Autonomi i havrommet

(og om “Hvordan bevare mennesket i loopen?”)

GCE Node, Grimstad, 15.mai 2017

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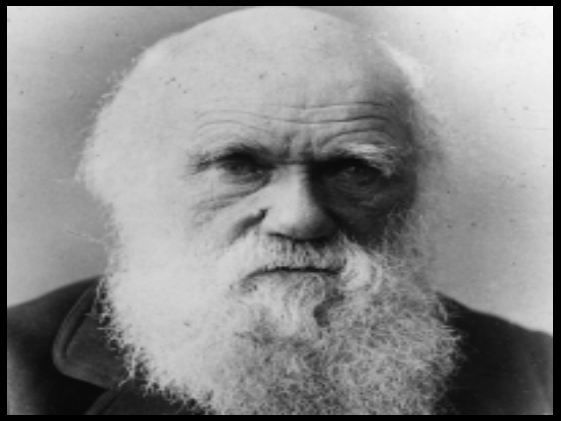
Thor Hukkelås, M.Sc.
Director Aquaculture R&D
Kongsberg Maritime, Subsea Division



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Has the evolution of man's cognitive abilities kept pace with the development of technology?

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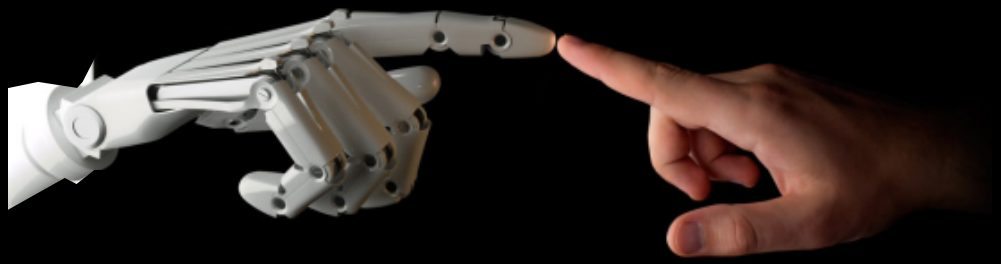
Are we loosing control of the machines?



Man vs Machines = Conflict?

or

Man + Machines = Partners?

“En automatisert industri kan gi oss overskudd og tid til å sitte og beundre solnedgangen”

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Interview in newspaper:
Fædrelandsvennen, mars 1965

Jens. G. Balchen (1926-2009)
Founder of Institute of Engineering Cybernetics, 1954

The world's first Unmanned Surface Vehicle?

Diplomoppgave NTH 1976, Thor Hukkelås

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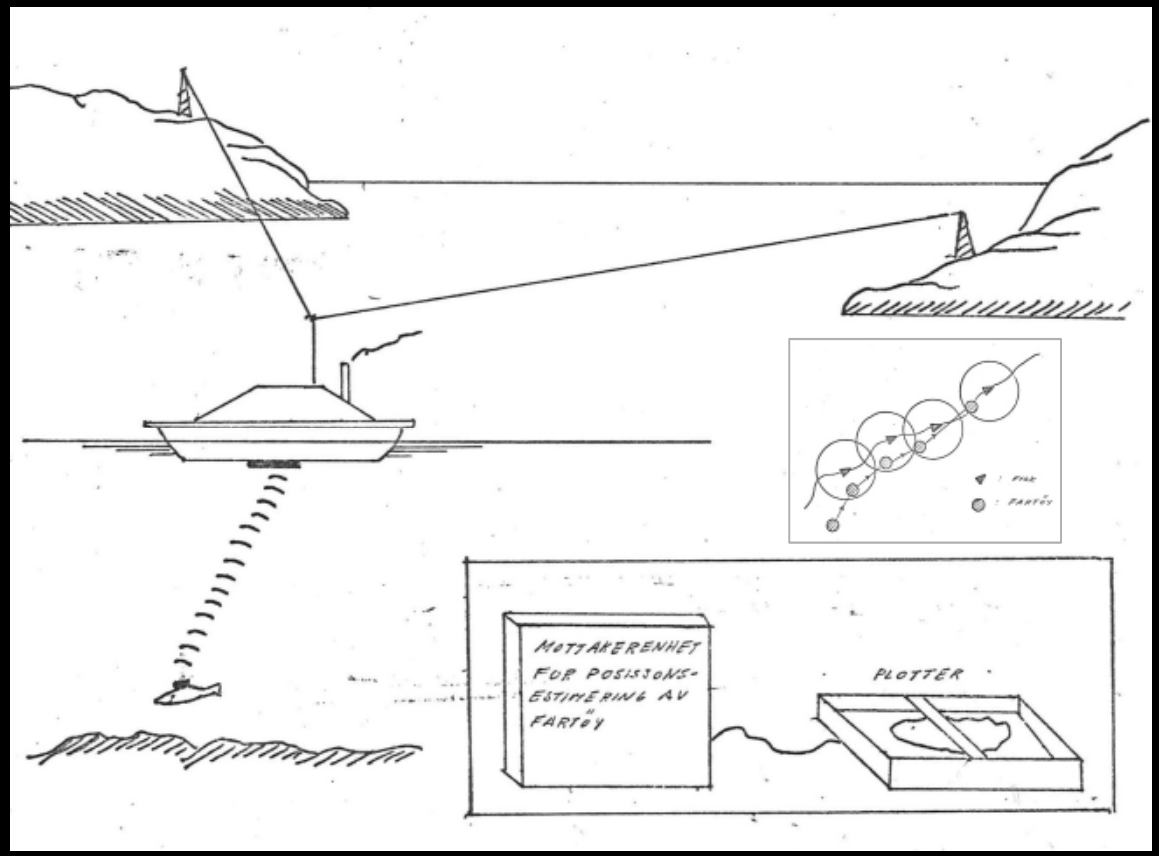

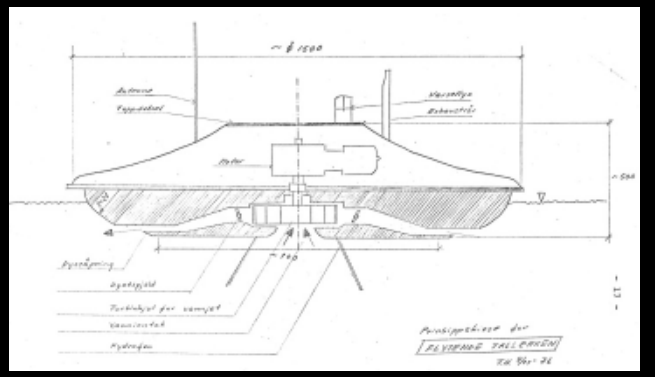

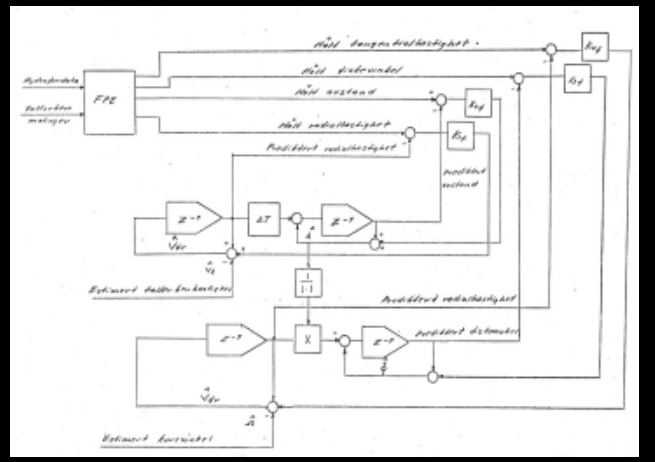

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Autonomy

2017 (41 years later..)

