



## **Risk**

# **The Road to Eliminating Operator-Related Dynamic Positioning Incidents**

**Arjen Tjallema – *Bluewater Energy Services BV***  
**Clemen van der Nat – *Bluewater Energy Services BV***  
**Hugo Grimmelius – *Delft University of Technology***  
**Douwe Stapersma - *Delft University of Technology***

*October 9-10, 2007*

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# *The Road to Eliminating Operator Related DP Incidents*

Arjen Tjallema · Hugo Grimmelius · Clemens Van Der Nat · Douwe Stapersma

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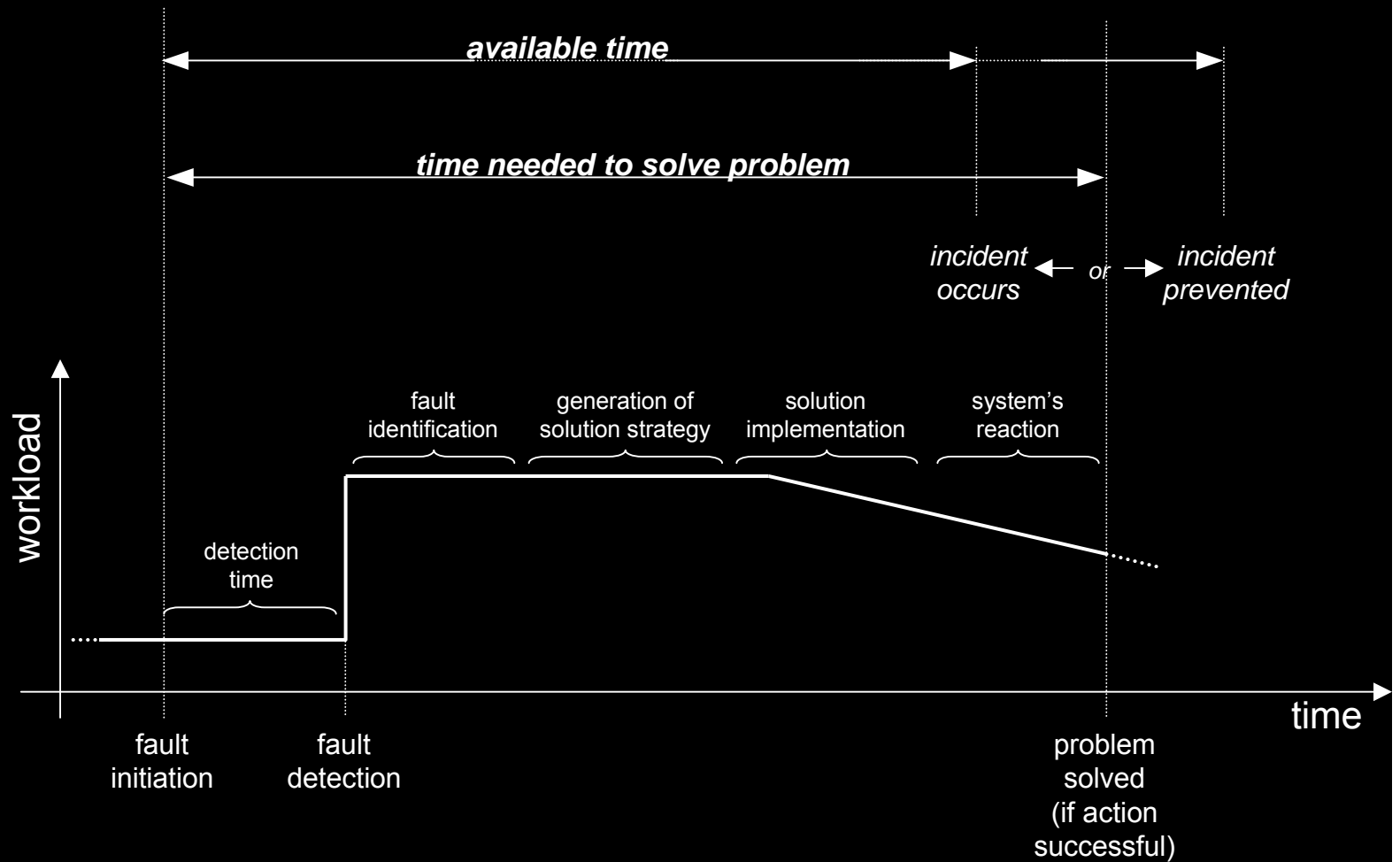


