



Risk

The Road to Eliminating Operator-Related Dynamic Positioning Incidents

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The Road to Eliminating Operator Related DP Incidents

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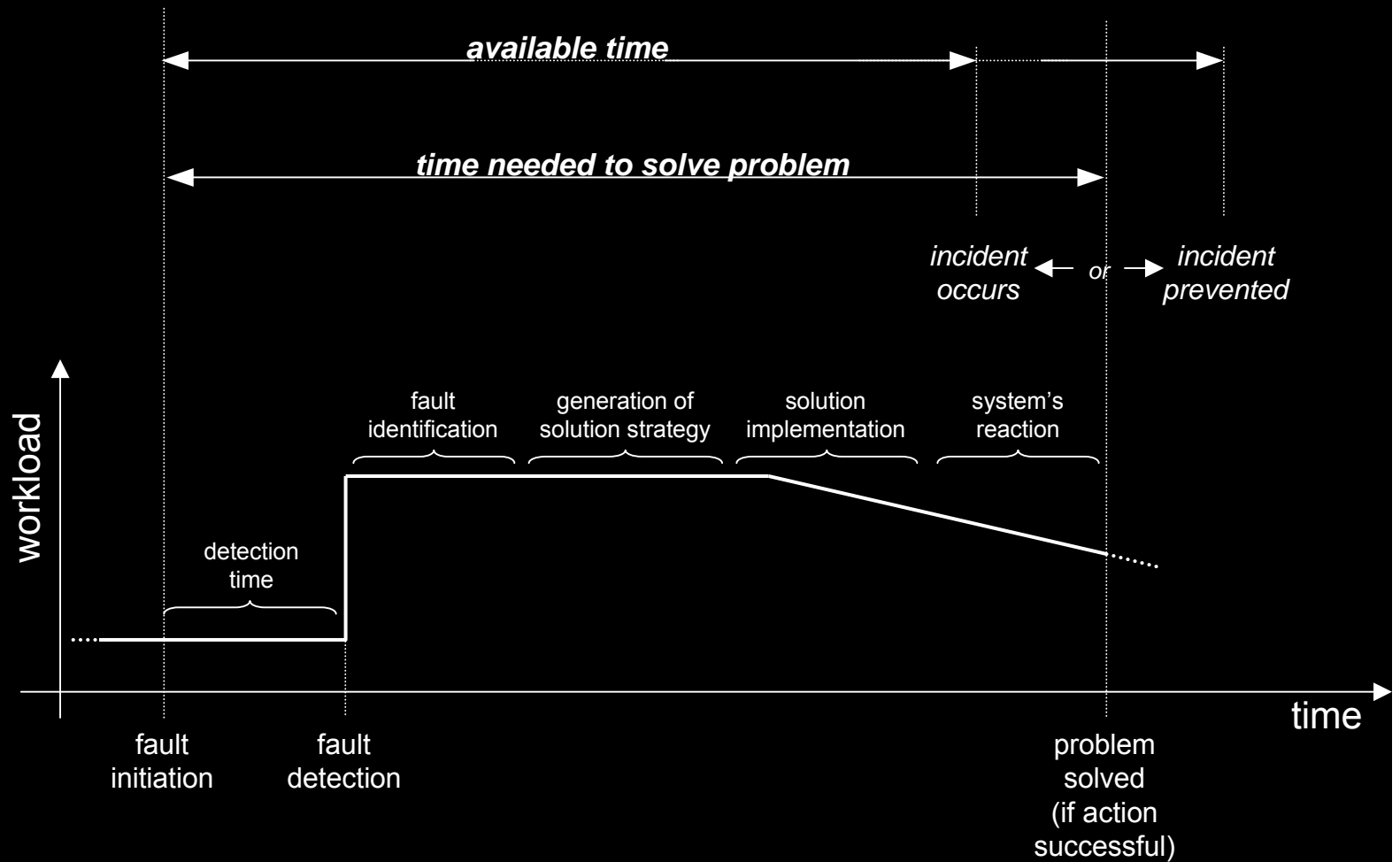