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Extreme Performance for Extreme Conditions

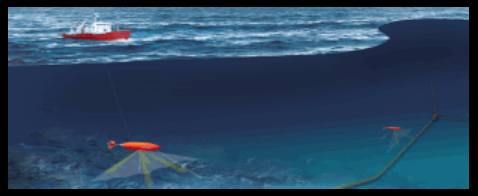
Applied Engineering Cybernetics - KONGSBERG

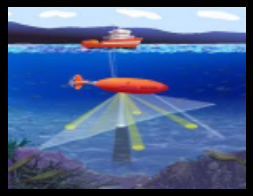










Air

- JSM, NSM, Penguin, UAVs

Land

- RWS, UGVs

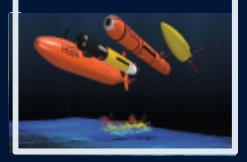
Sea surface

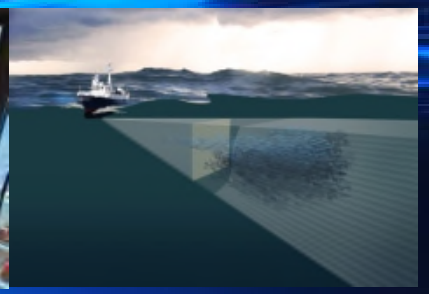
- DP, Man. Ctrl, Autopilot

Sub surface

- AUVs, ROVs

Kongsberg Maritime Ocean Space





KONGSBERG Offshore and Fishery Technology for Fish Farming

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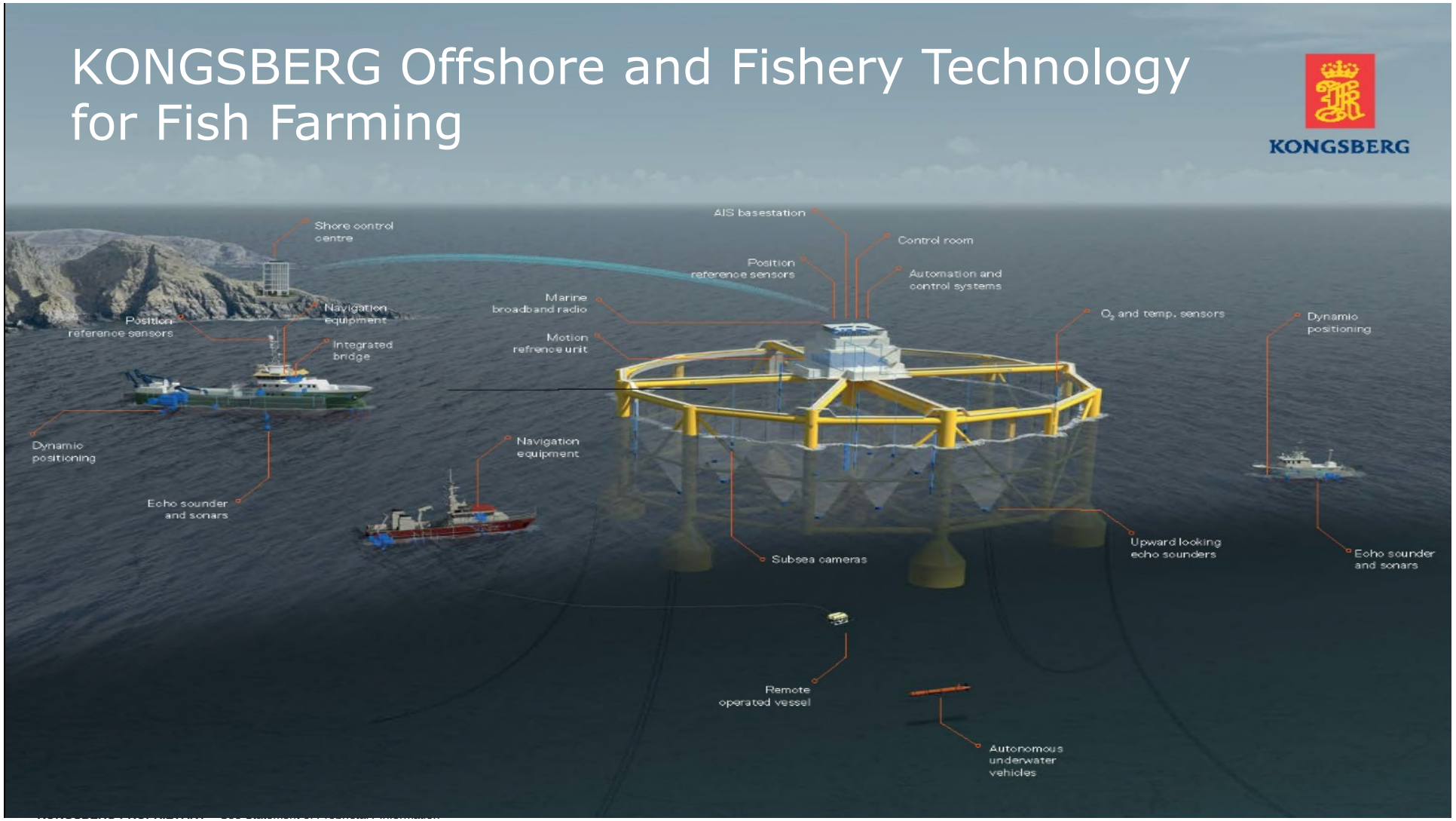

The autonomous ship has been here for a while..

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Dynamic Positioning (DP) is a computer controlled system to automatically maintain a vessel's position and heading by using its own propellers and thrusters (i.e. without the use of anchors).

