



# Fire Fighting & Damage Control Automation

*"Enabling future crew reduction"*





# Content

- 1 Introduction: Holland Class Patrol Vessel
- 2 Battle Damage Repair Task Analysis
- 3 Theoretical Framework: Workload Analysis
- 4 Design of Task Oriented Based FFDC Applications
- 5 Future Developments
- 6 Conclusion



## Reduced manning of Naval Vessels

‘Holland Class’ Patrol vessel: Complement of 50

Enabling technologies:

- Watermist systems
- Automation systems
- Human Centered engineering





## Prerequisites RNLN

Patrol vessel: 50 crew

Operational Requirements:

- Single threat
- No fight through

Future frigate for RNLN  
similar manning targets:

- Operational decision support
- Operational Maintenance support
- Reduced BDR organisation





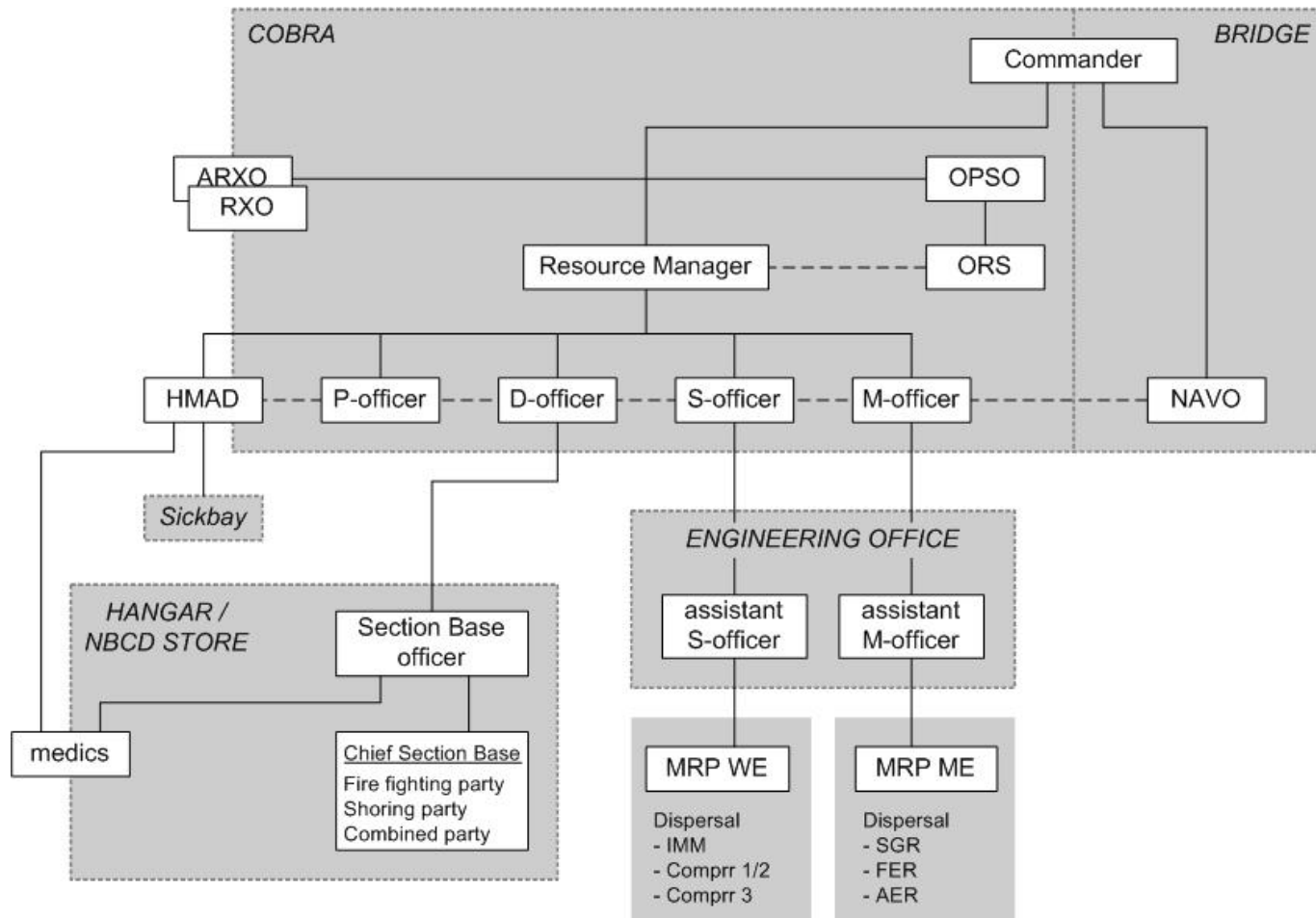
# Patrol Vessel Command Bridge Infrastructure







