominator…

(which validates <u>any</u> training program)

# Application




Every Student <u>anticipates</u> performing a lot of actions.

<u>I Want You</u>…r Actions to be:

- Correct
- Timely
- Appropriate
- Effective
- Predictable
- Consistent

And by the way…while this thing is moving fast!

Thank you – CAA/Management/Flying Public.

# What makes <u>acting</u> on data difficult in aviation?

The element of speed…

Is there something else?

# Acting on data at?    230 m/sec

Difficult

# Acting on data at?    75 m/sec

Very Difficult

Recognition
Of
Failure

V1 - Action

72 m/sec

75 m/sec


1 second

73 m

The **key** denominator:

**applicable knowledge**

which leads to

**proper action**

Only this validates <u>any</u> training program.

OK, but how do we achieve this?

Pilot continuously processes data.

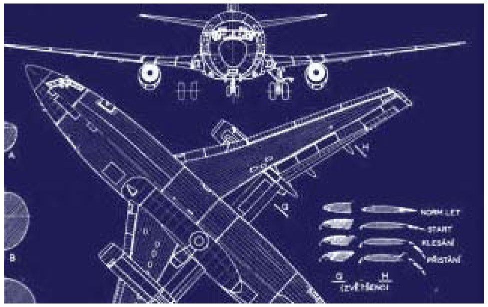
So let's follow the data…

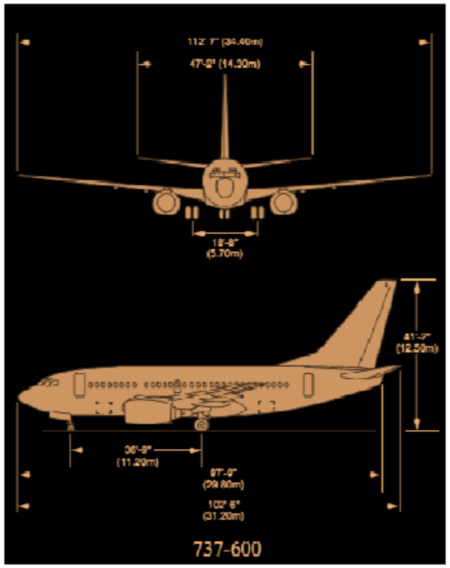
…and find out what else blocks our path to

**application**

# From manufacturer to pilot-

Blueprint → Final Product → Stylized Version

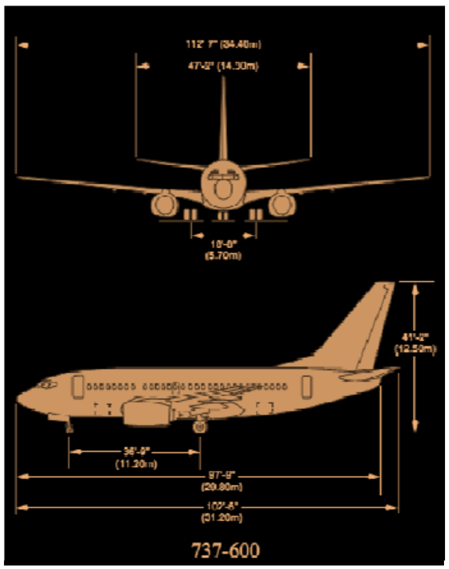




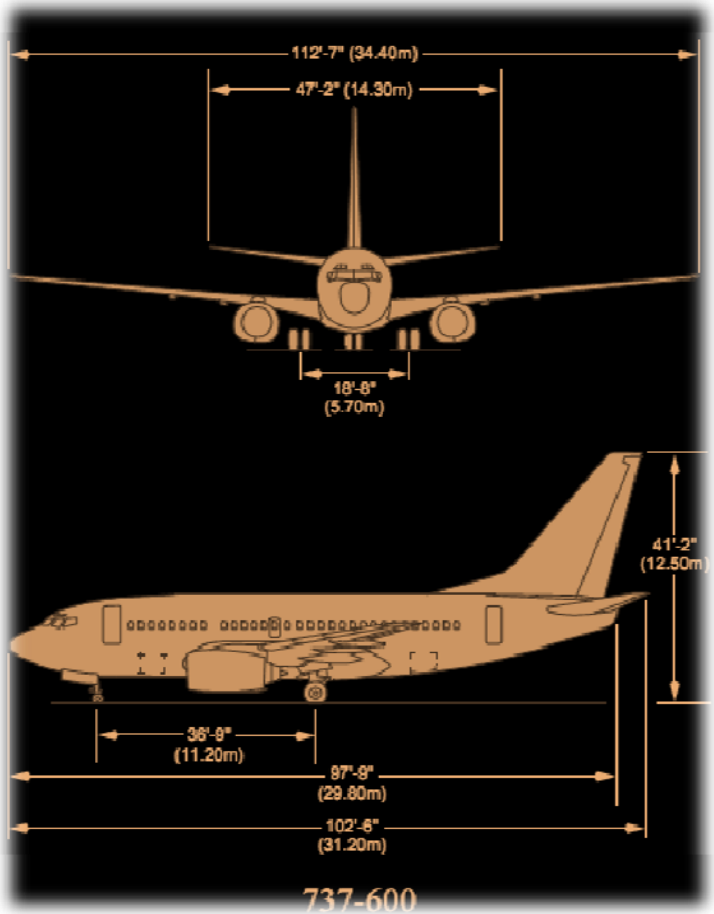

Manufacturer controls this data

# Starting point of data in a training program

Manufacturer's stylized version → Pilot Training Program



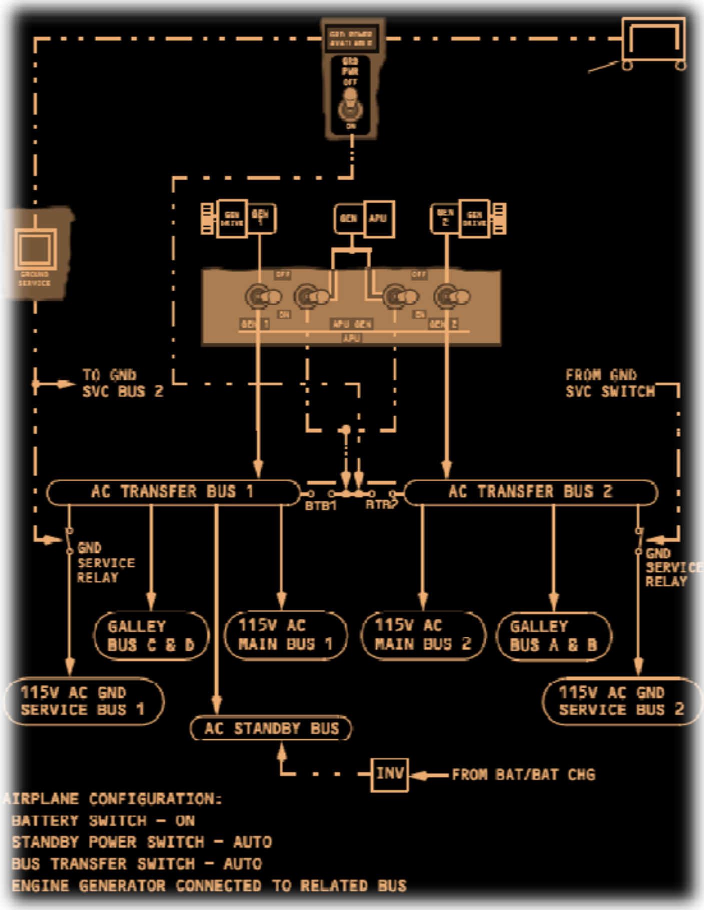

Stylized version




# Manufacturer provides:

- Airplane Flight Manual
- Airplane Maintenance Manual
- Airplane Dispatch Deviation Guide
- Aircraft Performance
- Aircraft Weight & Balance
- …and more!