Autosea: Sensor Fusion & Collision Avoidance

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Look to Trøndelag…

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Yara Birkeland

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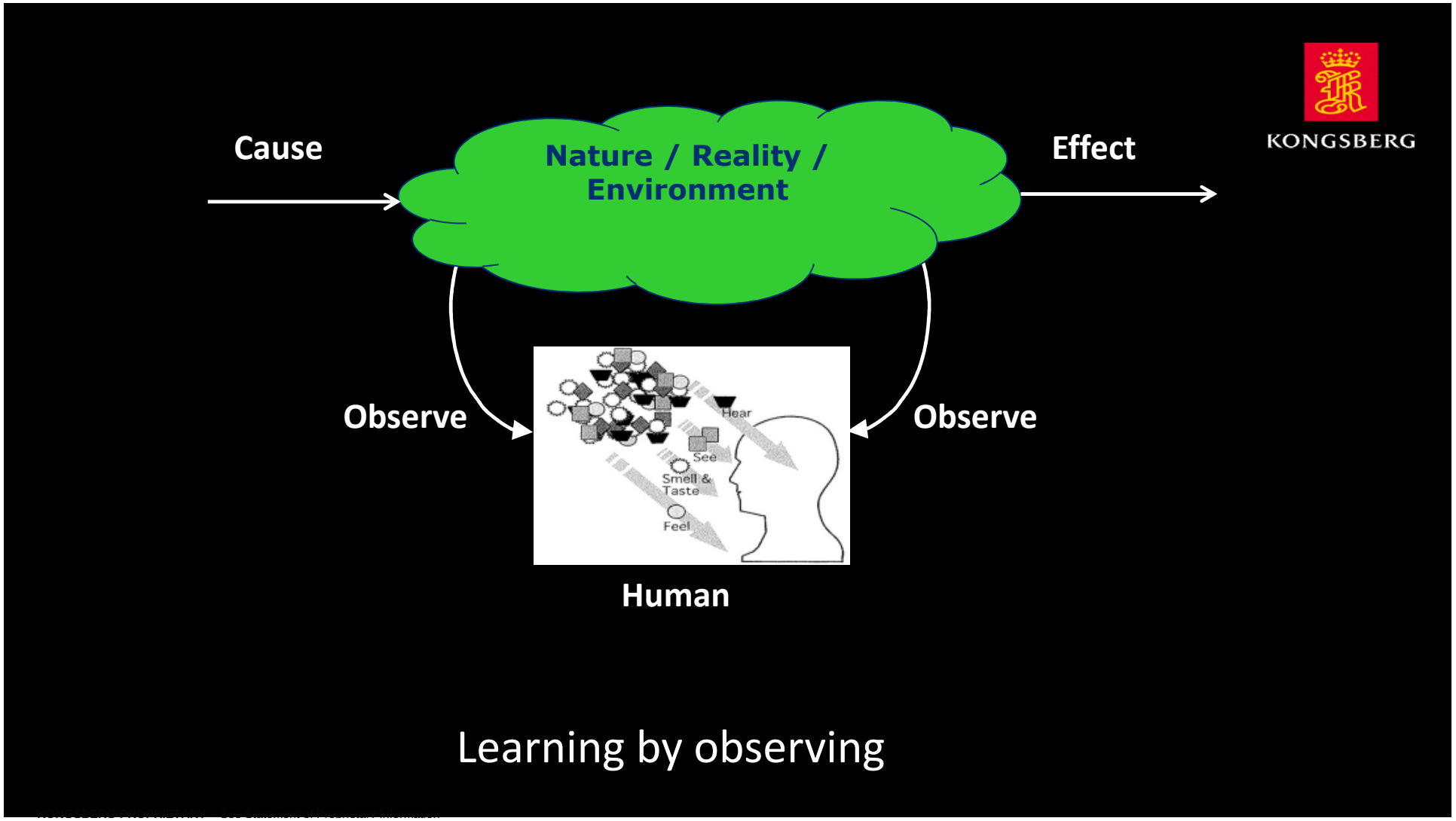
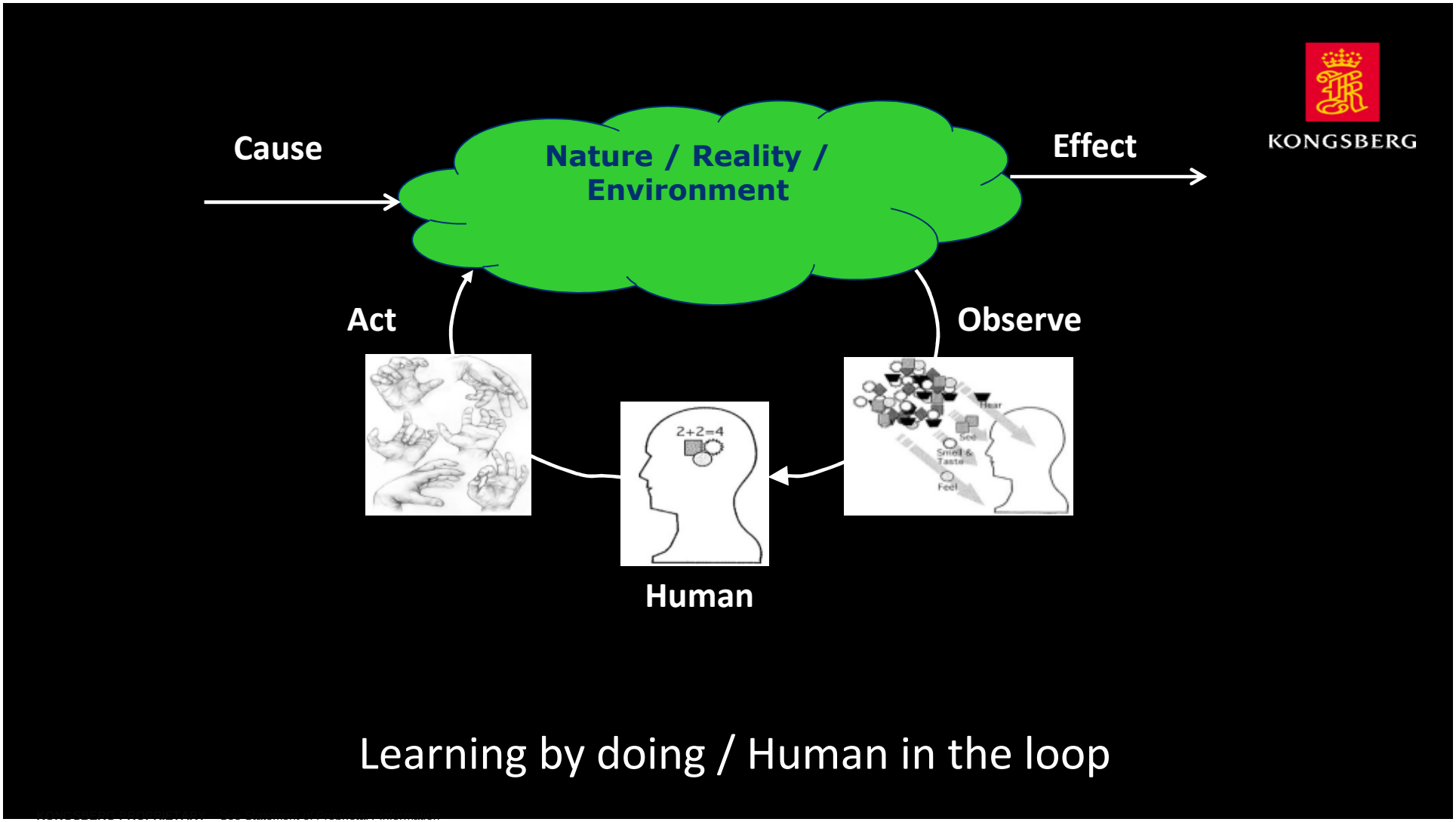
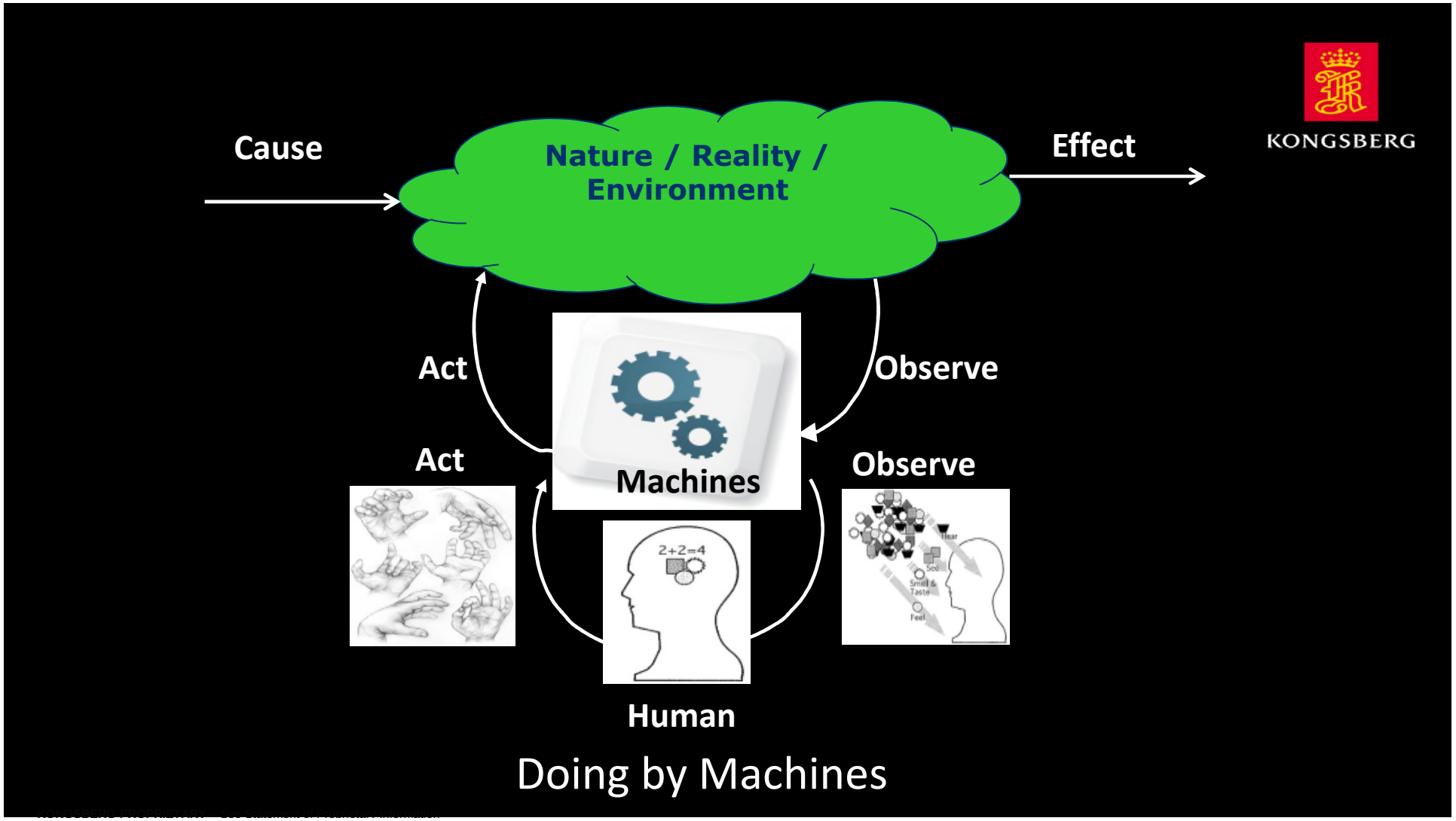
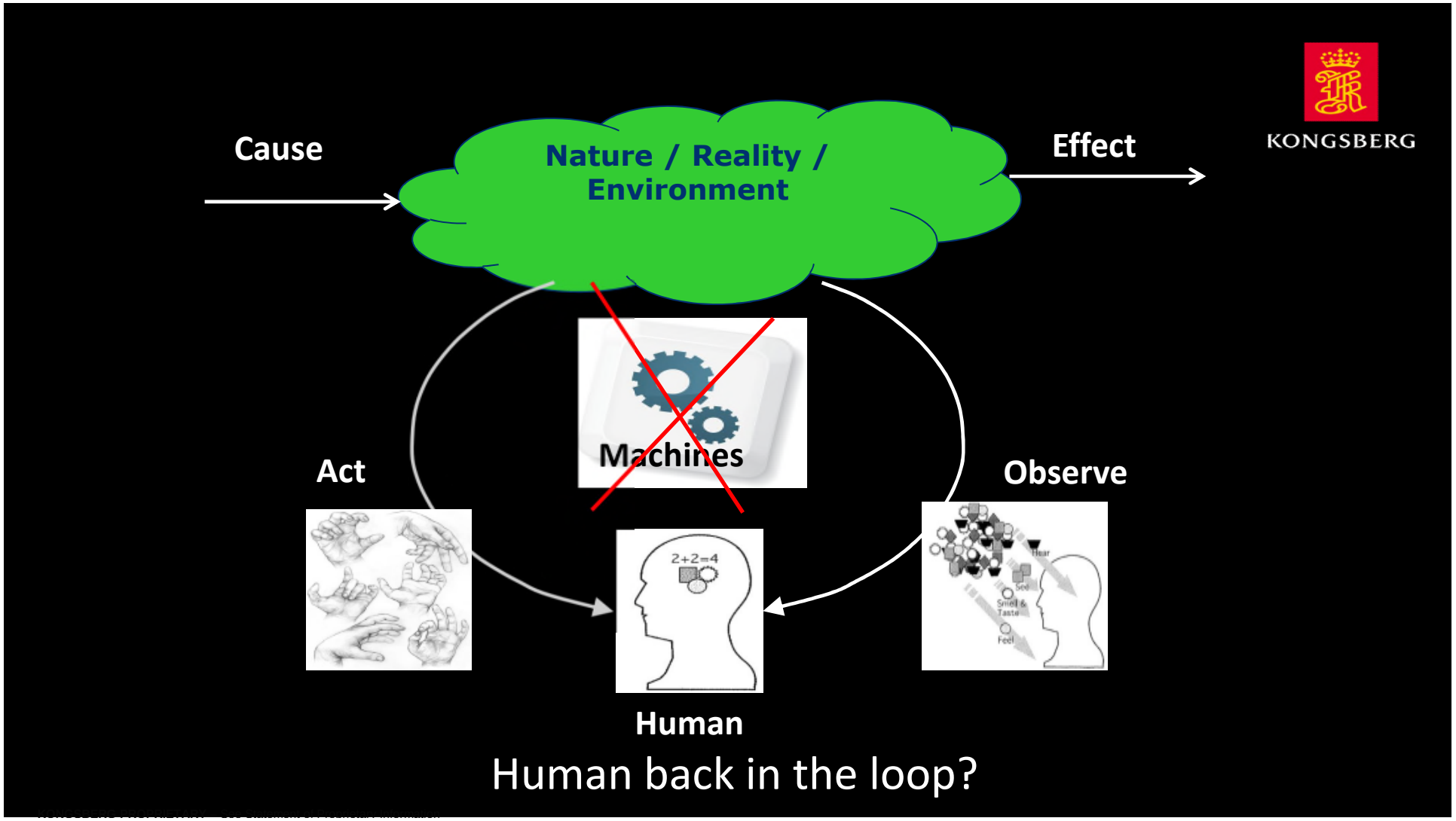
How to maintain the human in the loop