# Patrol Vessel FFDC Organization



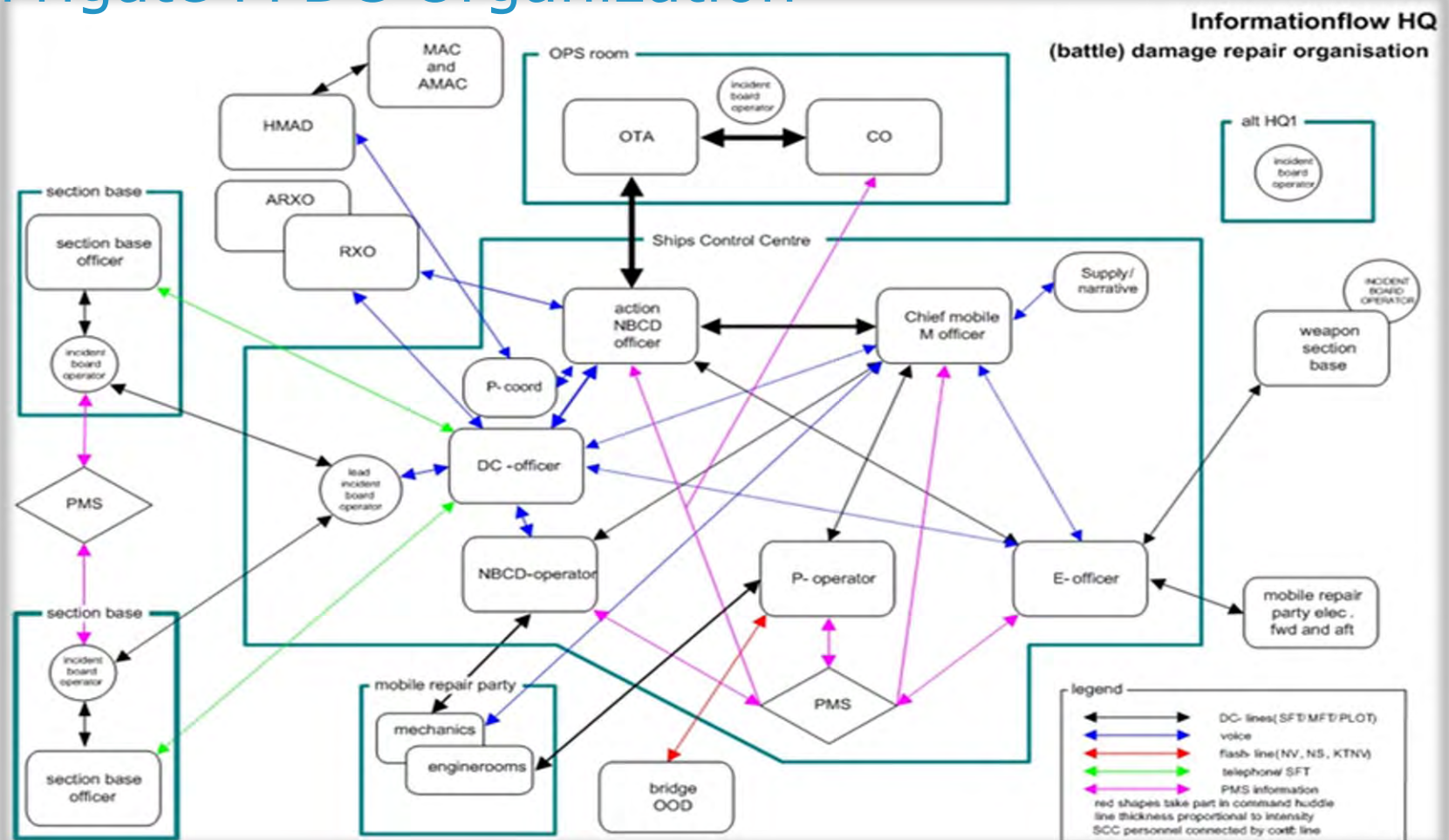


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# Frigate FFDC Organization









## 2 Task analysis of frigate BDR Organization

	Gather information (comm's and plot)	Assess information: Situational awareness	Decision making	Acting: Repetitive operator sequences
NBCD officer	50%	30%	20%	
Damage control officer	50%	30%	20%	
Survivability operator	20%		10%	70%
Plotter DCO	100%			
Plotter SBO FWD	100%			
Plotter SBO AFT	100%			
SBO FWD	40%	30%	30%	
SBO AFT	40%	30%	30%	
Messenger FWD	100%			
Messenger AFT	100%			
Mechanical Officer	50%	30%	20%	
Mobility Operator	20%		10%	70%
Electrical Officer	50%	330%	20%	
Electrical Operator	20%		10%	70%
<b>TOTALS 14</b>	<b>840%</b>	<b>180%</b>	<b>170</b>	<b>210%</b>
<b>Overall percentage</b>	<b>70%</b>	<b>13%</b>	<b>12%</b>	<b>15%</b>