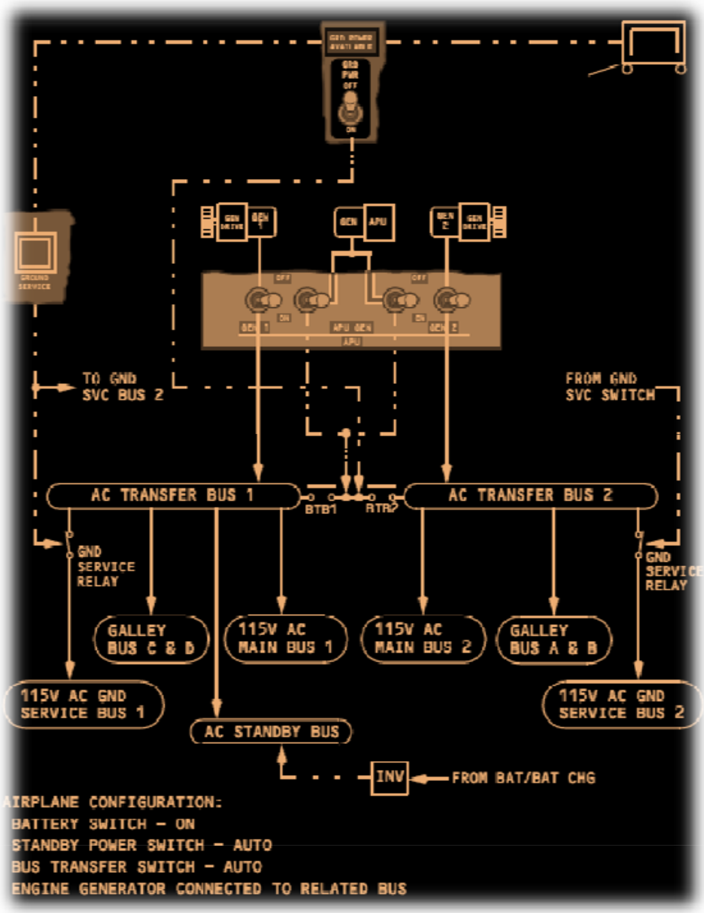
Stylized version




Manufacturer must make a set of assumptions.

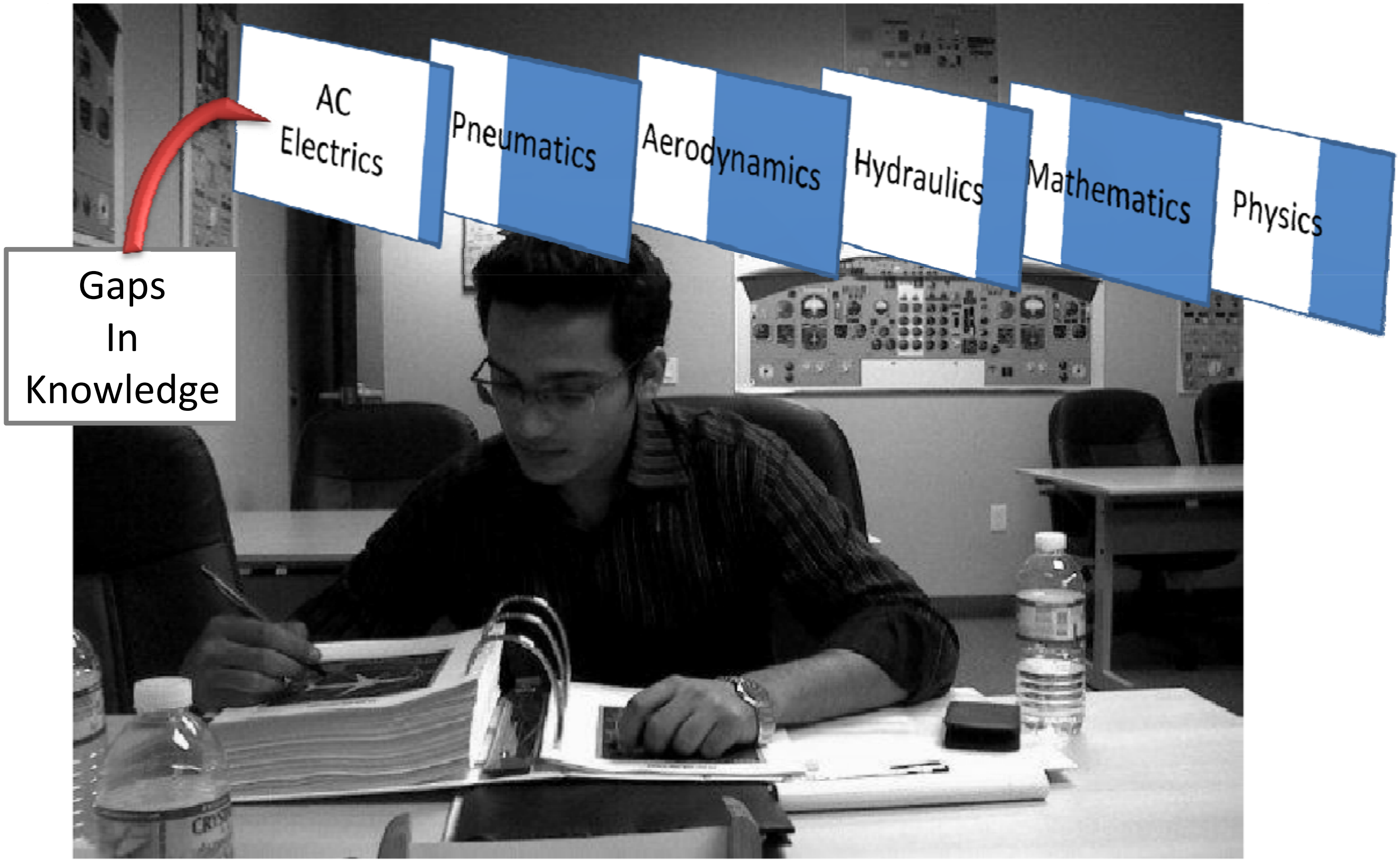
Its all for the average Joe!

Stylized version



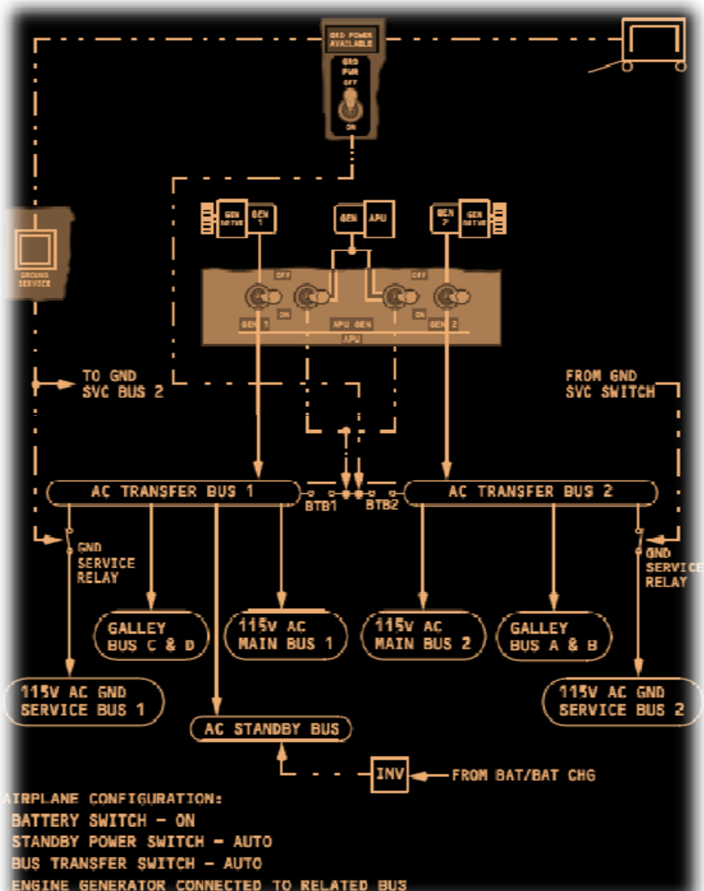

# Manufacturer's <u>assumptions</u>:

- Pilots possess basic knowledge of technology employed
- … and the instructor will fill any gap in knowledge.