Mental & Mathematical Models for Decision Making


Cause
Nature / Reality / Environment
Effect
KONGSBERG
Observe
Observe
Hear
See
Smell & Taste
Feel
Human
Learning by observing


Cause
Nature / Reality / Environment
Effect
KONGSBERG
Act
Observe
2+2=4
Human
Learning by doing / Human in the loop


Cause
Nature / Reality / Environment
Effect
KONGSBERG
Act
Observe
Act
Machines
Observe
2+2=4
Human
Doing by Machines


Cause
Nature / Reality / Environment
Effect
KONGSBERG
Machines
Act
Observe
2+2=4
Human
Human back in the loop?

Applied Cybernetics & Feedback Loops

The anatomy of all autonomy

Engineering Cybernetics
-from Automation to Autonomy

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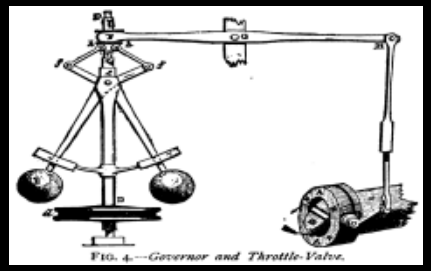
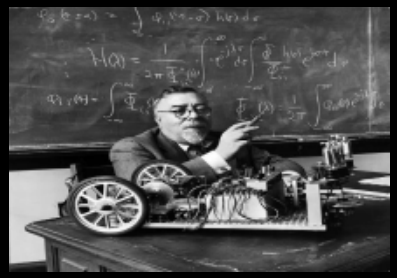
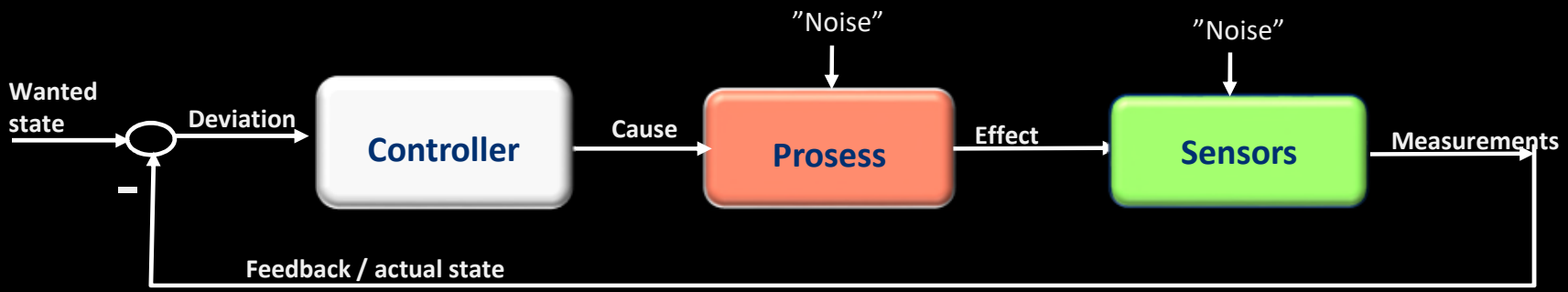


Centrifugal Govenor
James Watt (1736-1819)