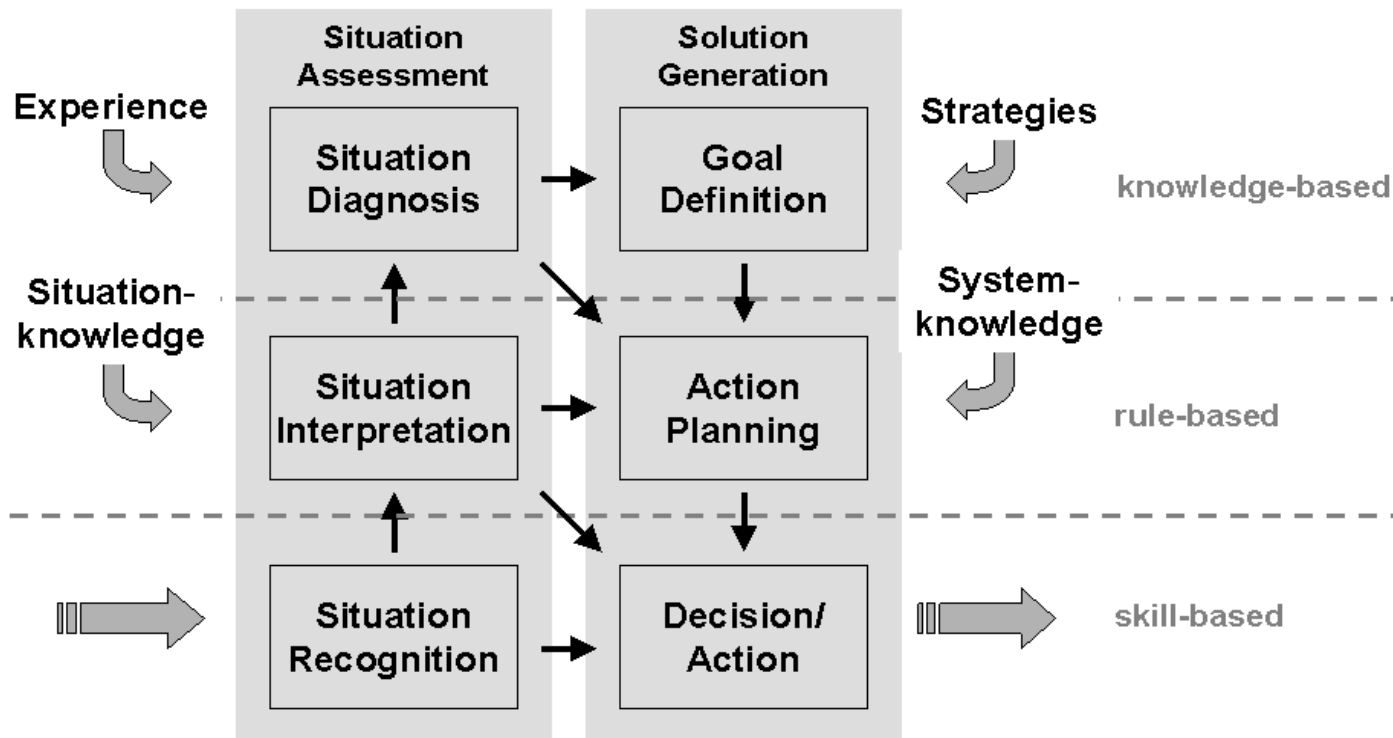


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# Decision Model (Rasmussen)





# Performance Shaping Factors

Operator Workload is primarily determined by:

## 1. Situational Awareness

- Communication
- Visual Aids
- Experience

## 2. Procedures

- Battle Damage Repair procedures
- Operational procedures (technical)
- Experience / Training

## 3. Automation

- Automated control Sequences
- Human Machine interface
  - Visual, design of mimics
  - Decision Support Systems