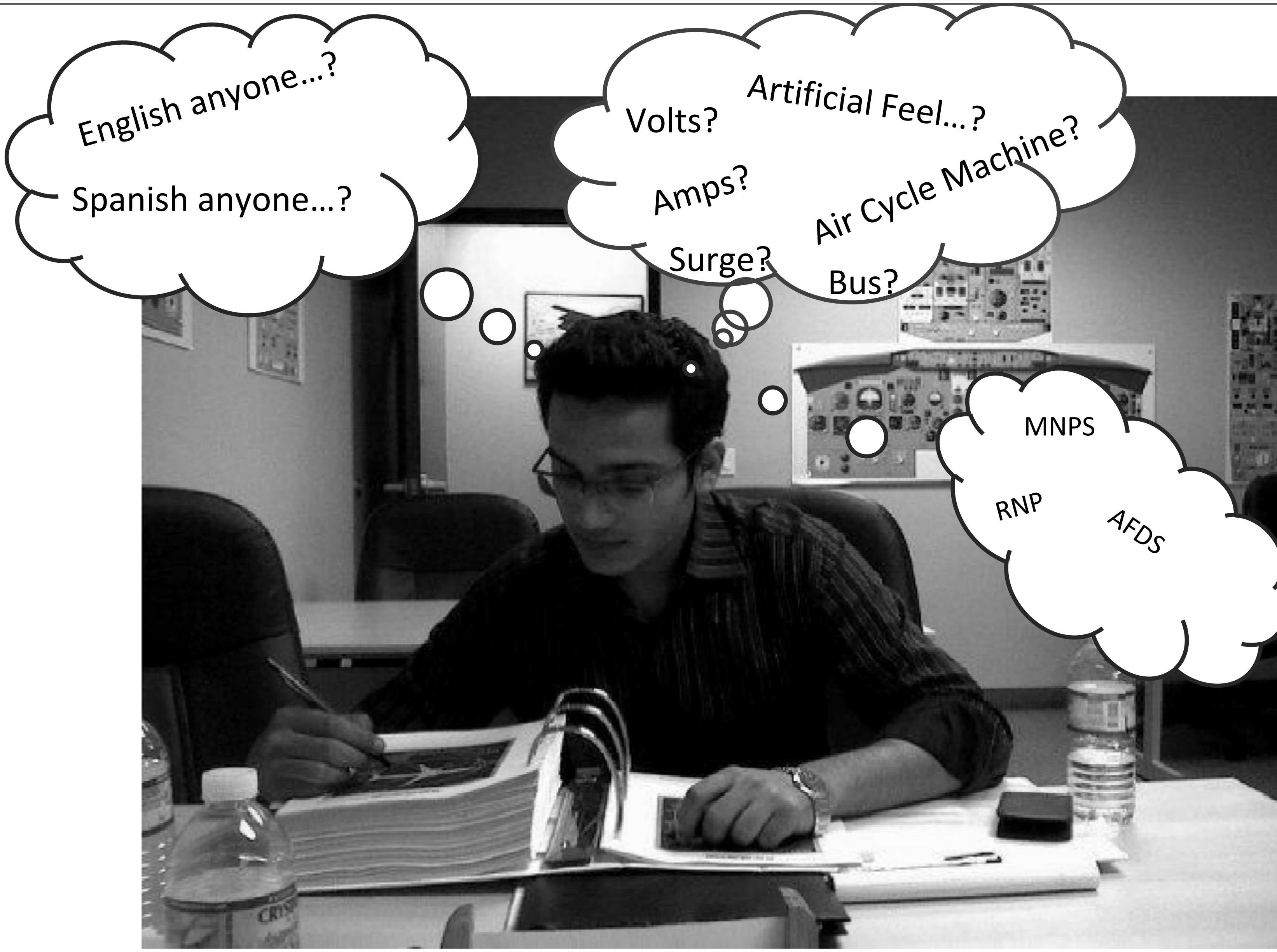

What data does the candidate bring to program?

Stylized version




# Manufacturer's assumptions:

- Technical nomenclature is understood by pilot

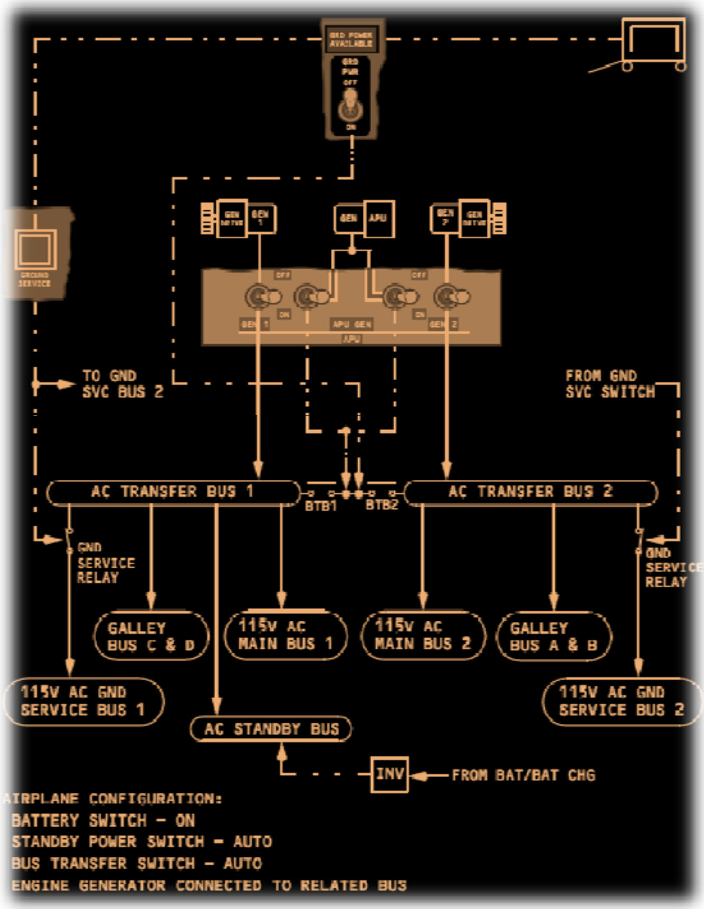


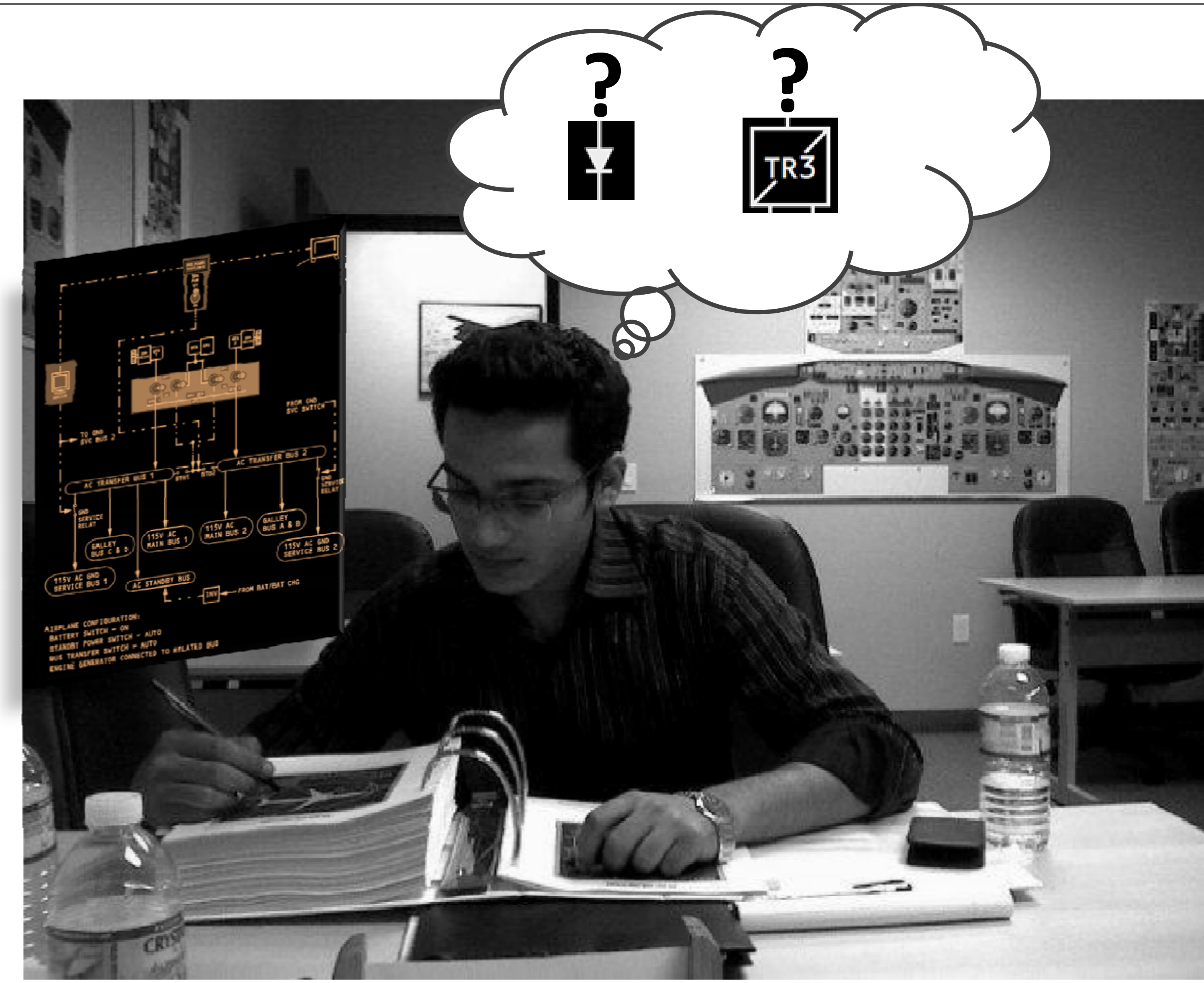

…and they just keep piling up!