# *Introduction*

- Operator involved in majority of DP incidents
- Nature of DP incidents
- Role of DP operator
- Modes of operation
- Monitoring DP

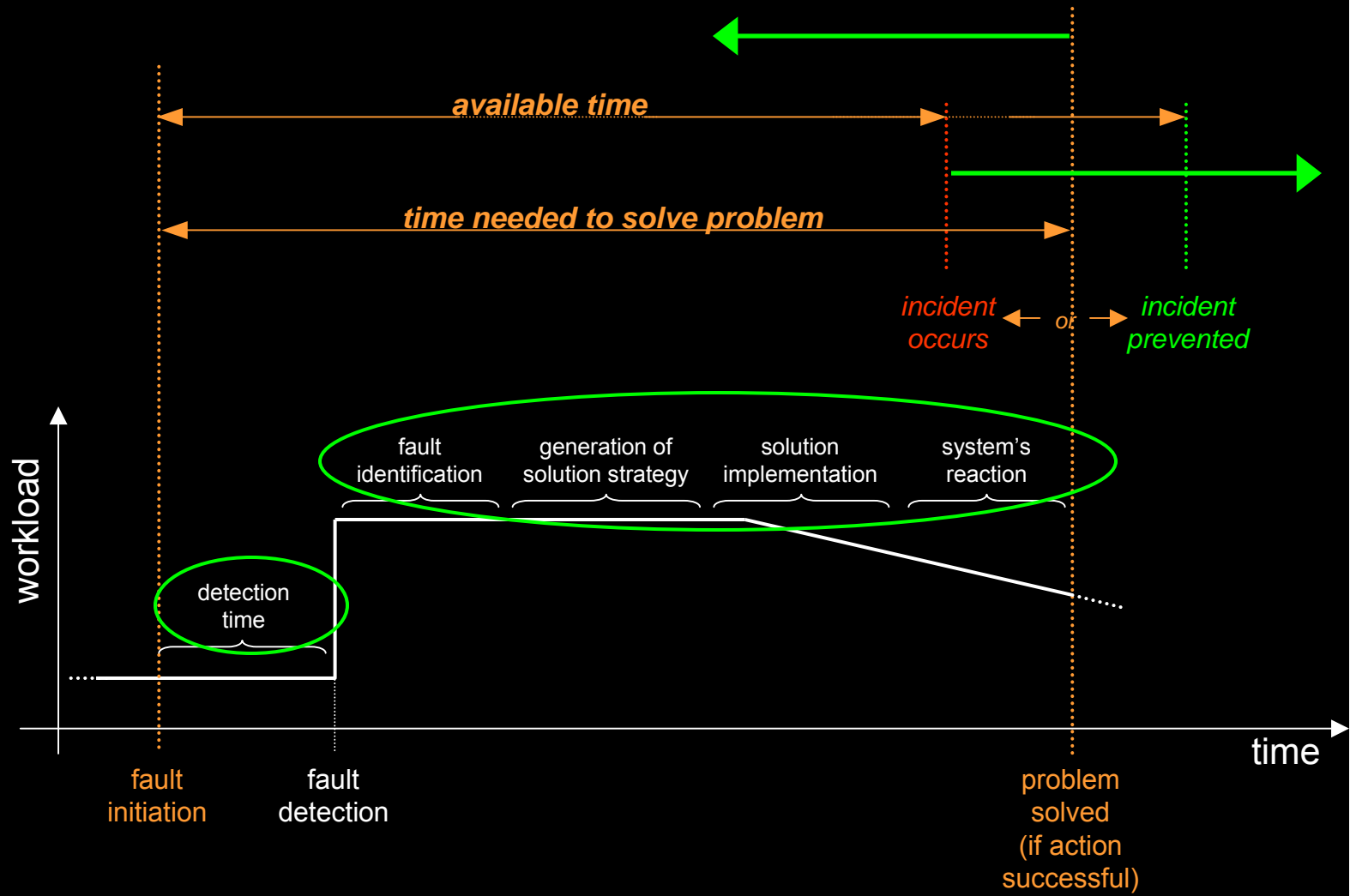


# Incident process





# Incident process





# The operator's role

- Level of automation
- Failure experience
- Situation awareness
- Reaction time
- Workload