Introduction

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

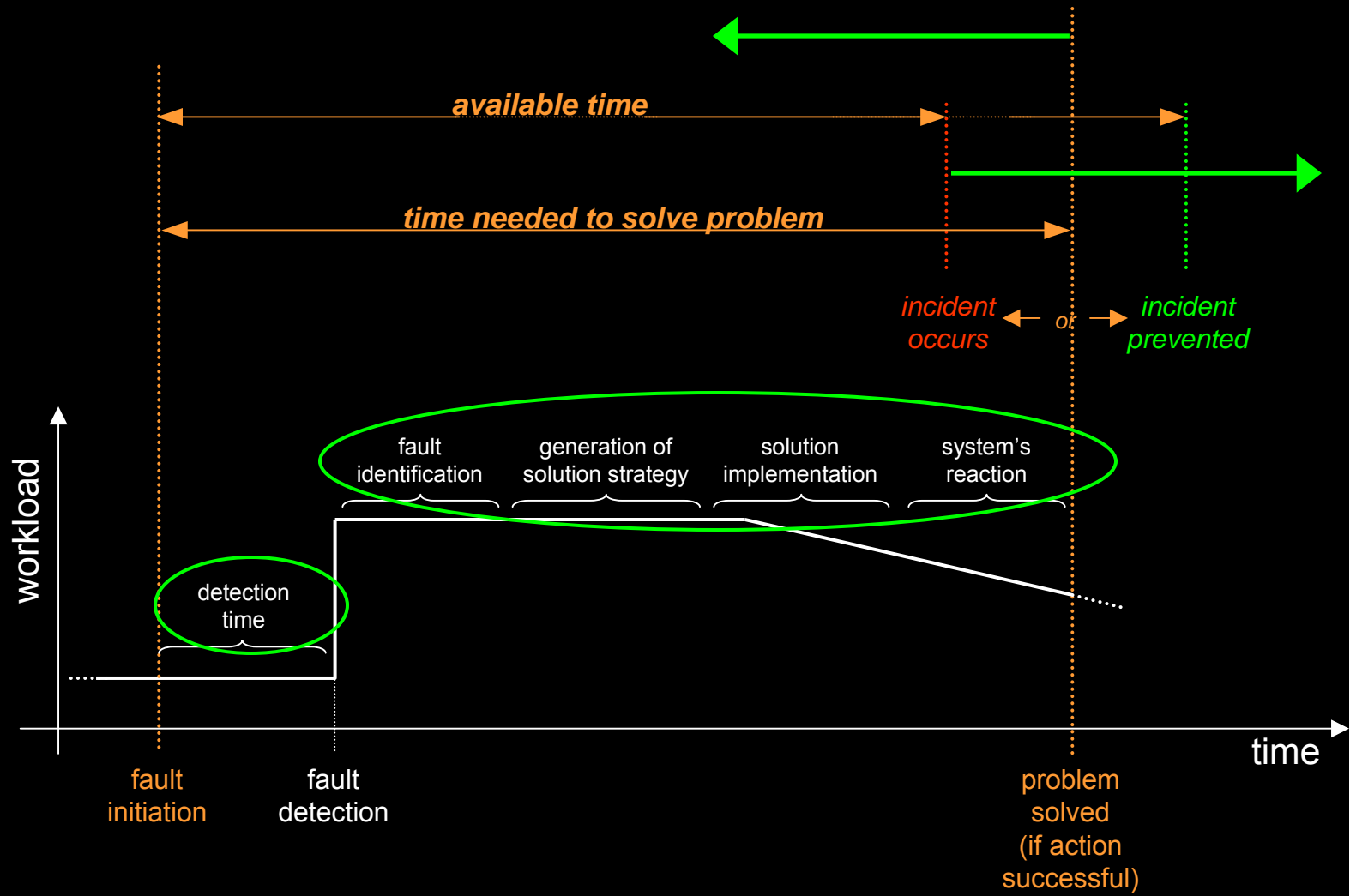


Incident process





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

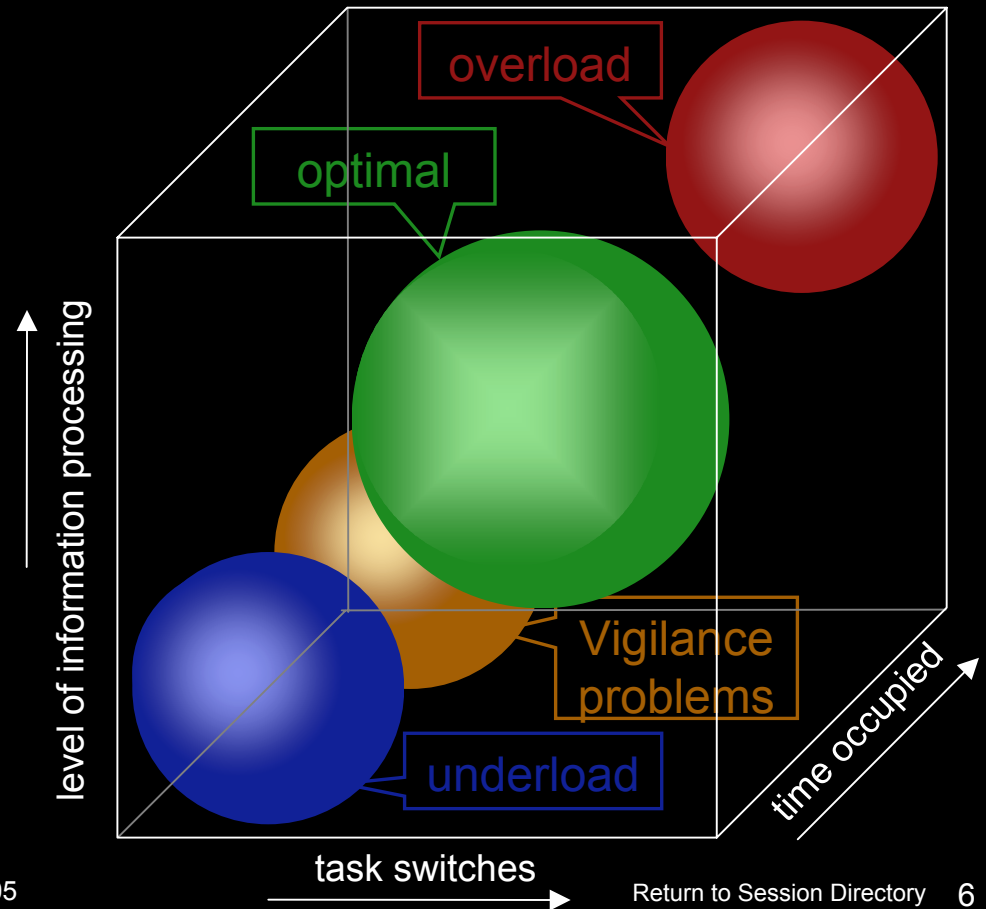