Stylized version

# Manufacturer’s assumptions:

- Technical symbology is readily understood





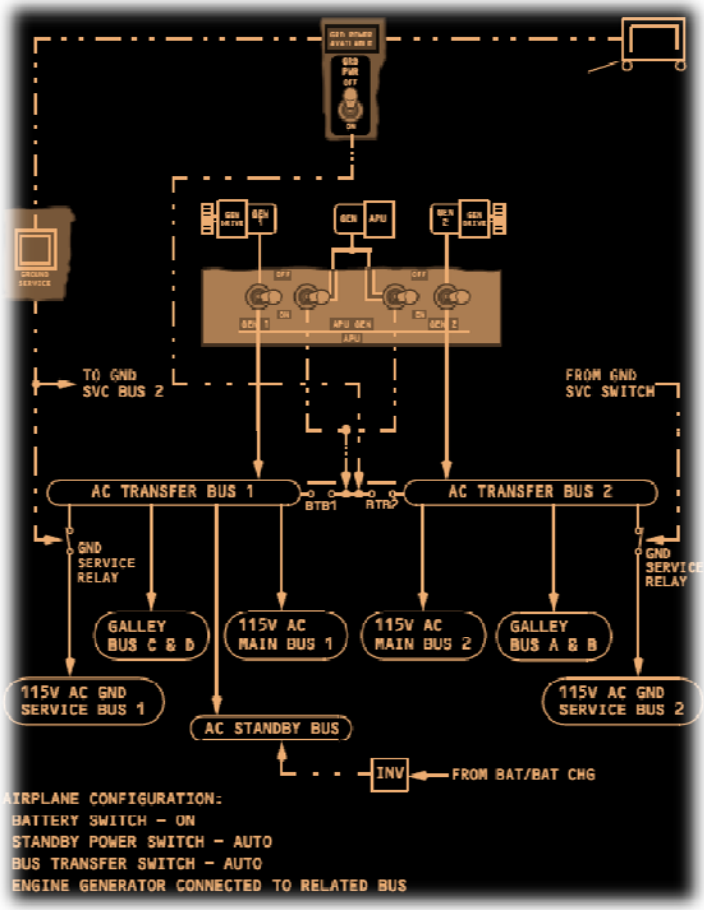

…and they just keep piling up!

# Instructor = Evaluator

Students

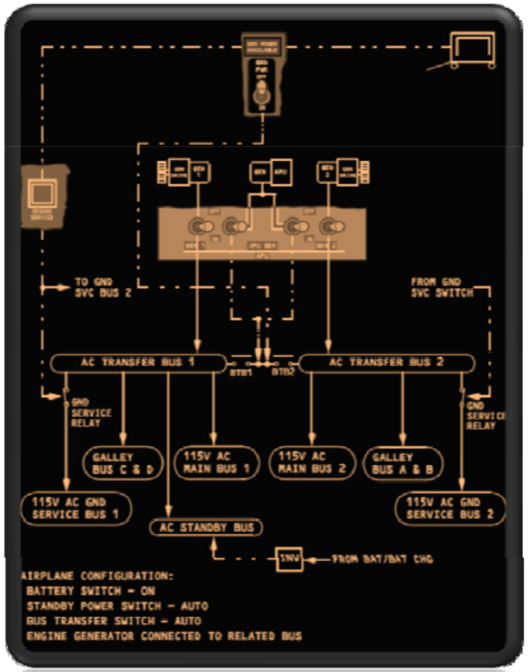
What data does the instructor bring to program?