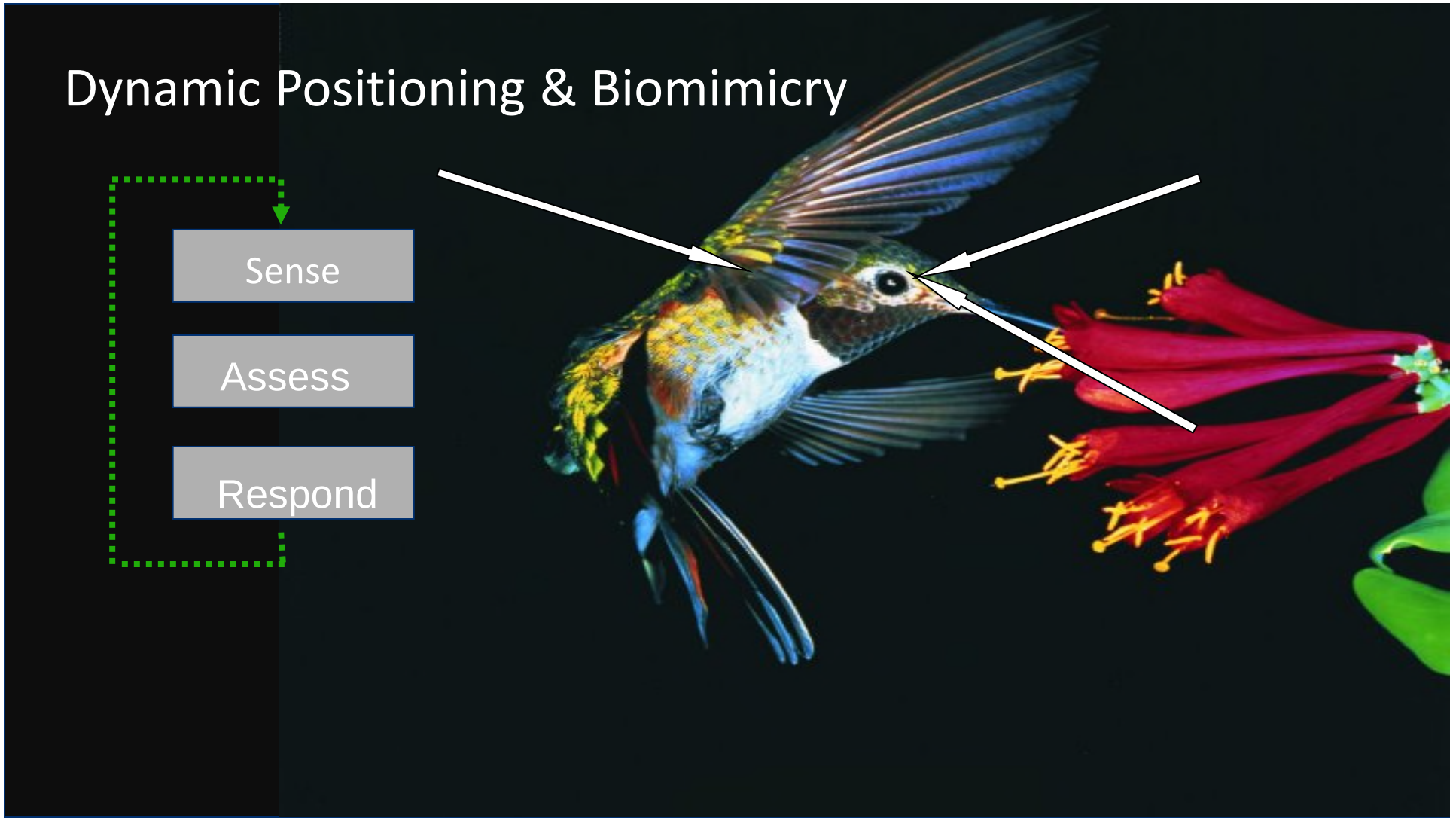


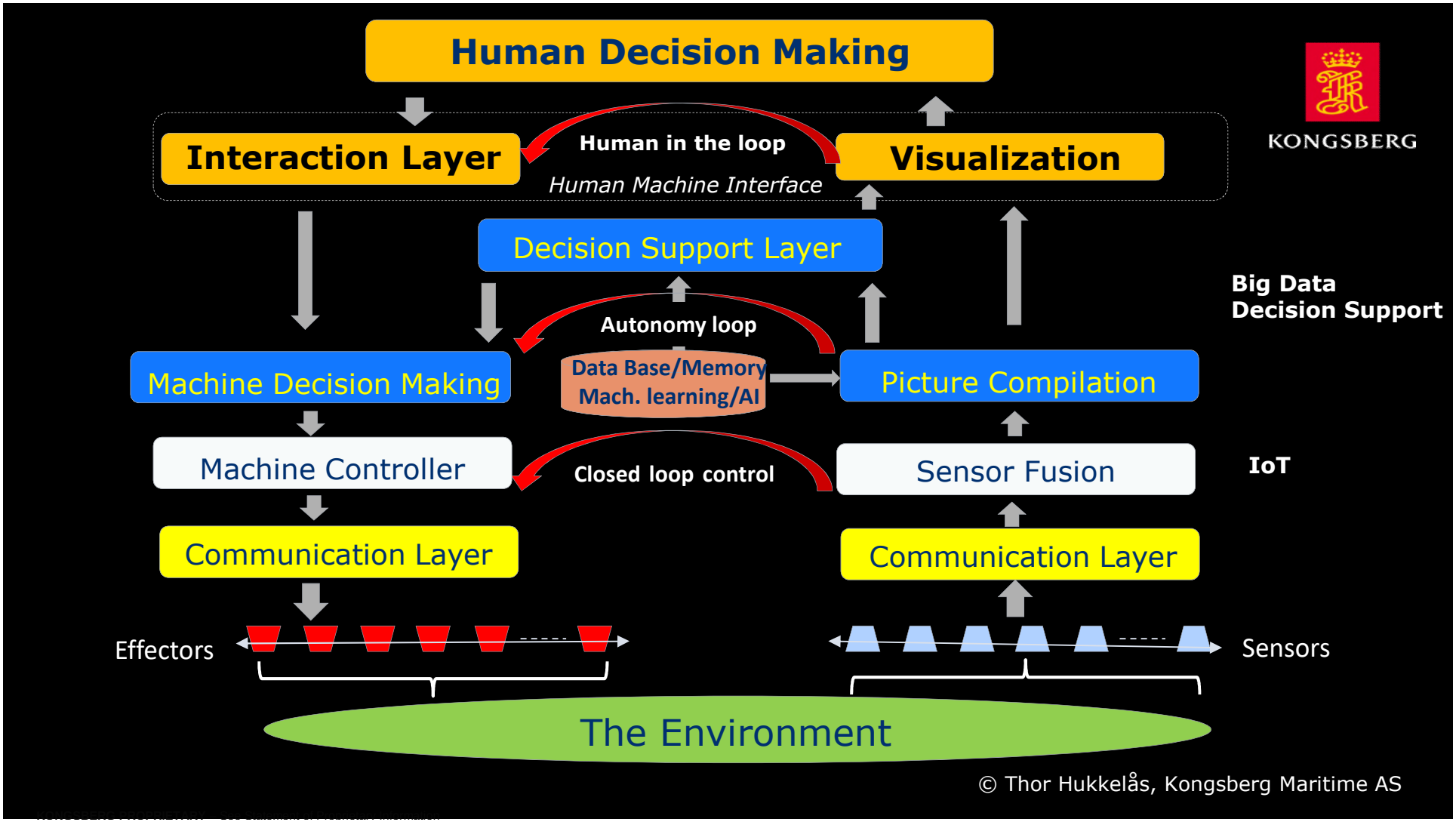
Cybernetics - 1948
Norbert Wiener (1894-1964)

Googles car
2013->



Dynamic Positioning & Biomimicry




Human Decision Making
Interaction Layer
Human in the loop
Human Machine Interface
Visualization
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Decision Support Layer
Big Data
Decision Support
Autonomy loop
Machine Decision Making
Data Base/Memory
Mach. learning/AI
Picture Compilation
Machine Controller
Closed loop control
Sensor Fusion
IoT
Communication Layer
Communication Layer
Effectors
Sensors
The Environment
© Thor Hukkelås, Kongsberg Maritime AS

Should we rather talk more about the need for

Decision Support

(for humans & machines)

than Autonomy, Automation, Big Data etc.?