Source: Grootjen & Neerinx, 2005



The operator's role

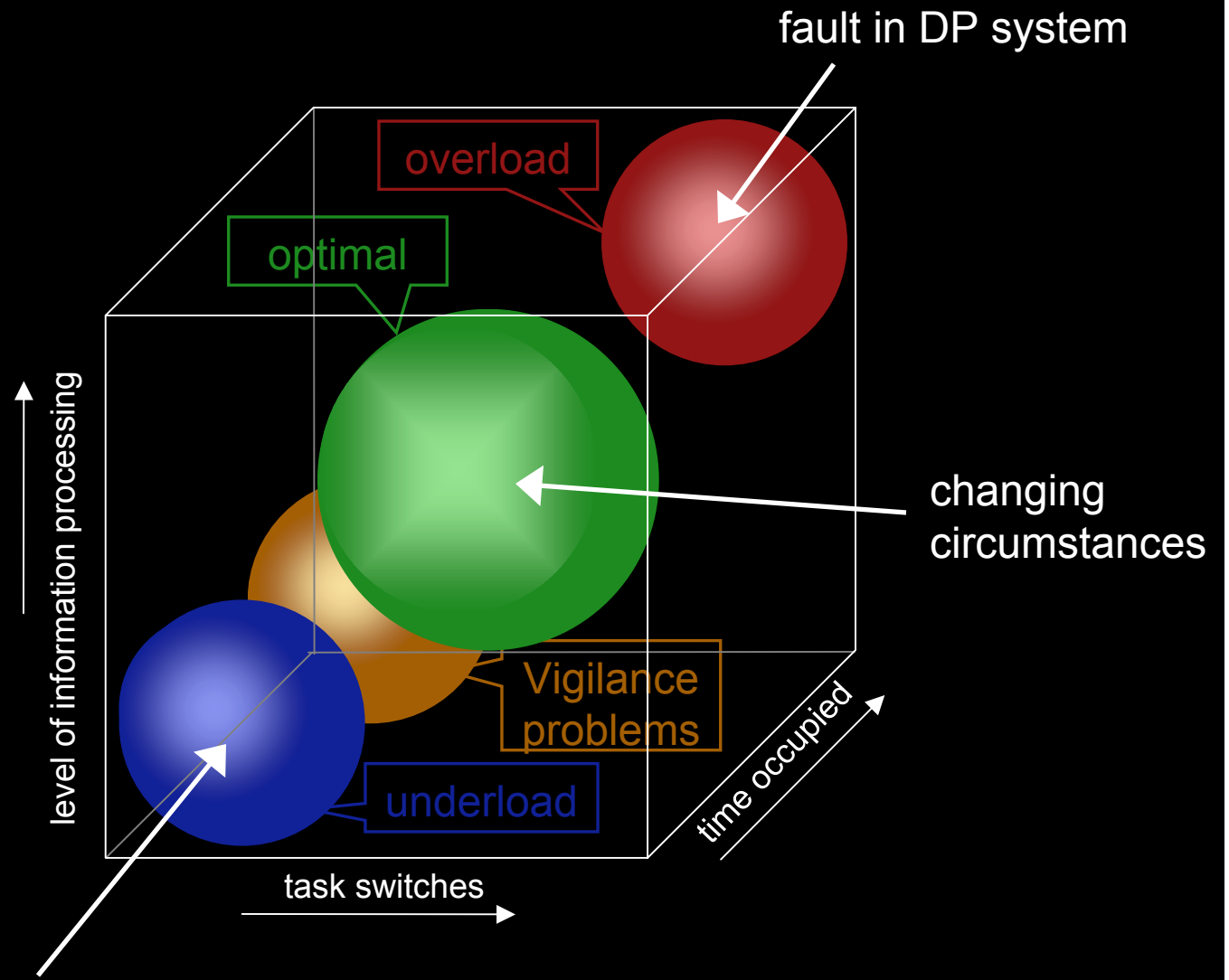
- Level of automation
- Failure experience
- Situation awareness
- Reaction time
- Workload