Stylized version



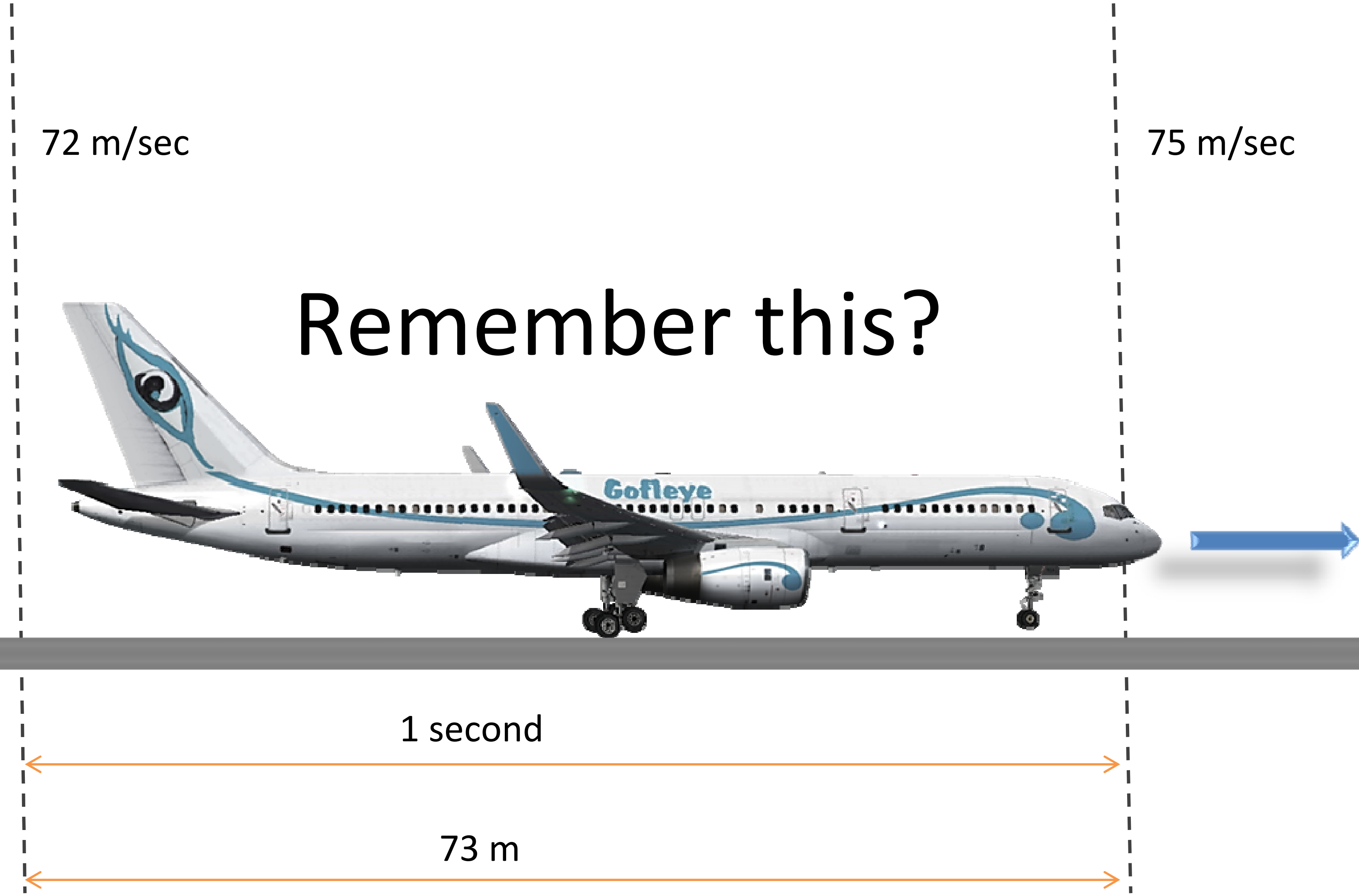

# Manufacturer's assumptions:

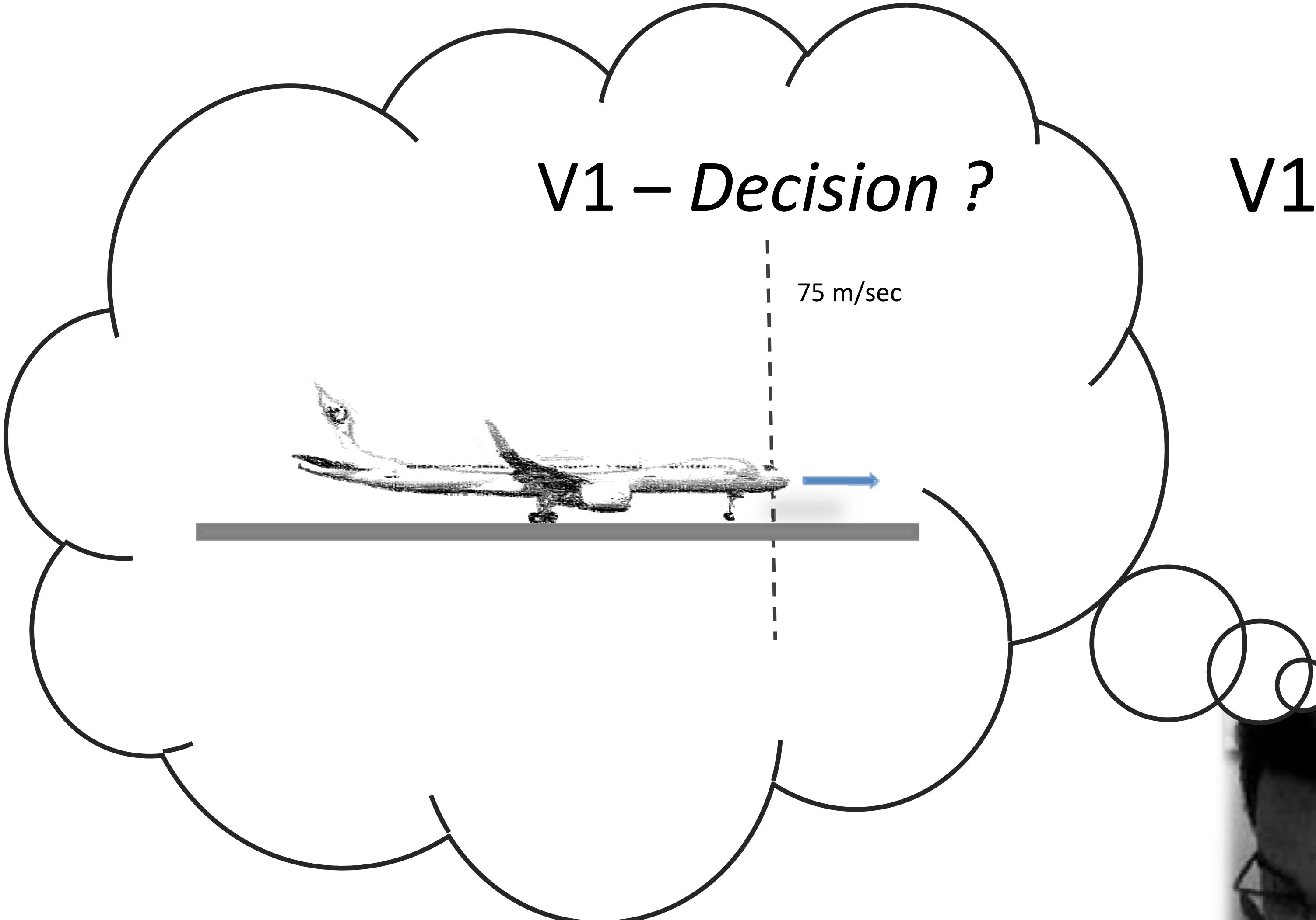
- Pilot visualizes the desired image created by engineering staff


TO GND
SVC BUS 2
FROM GND
SVC SWITCH
AC TRANSFER BUS 1
AC TRANSFER BUS 2
BTB1
BTB2
GND
SERVICE
RELAY
GALLEY
BUS C & D
115V AC
MAIN BUS 1
115V AC
MAIN BUS 2
GALLEY
BUS A & B
115V AC GND
SERVICE BUS 1
115V AC GND
SERVICE BUS 2
AC STANDBY BUS
FROM BAT/BAT CHG
AIRPLANE CONFIGURATION:
BATTERY SWITCH - ON
STANDBY POWER SWITCH - AUTO
BUS TRANSFER SWITCH - AUTO
ENGINE GENERATOR CONNECTED TO RELATED BUS

# V1 - Action

## Remember this?

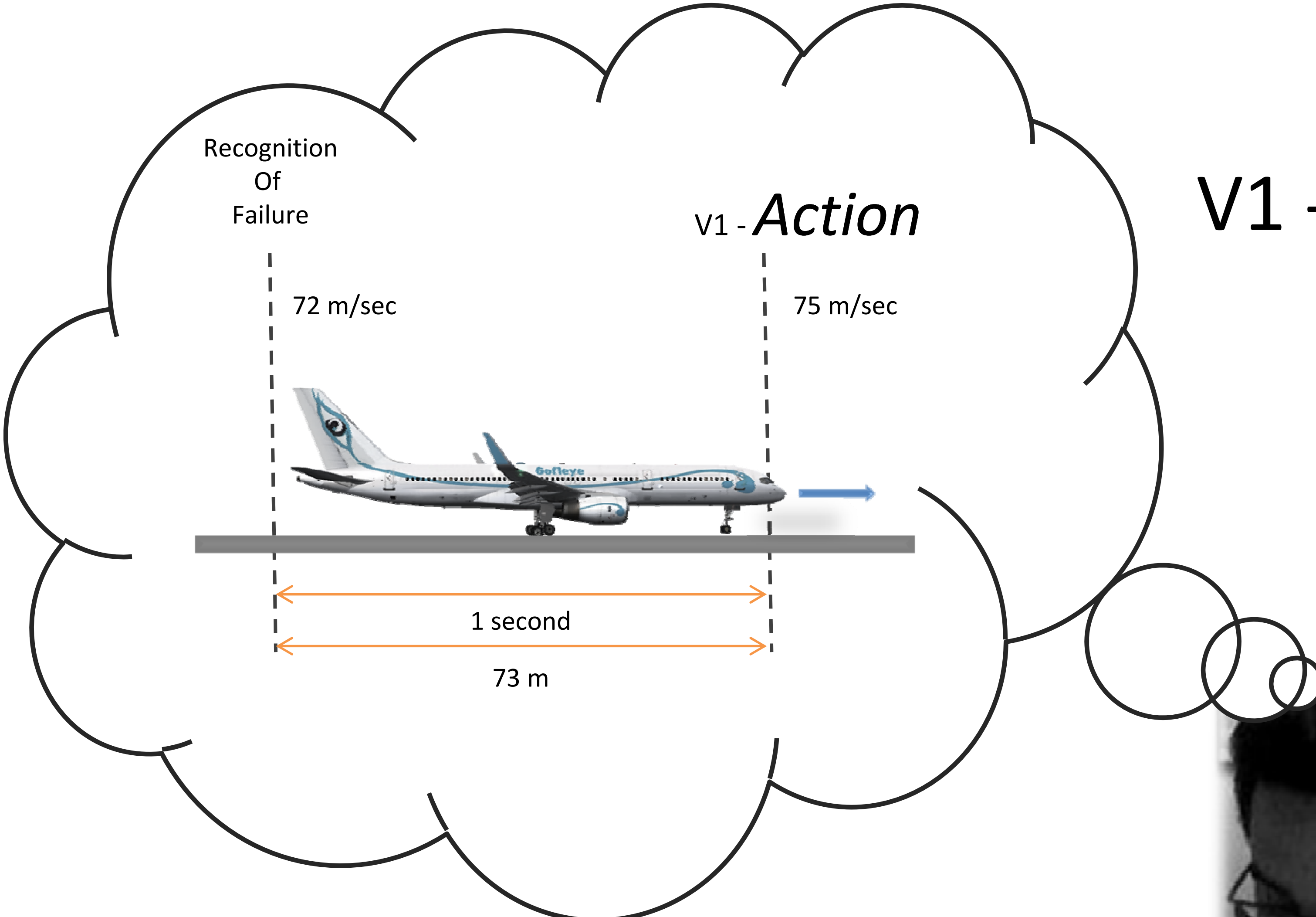





V1 - **?**

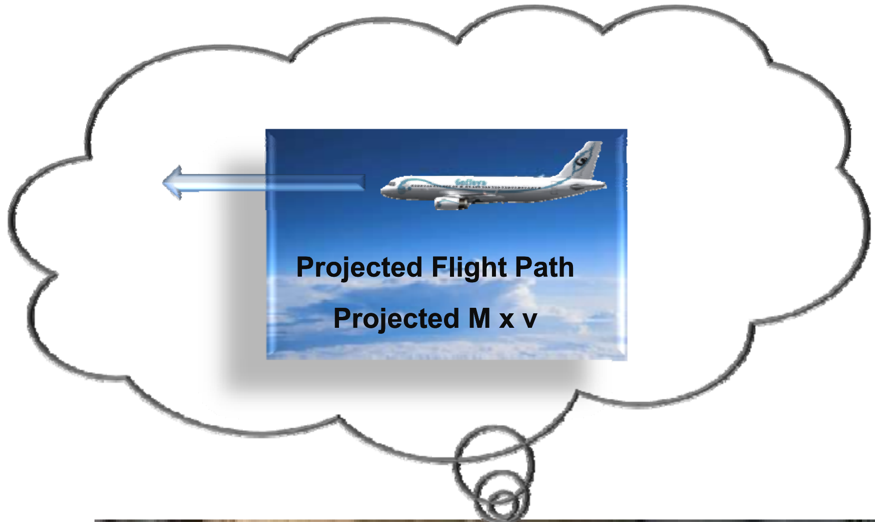
Poor action at high speed!

