

# Leonardo da Vinci (1452-1519)

***“Before you make general rule of this cure, test it 2 or 3 times and observe whether the tests produce the same effects.”***

Paris Manuscript 57e, cited by Walter Isaacson in *Leonardo da Vinci*

THE *NEW YORK TIMES* BESTSELLER

# THE **CHECKLIST** MANIFESTO

HOW TO GET THINGS RIGHT



PICADOR

# ATUL GAWANDE

BESTSELLING AUTHOR OF *BETTER* AND *COMPLICATIONS*

**October 30, 1935**

## **U.S. Army Air Corps competition for Long Range Bombers**

### **Boeing Model 299**

- **Aluminum alloy**
- **4 engines**
- **Best design compared to Martin and Douglas entries**
- **Could:**
  - **Carry 5 times as many bombs as required**
  - **Fly faster than other bombers**
  - **Fly twice as far**

**Army anticipated buying 65**

**Plane took off, climbed to 300 feet, stalled, and crashed**

**Major Ployer P. Hill, pilot, and one other crew member died**

## **Investigation:**

**No mechanical failure – pilot error due to unprecedented complexity**

## **Pilot responsible for:**

- **4 engines with oil-fuel mixture**
- **Retractable landing**
- **Wing flaps**
- **Electric trim tabs**
- **Constant speed propeller pitch**
- **Etc.**

**Pilot forgot to release a new locking mechanism on the elevator and rudder controls**

**“Too much plane for one man to fly”**

**Boeing went nearly bankrupt**

# Aftermath

- **Army purchased a few Boeing 299s as test planes**
- **Group of test pilots assigned to improve safety**
- **Created pilot checklist - short enough to fit on index card**
- **Step-by-step checks for takeoff, landing, and taxiing**
- **“Dumb stuff”**
- **Pilots went on to fly B-17 (nee 299) 1.8 million miles without a single accident!**
- **Army ordered almost 13,000 aircraft**
- **Decisive advantage in war against Germany**

# Checklist Applicability

	<u>Flying a B-17 Safely in 1935</u>	<u>Performing and Reporting Science in 2019</u>
Alignment of incentives	Absolute	Relative
Complexity	Analogue World: Dials and binary switches	Digital World: 50 Shades of Gray
Number of decisions	Large, but finite	Virtually infinite
Dependence on others	Important, but limited universe	Important, and expanded universe
Dependence on black boxes	Important, but finite and relatively simple to 'kick the tires'	Vital and increasingly difficult to 'kick the tires'