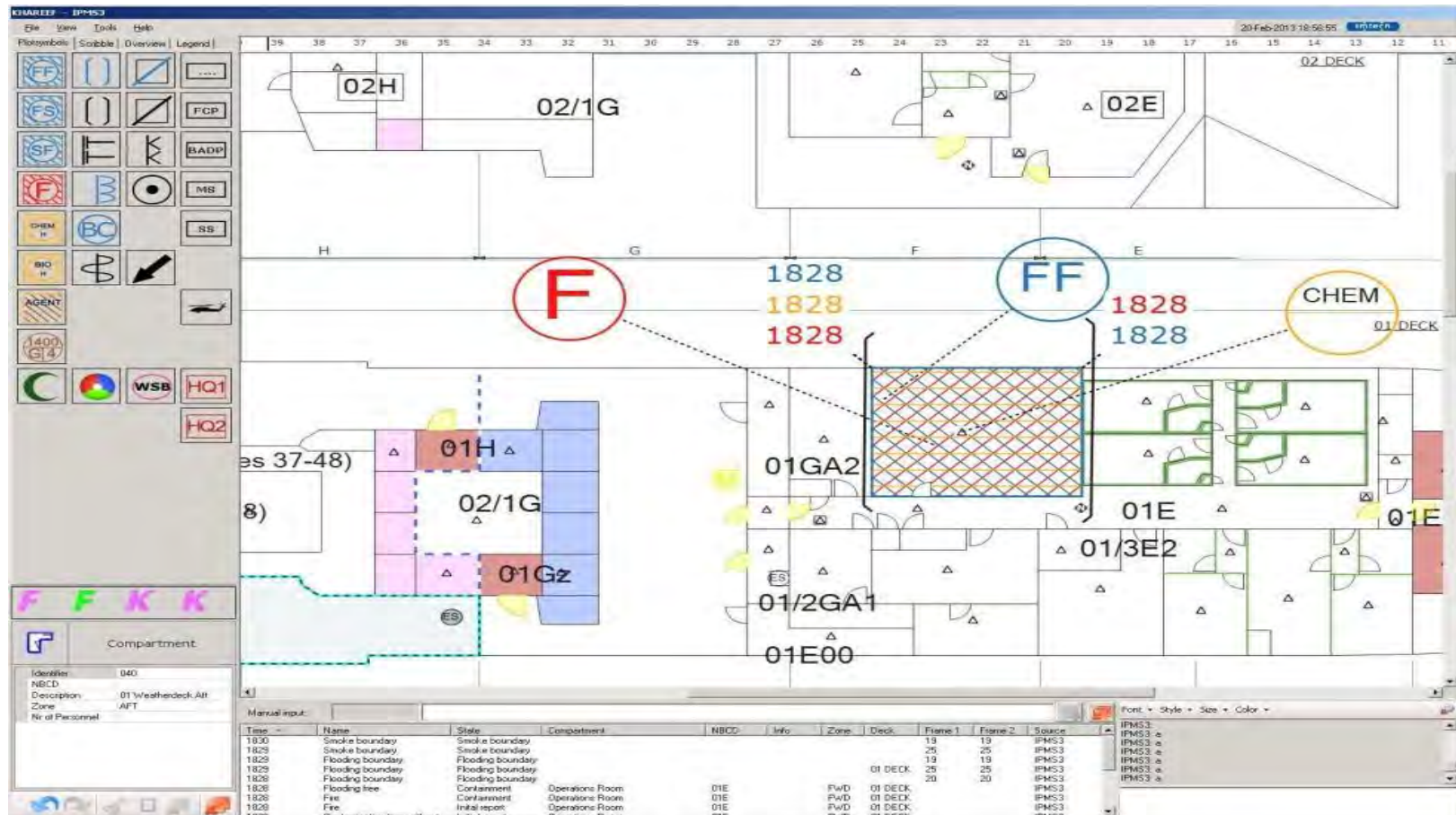


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# Interactive Electronic Incident Board





# Wireless Handheld Devices

## Flexible Task Allocation

1. Person in Control
2. Responsible Person #1
3. Responsible Person #2
4. Listeners



## Features

- Control & Monitoring via WLAN
- Messaging / MMS
- Function Allocation
- Potential: Ticket System

PIC





# BCD Procedure Human Machine Interface

**Automated Advisory Function Viewer**

Bestand Weergave Privileges Versie

Systemfuncties

Adviezen

Detectie actief of advies niet uitgevoerd Detectie inactief en advies uitgevoerd Time-outs Bevestigingen

Detectie	Status	Prioriteit	Primary	Secondary	Beperking	Adviesfunctie	Advies	Storing	Gegenereerd
	T	3			BB	Storingsdetectie voortstuwing	Noodstop BB	Noodstop: initiatie door operator (A-2)	14:20:42

Acties

Primary Secondary

Operator

Stap	Status	Omschrijving	Stapafhankelijkheid
1	—	VRA BB staat op Hand?	
2	✓	Gereedheidsgraad 1	
2.1	A	Meld via MANO: NOODSTOP BB.	
Executiemodus: Handmatig			
3		Mimic 45 openen en controleren.	
4		Mimic 31 openen en controleren.	