# V1 - **Action**




Ensure the correct image in training!

This will greatly enhance the possibility that the projected flight path will become the actual flight path


The **key** denominator:

**applicable knowledge**

which leads to

**proper action**

Only this validates <u>any</u> training program.

OK, but how do we achieve this?

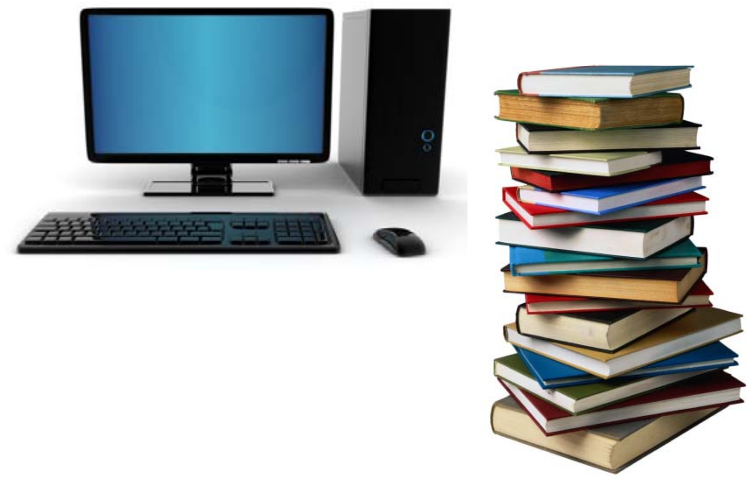
If the instructor notices the 4 in- and the 1 un-:

- In-correct
- In-appropriate
- In-effective
- In-consistent
- Un-predictable

**ACTION** …on the part of student!

# Send Student back to here!

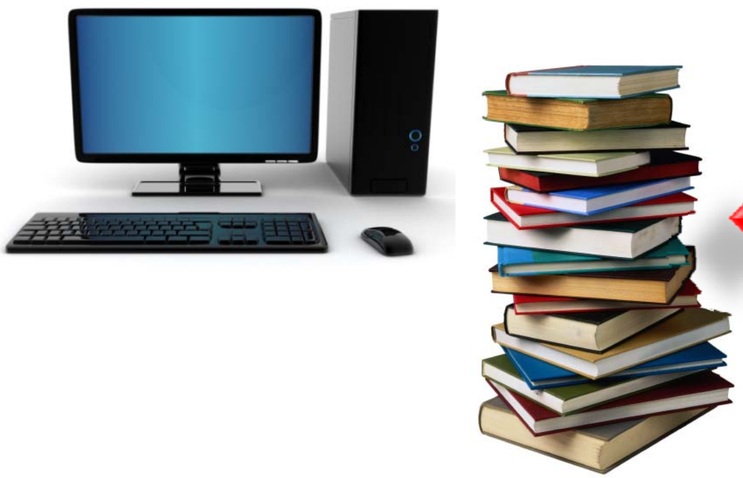
Look for misunderstanding in:



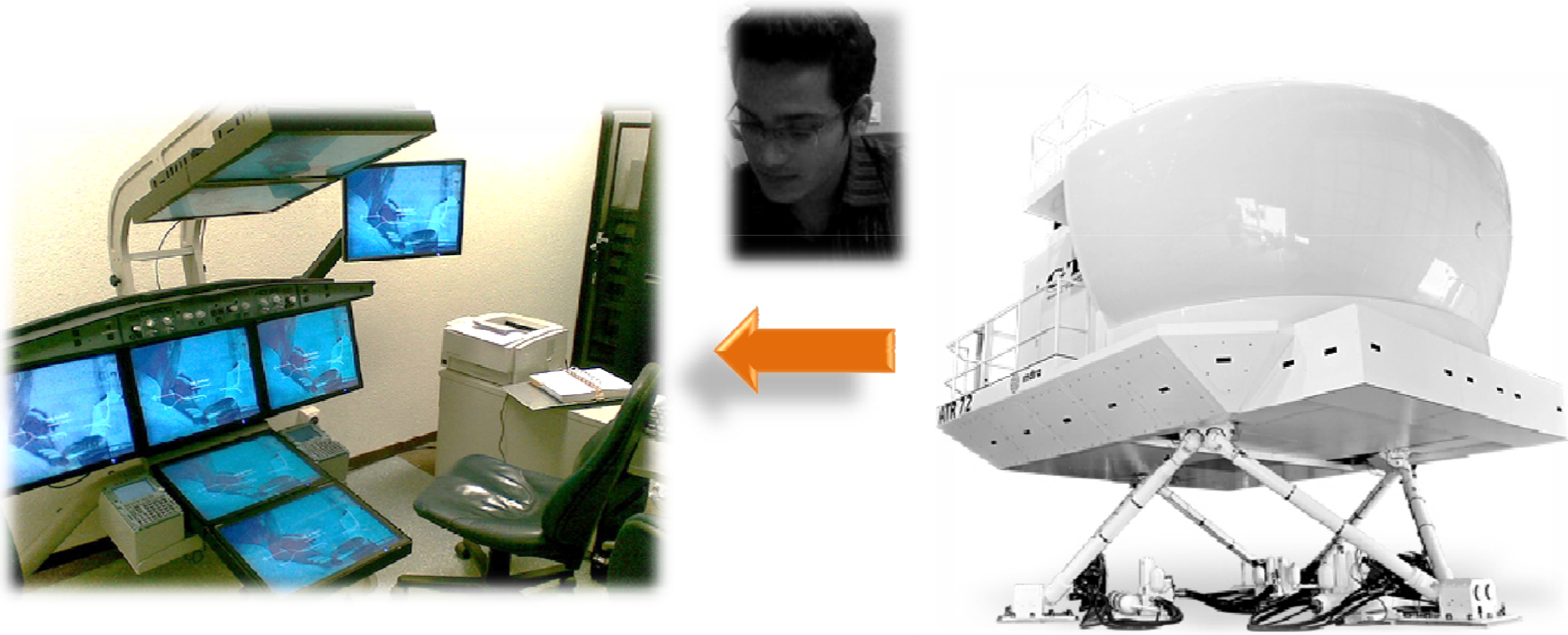
- Purpose of System
- Nomenclature
- Abbreviations
- System Symbology

You will be surprised what you will find and correct action will ensue in SIT and simulators!