Situational Awareness & Decision Support

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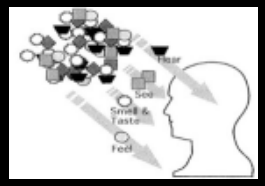
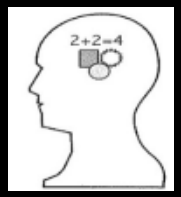
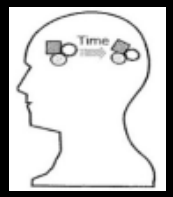






Perception
of data and the elements of the environment
(Level 1)

Comprehension
of the meaning and significance of the situation
(Level 2)

Projection
of future states and events
(Level 3)

Decision Support Needed

- Alternative 1
- Alternative 2
- Alternative n

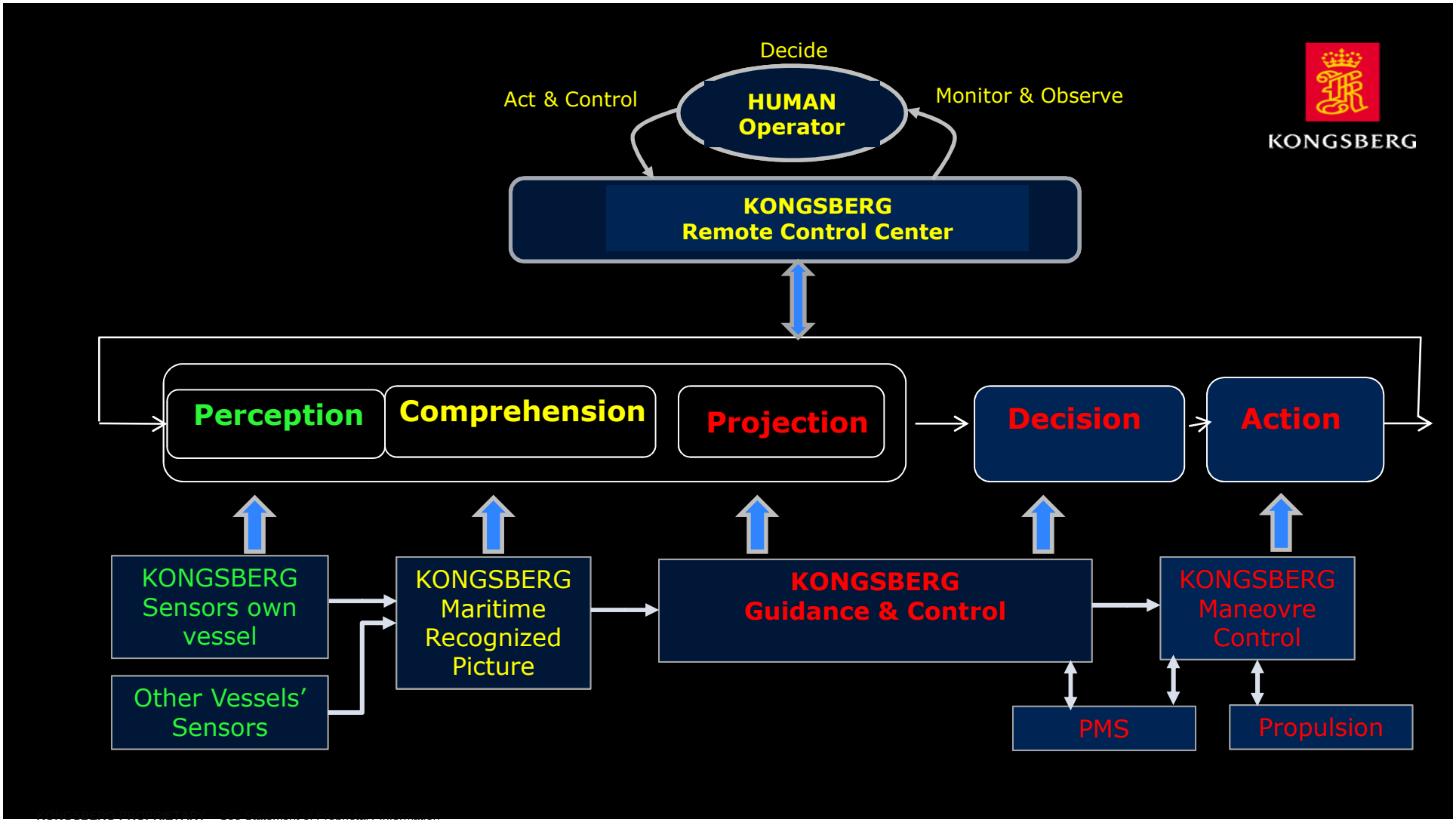
Decision

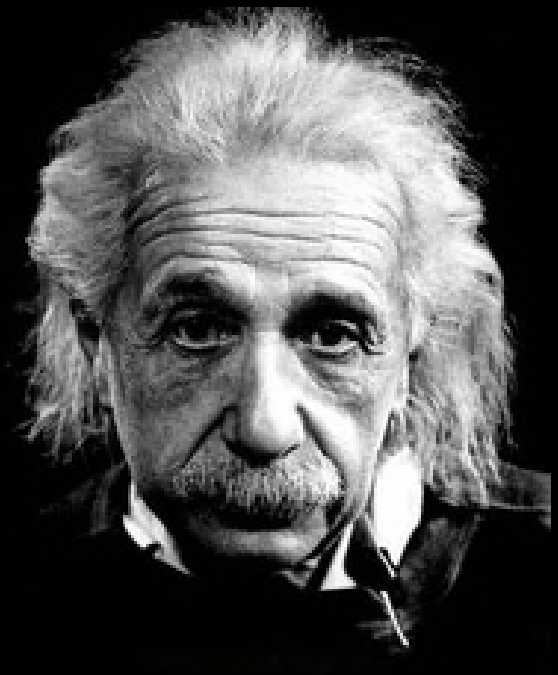
Action

Effect

Nature / Reality / Environment

Cause


Decide
Act & Control
HUMAN Operator
Monitor & Observe
KONGSBERG
KONGSBERG Remote Control Center
Perception
Comprehension
Projection
Decision
Action
KONGSBERG Sensors own vessel
Other Vessels' Sensors
KONGSBERG Maritime Recognized Picture
KONGSBERG Guidance & Control
KONGSBERG Maneovre Control
PMS
Propulsion



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"If I had an hour to solve a problem I'd spend 55 minutes thinking about the problem and 5 minutes thinking about solutions."

Autonomy is not a goal, it may be a means

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Table 1: Sheridan & Verplank (1978) Levels of Automation

Automation Level	Automation Description
1	The computer offers no assistance: human must take all decision and actions.
2	The computer offers a complete set of decision/action alternatives, or
3	narrows the selection down to a few, or
4	suggests one alternative, and
5	executes that suggestion if the human approves, or
6	allows the human a restricted time to veto before automatic execution, or
7	executes automatically, then necessarily informs humans, and
8	informs the human only if asked, or
9	informs the human only if it, the computer, decides to.
10	The computer decides everything and acts autonomously, ignoring the human.