Collisions	Recovery action time since drive-off initiation (s)	Collision time since drive-off initiation (s)
1	<i>close to 120</i>	120
2	91	143
3	167	<i>Not available</i>
4	58	125
Near misses	Recovery action time since drive-off initiation (s)	Collision time since drive-off initiation (s)
1	45	140
2	<i>very short</i>	75

Source: Chen & Moan, 2003

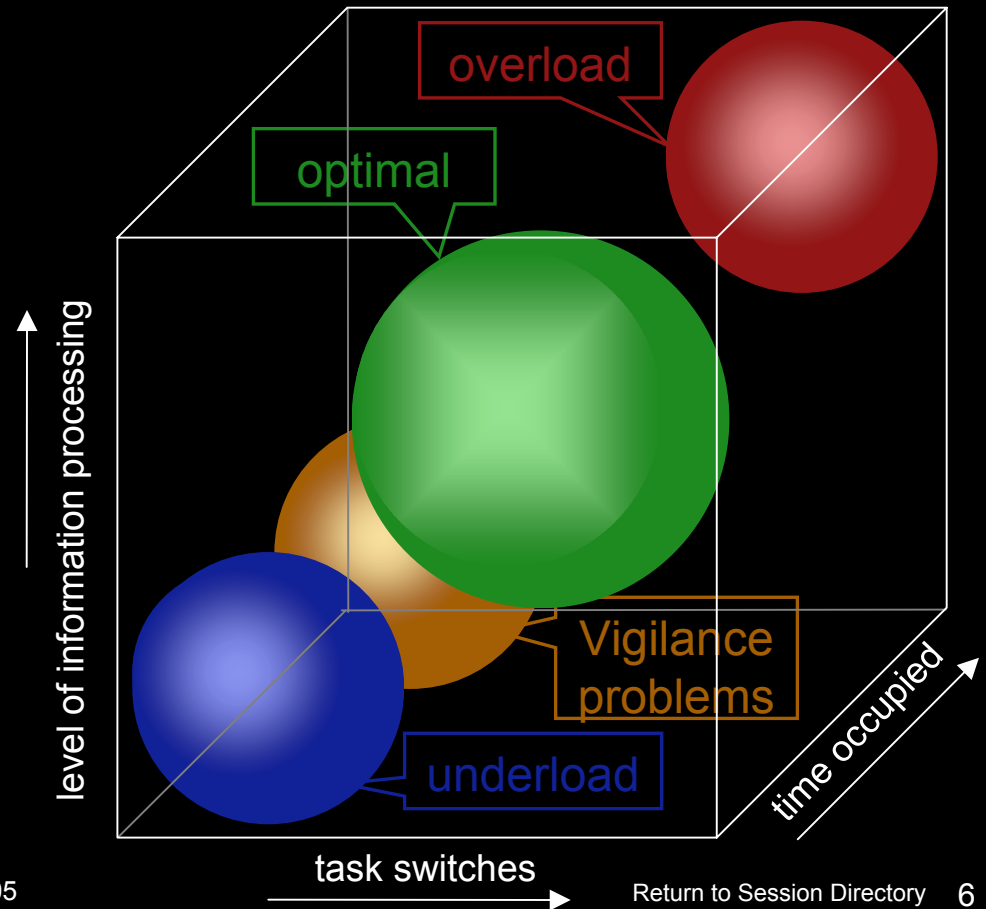
Source: Grootjen & Neerinx, 2005



# The operator's role

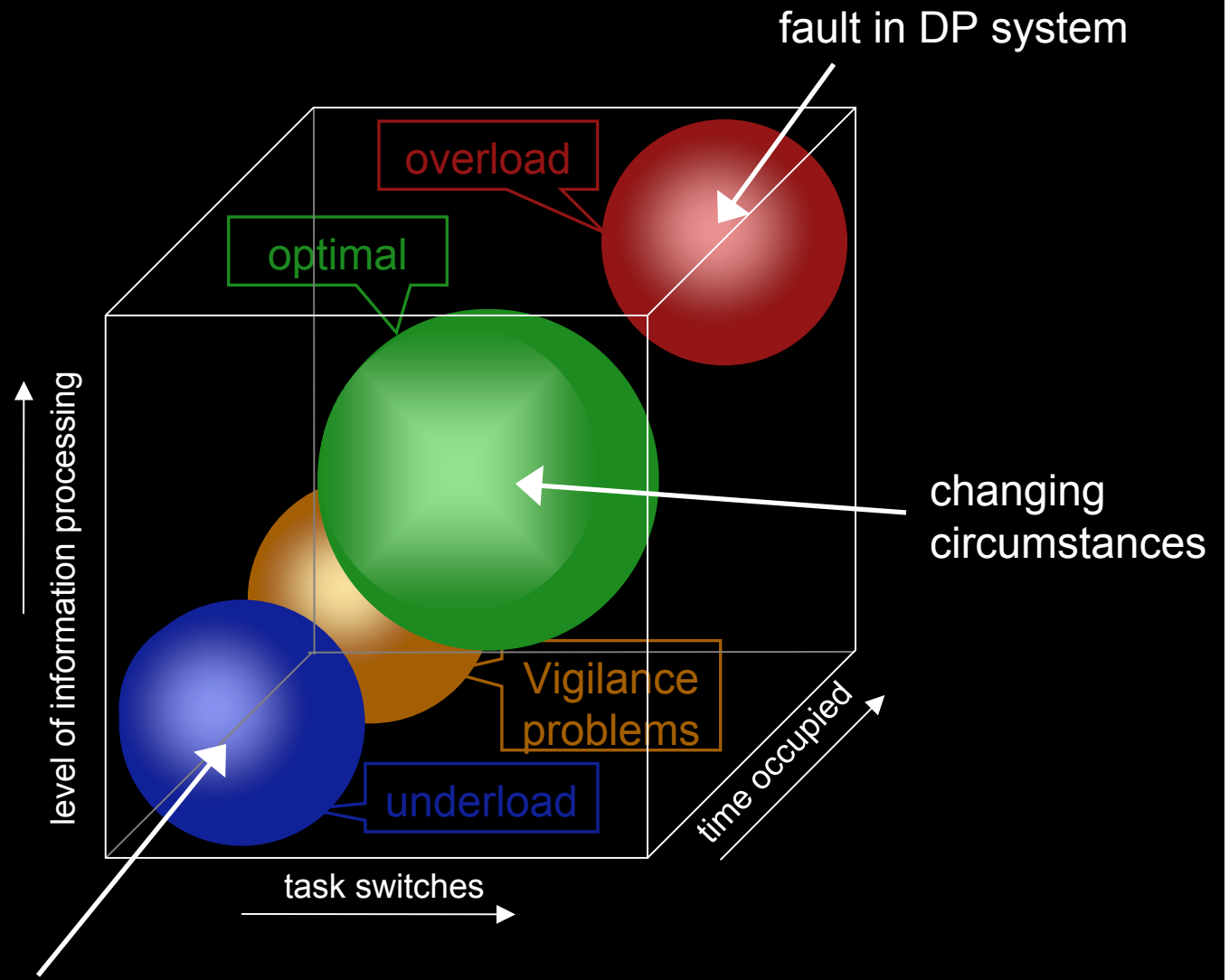
- Level of automation
- Failure experience
- Situation awareness
- Reaction time
- Workload

Source: Chen & Moan, 2003



Source: Grootjen & Neerincx, 2005

# Workload in DP operations



normal operation



# Modes of operation



*normal operation*

Low workload  
DP system can operate autonomously



*alerted operation*

Normal workload  
Operation as is currently done



*emergency situation*

High workload  
Operator support



# Modes of operation



normal operation

- Operator only monitoring
- Workload very low
- DP system takes over operator's task
- Self-monitoring system
- *Unattended operation*
  - Operator can perform other tasks
  - Normal workload
- After fault detection: emergency mode



# Modes of operation



alerted operation

- Situation with relatively high risk
  - Offloading / bad weather
- Self-monitoring system not reliable enough
- Similar to current DP operations