# This should become policy in any training program!

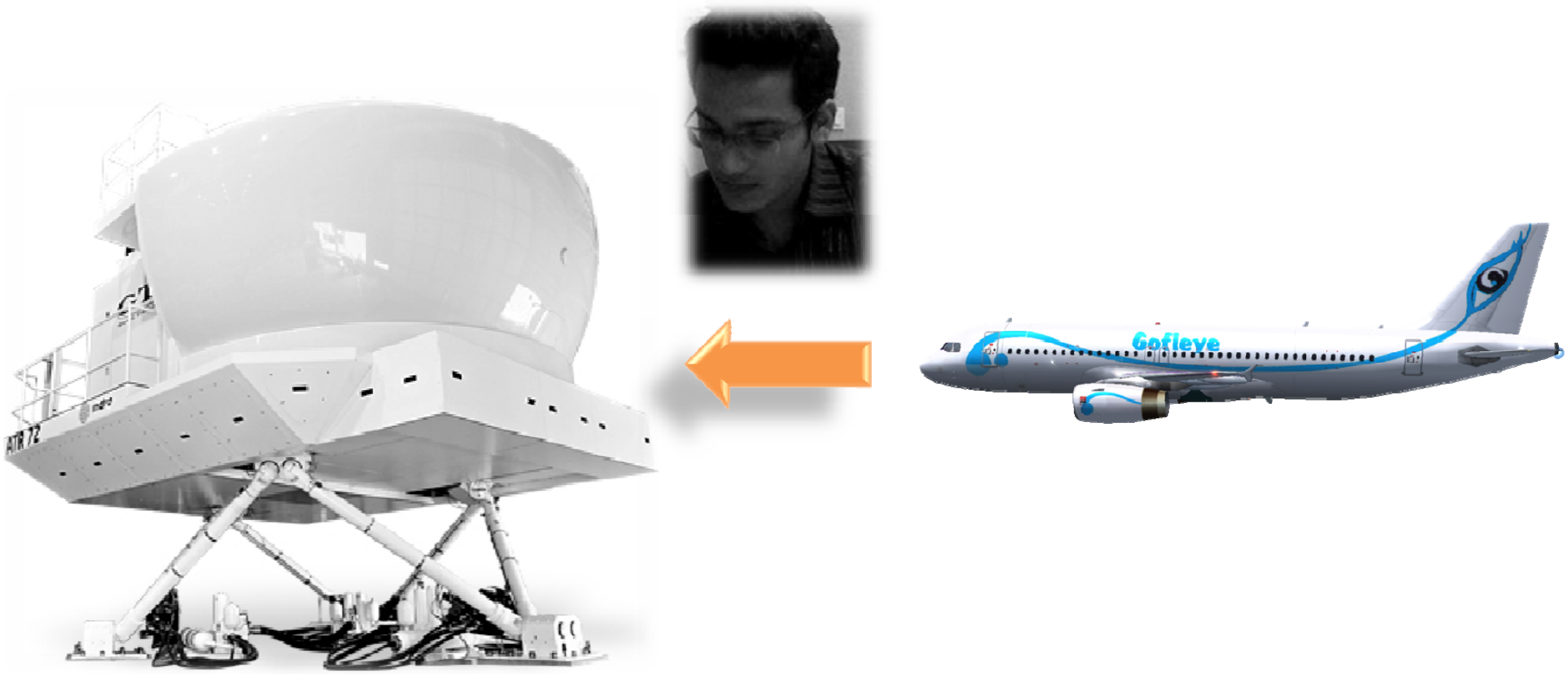


# What do we see in reality:



## Or worse:

- US Regionals – 2006 – 2007 – CPL 350-500 hrs.
- Asian Carriers - continually



# Oh yeah…we may have tried this as well!

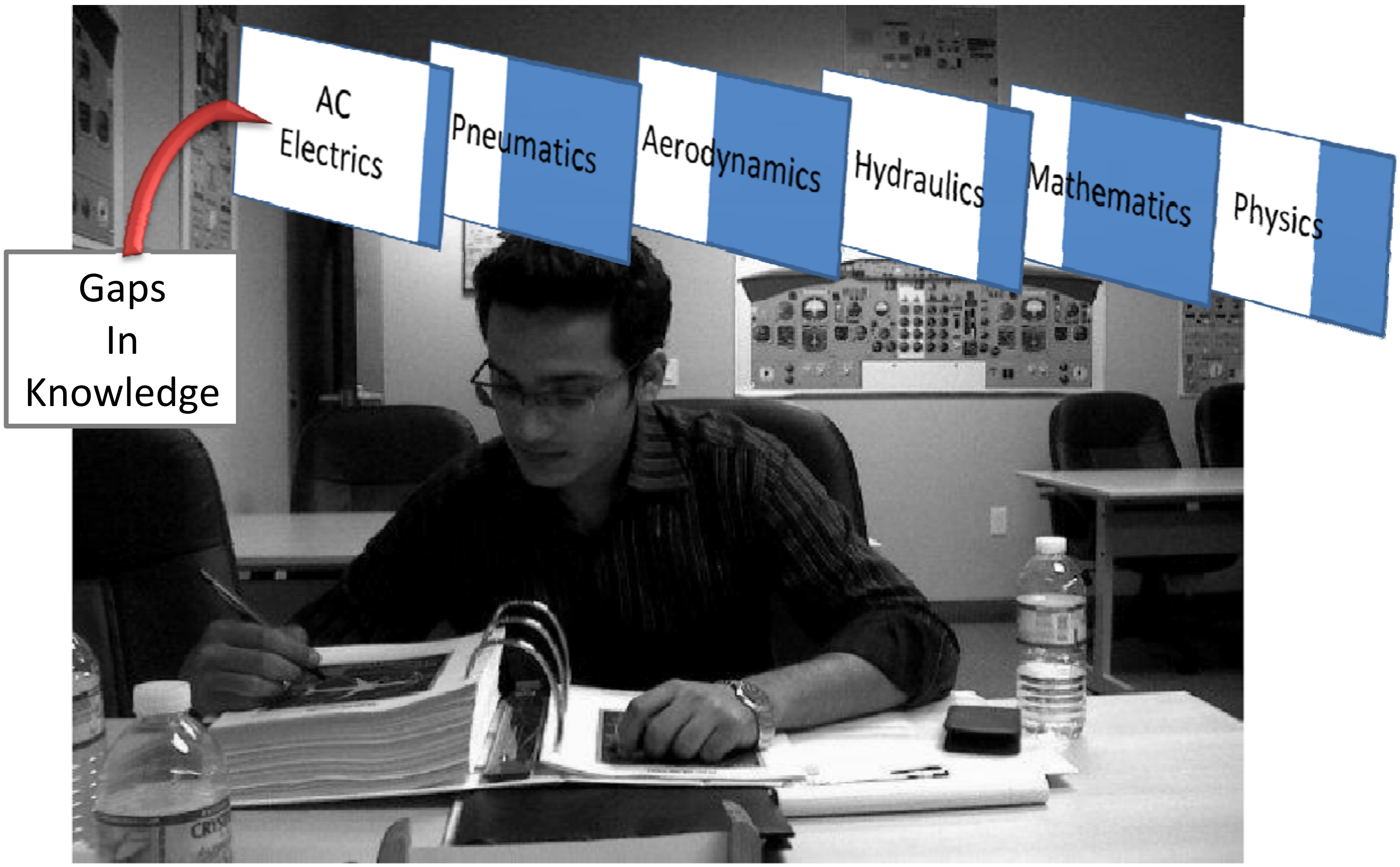
The worst:

**Zero** Return on Investment

# The industry wants to achieve this:

**?**


# …and the industry is faced with this in reality!




# …we propose this!

K&S Aviation Services, Inc.

# Jet Orientation Training

## Aircraft Electrical Systems





### ELECTRICAL PRESSURE

Electrical pressure is generated by creating a deficiency of electrons (= charge) at one end of a conductor and an excess on the other end. Each end of a conductor is referred to as a pole and is given a symbol. One end is given a plus sign (+) and the opposite end a (-) sign. In practice, it does not matter which end receives which designation as long as one remains consistent throughout a circuit from source to all conductors and devices. **The excess equals the deficiency**. This excess or deficiency in electrons is created either mechanically or chemically on most transport jets.

**Electrical pressure** (Electromotive Force/EMF) is measured in **volts** (V). The greater the difference between deficiency and excess of electrons, the greater the electrical pressure in any electrical system. Nature tries to balance out this pressure difference by having current flow from the excess to the deficiency similar to a tire relieving its pressure if a valve is opened. Current will flow as long as a difference exists between excess and deficiency of electrons between two points in a conductor. This imbalance is similar to a stretched rubber band!

Engine generators create **mechanically** the voltage pressure. Aircraft batteries create **chemically** this pressure.


Even when all pressure is 'relieved' in a conductor, the excess still equals the deficiency; in this case it is zero!

## MASS IN MOTION



The light aircraft on the left will have a significantly lower momentum or quantity of motion than the transport jet on the right.

As a pilot, you must always bear in mind the **quantity of motion** you are dealing with. Again, the greater the momentum, the greater the forces must be to bring about a change over time.

Response to flight control or thrust inputs, distances needed to speed up or slow down, and the reaction to outside forces are all dependent on the momentum of the aircraft.

The **actual flight path** depends on your ability to predict that flight path BEFORE you attempt to fly it. A solid understanding of inertia and momentum with respect to the aircraft you intend to pilot will determine how closely your actual flight path resembles the mental image flight path created in your mind.





## MASS IN MOTION

**Projected Flight Path versus Actual Flight Path:** This is one of the most important concepts to understand and get right <u>every time</u> you operate any aircraft. This concept becomes even more crucial the greater the mass of the aircraft and/or the higher the true airspeed of that aircraft. The greater the momentum (or quantity of motion of an aircraft) the further out into space you must project the <u>**intended**</u> flight path such that the <u>**actual**</u> flight path is a copy of that mental image. Situational awareness and spatial orientation are key elements in this projected flight path.

**Always remember:** If a mistake in flight path has occurred, the aircraft will continue on this trajectory until the corrections have taken effect (inertial effect). The greater the momentum of the aircraft, again the more difficult it will be to correct a flight path. This is essential when flying in mountainous terrain, low to the ground, and/or in high density airspace.



## FAN

The fan is basically a large-diameter propeller and belongs to the propulsor section. The fan draws air into the engine and is responsible for approximately 80% of the total thrust produced.