The Paradox of Automation

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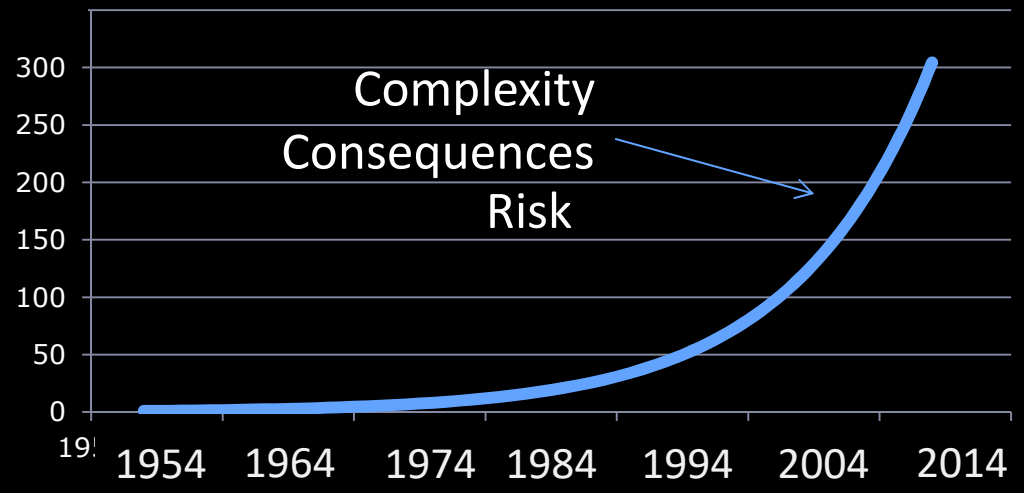
- Says that the more efficient the automated system, the more crucial the human contribution of the operators.
- Humans are less involved, but their involvement becomes more critical.

Efficient automation makes humans more important, not less.



The Innovation Challenge

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- Being engineers, we often end up with a solution looking for a problem
- (Well, we became engineers because we love to build these fantastic machines, didn't we?)
- But, perhaps should we rather identify problems looking for a solution?

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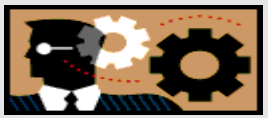
Tech “think”

Human “think”



Task “think”

Technology should adapt to humans, not the other way around!

Develop systems that

support and assist

the humans and give them

more interesting things to do

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- TTCAS: Terrain & Traffic Collision Alert and Avoidance System
- Dynamic Positioning
- Auto Docking
- Weather Routing
- Sensor Fusion for optimal SA
- Optimal path planning, e.g. ferry crossing
- Auto track pilot
- Condition monitoring & pre-active maintenance
- AI-assisted Logistics Support

Keep the human in the loop!

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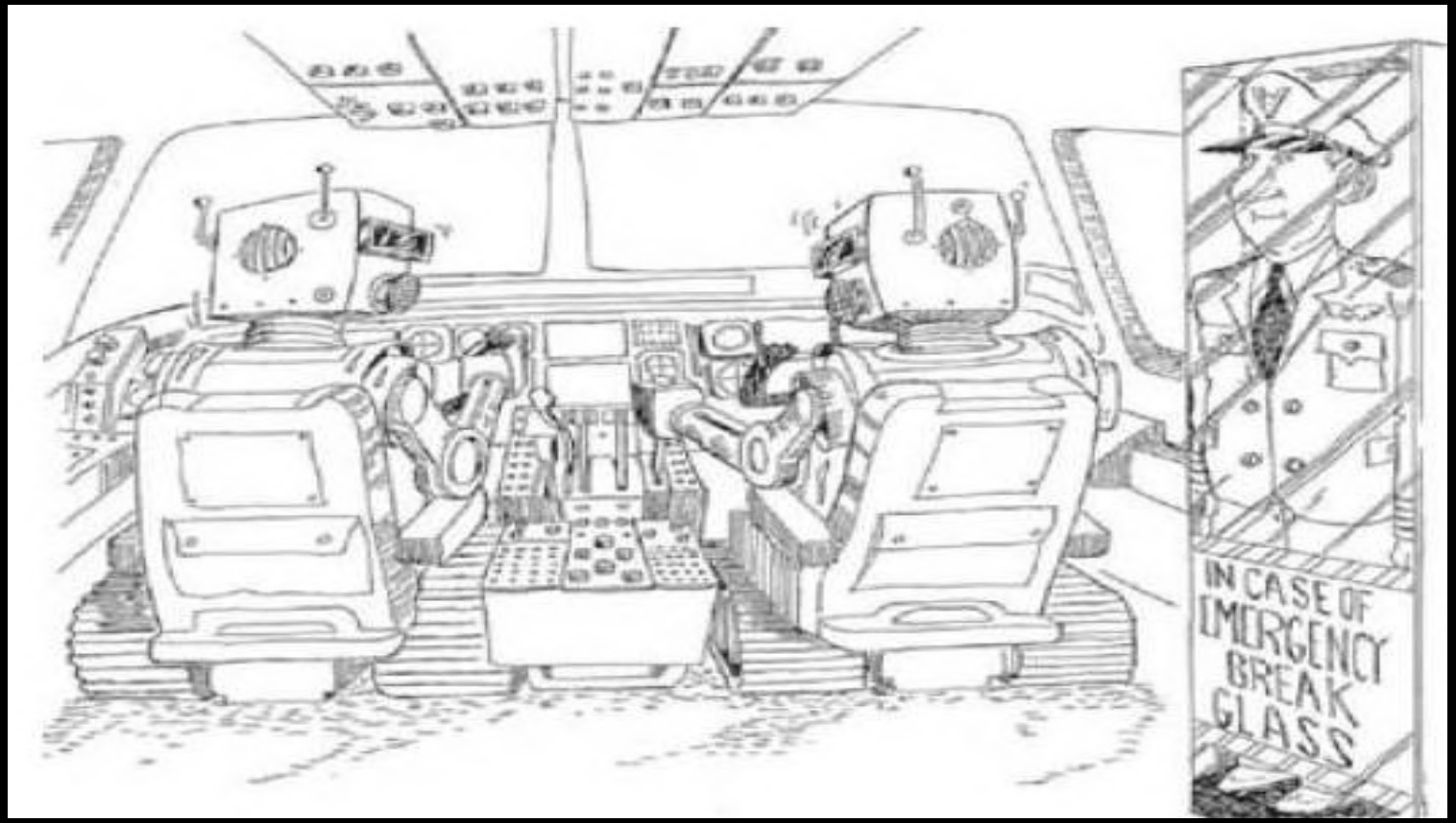

Man + Machine = Partners!

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Takk for oppmerksomheten!