# Modes of operation



emergency situation

- Operator called to DP system
- Very high workload
- DP system supports operator in five phases:
  1. Fault detection
  2. Fault identification
  3. Generation of solution strategy
  4. Implementation of solution strategy
  5. System's reaction

# *New functions*

- To enable three modes of operation:
  - Self-monitoring for normal operation
  - Operator support for emergency situation



# *Self-monitoring*



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Source: Grimmelius, 2005

# *Self-monitoring*



Source: Grimmelius, 2005

- SENSOR SELF-CHECK
- Compare sensors

# *Self-monitoring*



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Source: Grimmelius, 2005

Health monitoring:

- Threshold on residuals
- Level of threshold determines reliability



# *Self-monitoring*

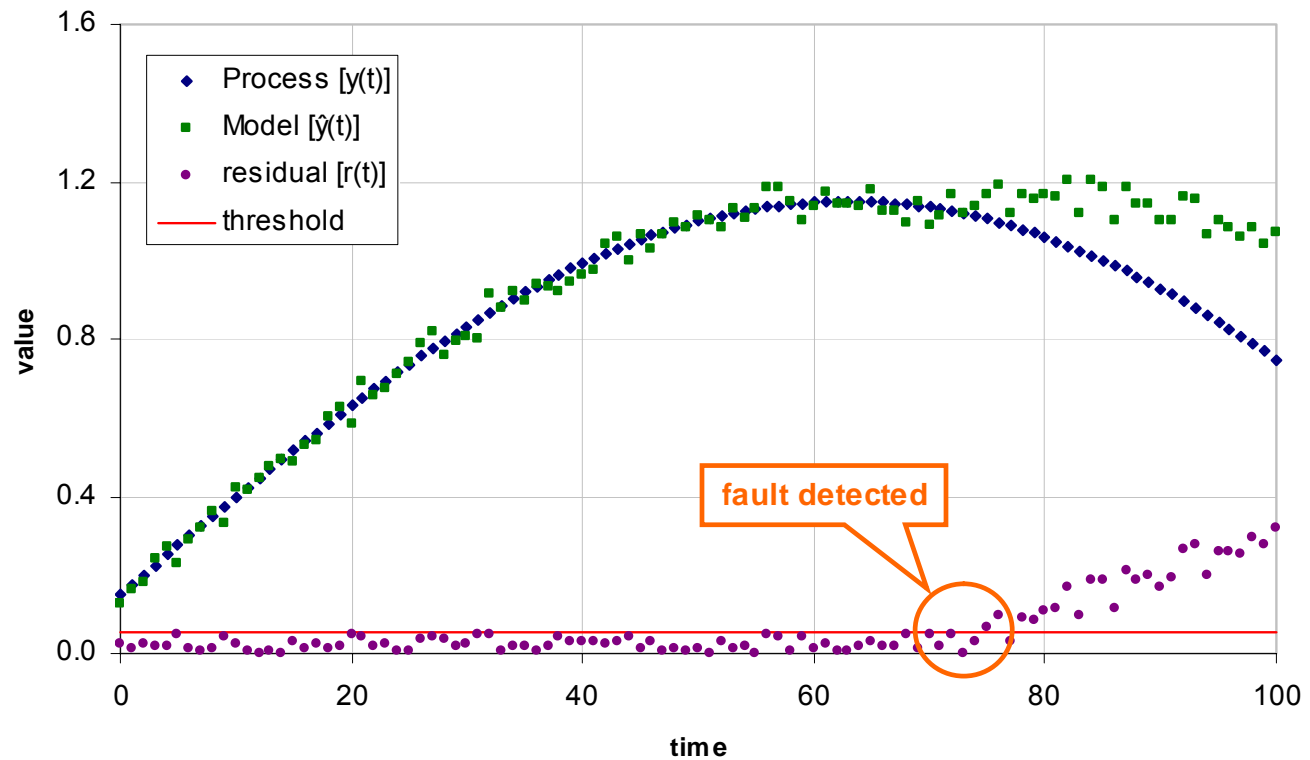


Source: Grimmelius, 2005

Reference value generation:

- First principle model
- Black-box model

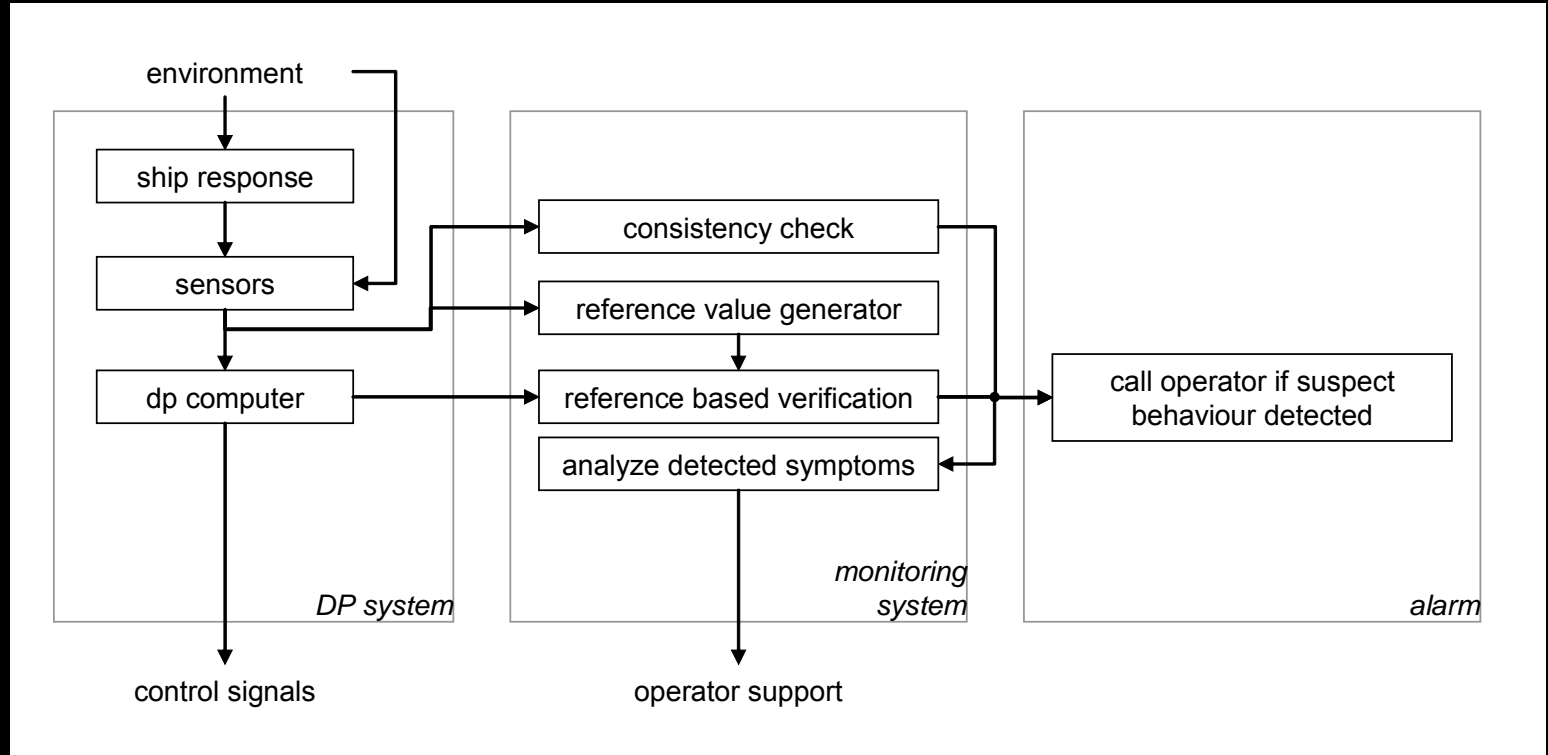
# Self-monitoring



Health monitoring:

- Threshold on residuals
- Level of threshold determines reliability

# Implementation of diagnostics





# *Operator support*

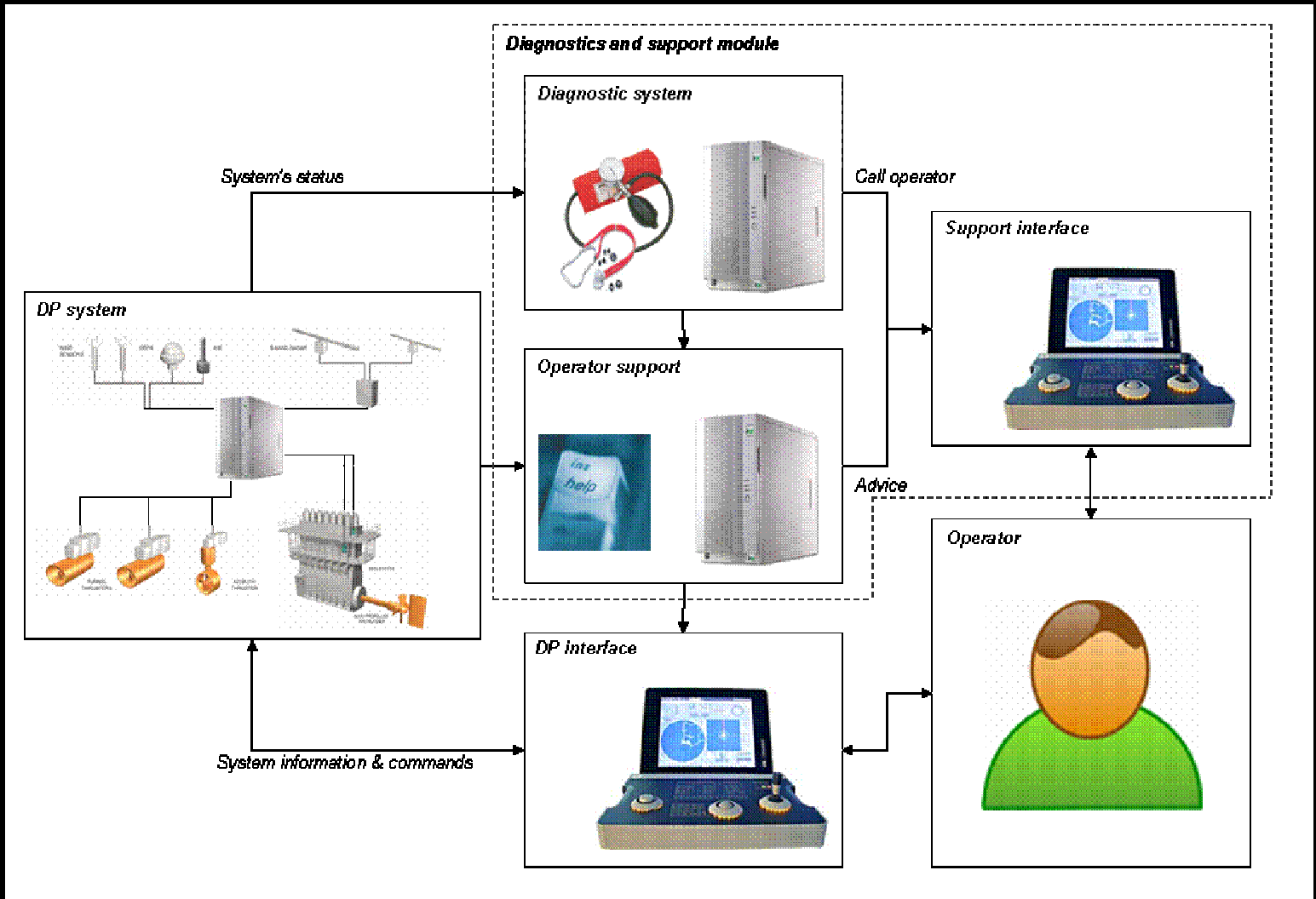
- Presentation of system status
  - Operator has to ‘familiarize’
  - Low situation awareness due to unattended operation
- Solving a detected problem
  - Analyze detected problem to find cause
  - Generate solution strategies
  - Predict effect of strategies
  - Present advice to operator



# *Requirements and risks*

- Fault detection:
  - Operator to be called in case of any fault
  - Too many false alarms harm functionality
- Quick operator familiarization after fault detection
- Online simulation:
  - Trade off: accuracy vs. computational power

# DP system with diagnostics and support





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Arjen.Tjallega@Bluewater.com