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

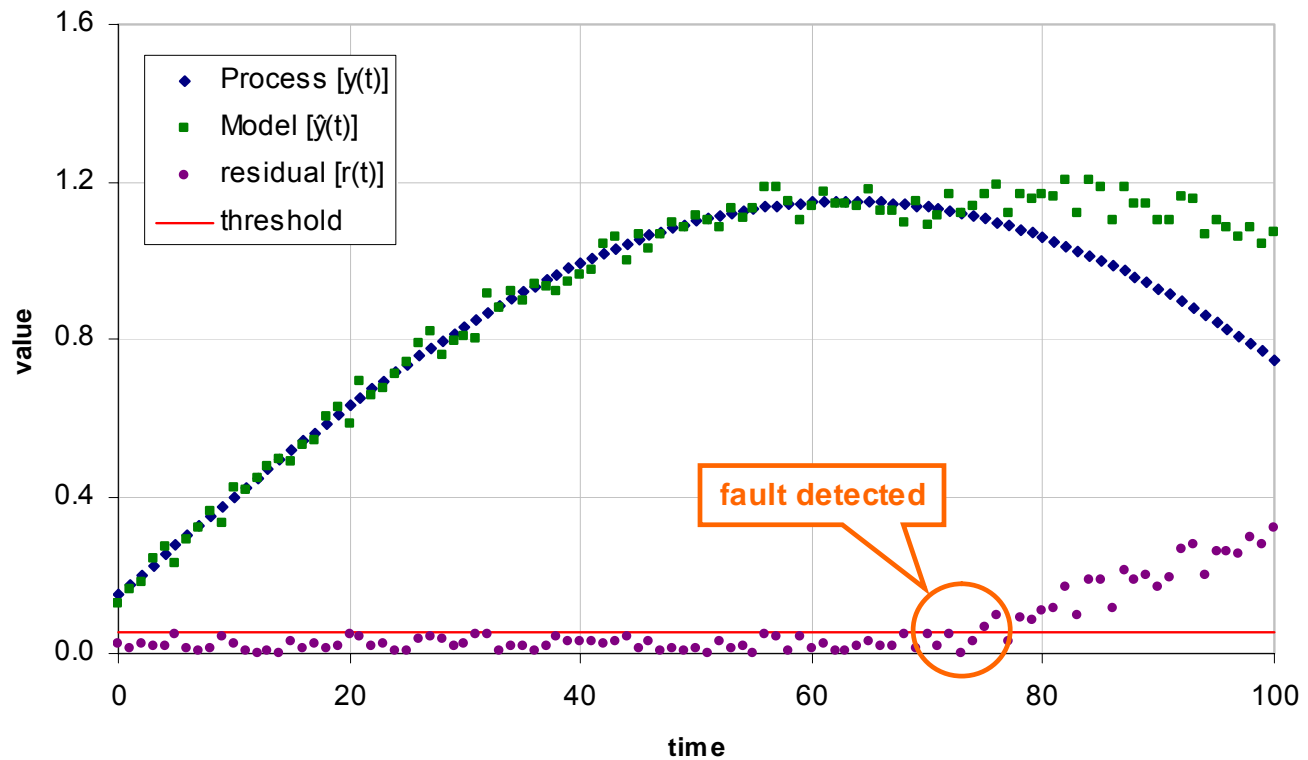


Source: Grimmelius, 2005