Fan speed is measured in % and is called N1. The letter N is used by engineers to denote engine speed (RPM). The number 1 refers to spool number 1 of which the fan is one component.

Note that the fan, like a propeller, is a set of rotating airfoils, called blades. Those blades share the identical airflow characteristics and limitations of an airfoil. In other words they can experience stall characteristics or airflow disruption which lead to loss of thrust, vibration, and/or structural failure.

The N1 gauges as seen in the cockpit. The fan is rotating at 75.3% of its maximum rated RPM. (REV = engine reverse is active)


N1 Gauges



## ACCESSORIES

It is important to note that a jet engine is referred to as a powerplant. A powerplant is responsible for providing useful energy for some human activity. In this sense, the jet engine provides for various forms of power useful for flight OTHER than thrust.

Electrical, pneumatic, and hydraulic power are provided by each jet engine on a transport aircraft. These are discussed in detail in your aircraft systems manual.

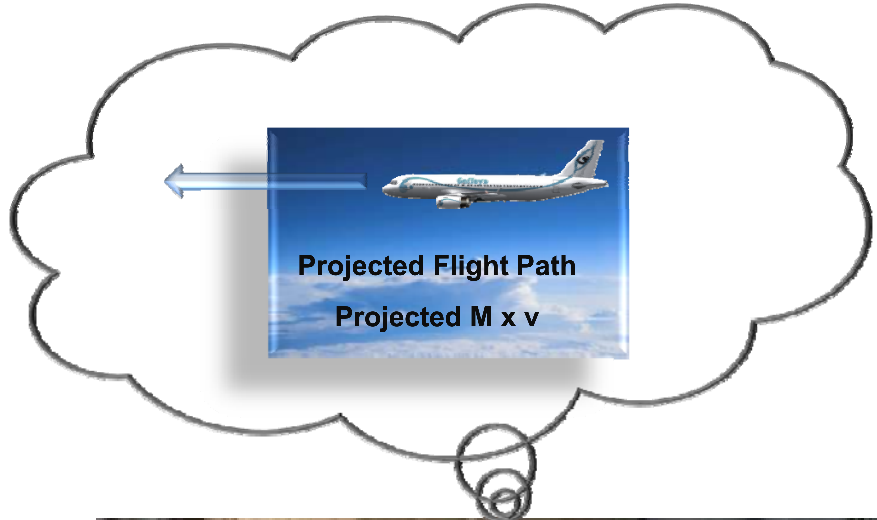
The **accessory drive** (or **gear box** in pilot jargon) provides the necessary power to drive various components such as the electrical generator, the hydraulic, fuel, and oil pumps. The gear box is a common attachment point for accessories, each accessory experiencing different rotation speeds as determined by its **gearing.**

On the left is a typical gear box. One clearly sees the vertical shaft which is the N2 input shaft to the gear box.

As noted, some of the shaft horsepower from the turbine section must drive the gear box.

This will greatly enhance the possibility that the projected flight path will become the actual flight path


A student must understand the WHY of a system or performance element(s) of his aircraft BEFORE we ask for:

- Timely
- Appropriate
- Predictable

**ACTION**

Similar to a musician, this comes about through:

- Repetition on a flight training device
- Repetition under the supervision of a conscientious captain
- Repetition through experience.

- Once can only train a known quantity.
- One cannot effectively train an unknown.
- Repetition without knowledge becomes a great variable.

Francois Robichon de la Gueriniere

"However, practice without true principles is nothing other than routine, the fruit of which is a strained and unsure execution, a false diamond which dazzles semi-connoisseurs …“

**1733**

Industry trend is:

- Less theory
- More procedures
- More regulations

We will do this until we enforce enough knowledge gaps and write enough procedures to <u>regulate</u> us out of this business!

# So… Knowledge is <u>NOT</u> evidenced by…?

# … by memory only!

Engine Fire Checklist:

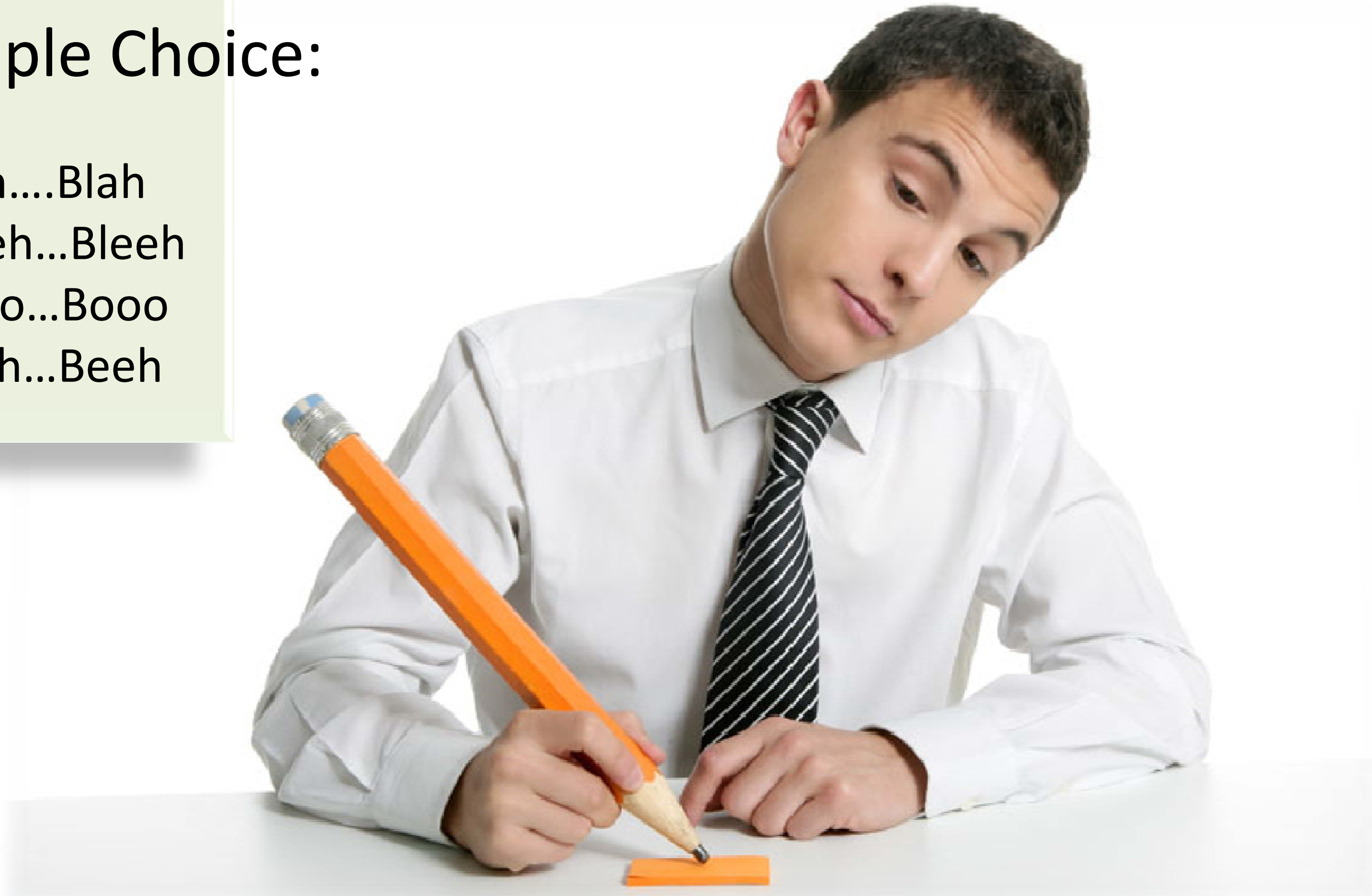
Thrust Lever……Closed
Start Lever……Cutoff
Engine Fire
SW…Pull/Rotate
…..
…..

Polly wants a cracker!!!

# … by memory only!

Multiple Choice:

a. Blah….Blah
b. Bleeh…Bleeh
c. Booo…Booo
d. Beeh…Beeh



# When in doubt C out!

# Memory in a critical situation often goes…

Memory associated with applicable knowledge does not vanish easily in stressful situations.

Other elements evidenced by a lack of <u>or</u> misunderstood applicable data:

- Fatigue
- Malnutrition
- Mental Anguish
- Physical Stress

Because of the speed element, it is critical that knowledge:

- is evidenced in action

Not mimicking or parroting an instructor or manual.

This responsibility lies with:

- Training Department Supervisors
- Student
- Instructor
- Evaluator

# Man/Machine Interface

## Training the Modern Airline Pilot

K & S AVIATION SERVICES, INC.

# Gracias!