Reference value generation:

- First principle model
- Black-box model

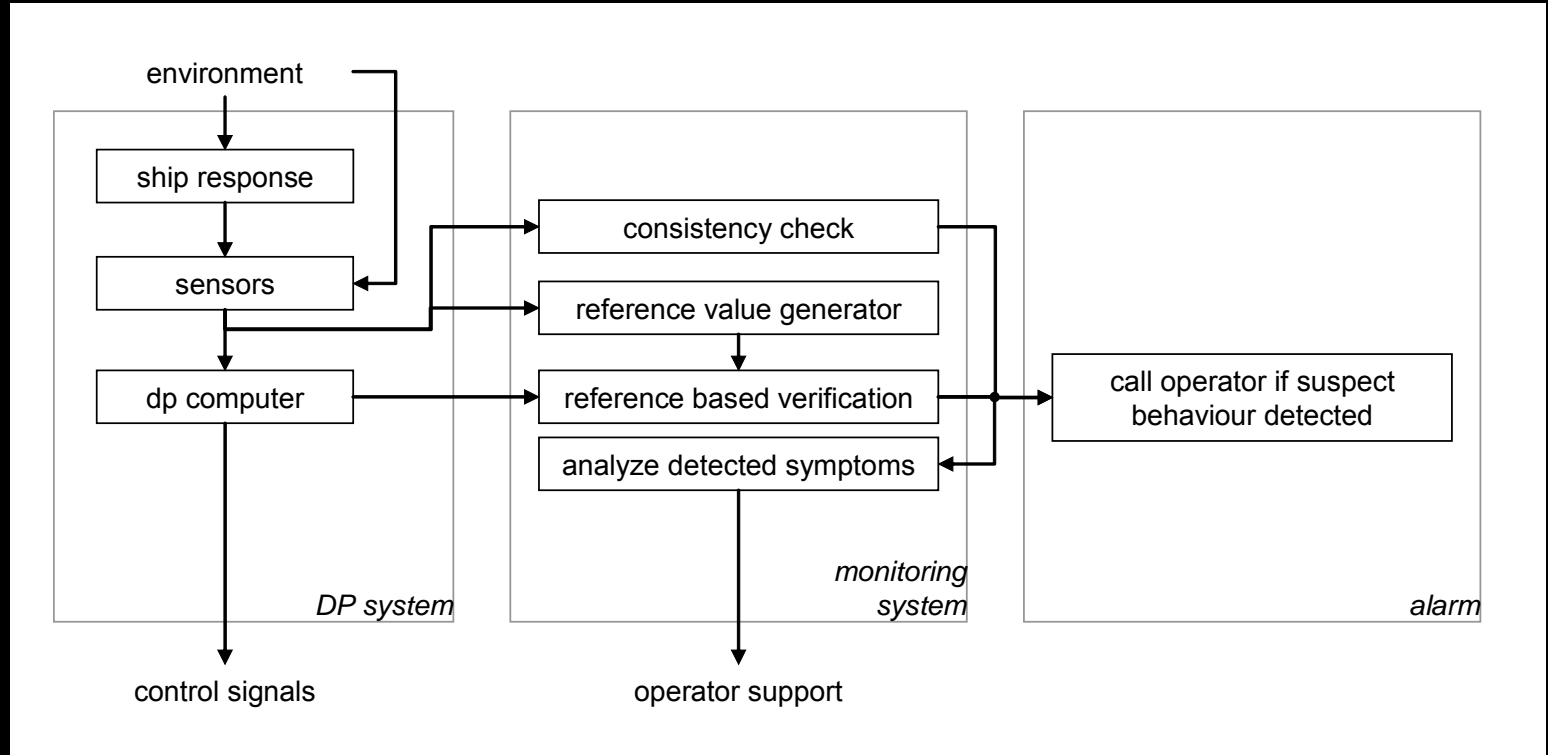
Self-monitoring



Health monitoring:

- Threshold on residuals
- Level of threshold determines reliability

Implementation of diagnostics





Operator support

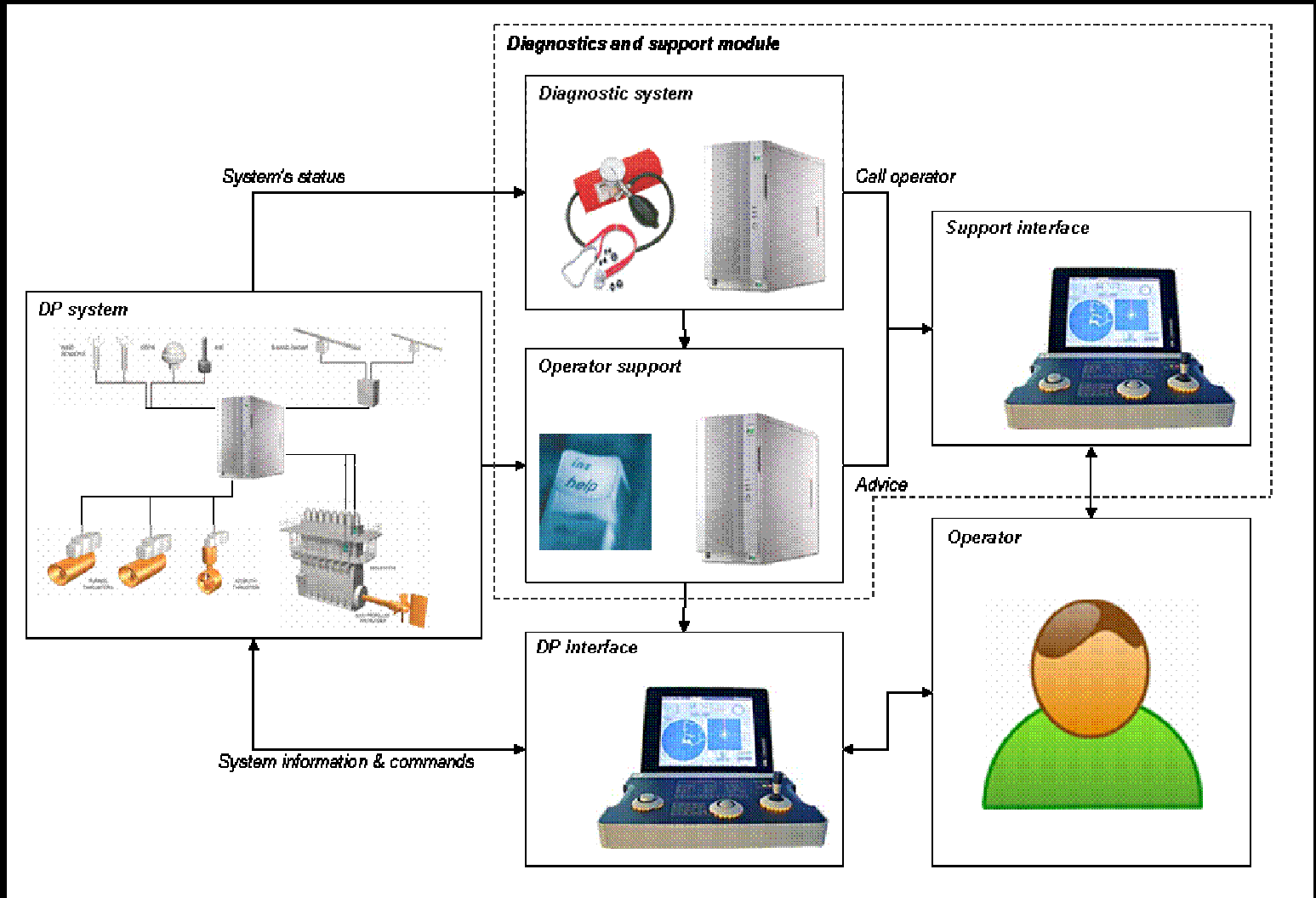
- Presentation of system status
 - Operator has to ‘familiarize’
 - Low situation awareness due to unattended operation
- Solving a detected problem
 - Analyze detected problem to find cause
 - Generate solution strategies
 - Predict effect of strategies
 - Present advice to operator



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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