5		Mimic 32 openen en controleren.	
6		Controleer via CCTV de AMK.	
7		Smeerolie lekkage TWK installatie? > 9	
8		VSI lekkage? > 10	
9		Smeerolie lekkage draaglager?	
10		Operator acties voltooid.	

IPMS

Stap	Status	Omschrijving	Stapafhankelijkheid
1	—	VRA BB staat op Hand?	
2	✓	Gereedheidsgraad 1	
3	—	Omroepbericht: NOODSTOP BB.	
4	T	Wanneer Noodstop BB geaccepteerd.	
Executiemodus: Automatisch Timeout: 00:00:20 Verstreken tijd: 00:00:45			
5		Wanneer BB DTS op STOP.	
6		Wanneer HVD koppeling BB UIT.	
7		Wanneer asrem BB IN.	
8		Wanneer HVD BB genoodstopt.	
9		Smeerolie lekkage TWK installatie? > 7	
10		VSI lekkage? > 8	
11		IPMS acties voltooid.	

Bevestigen Overslaan

Weergeven HMI: Automatisch Wisselen adviezen: Automatisch Wachttoestand: Gevechtswacht

Configuratie

Alle adviezen

Weergeven HMI: Automatisch

Wisselen adviezen: Automatisch

Wachttoestand: Gevechtswacht

Advies

Beperkte zijde Voortst.

BB SB

Acties

Opnieuw

Bevestigingen

Vernieuwen

Afdrukken

Adviesmode

Storingsdetectie voortstuwing

Automatisch Tonen

Storingsdetectie PCU

Automatisch Tonen

Storingsdetectie stuurmachines

Automatisch Tonen

Elektrisch isoleren

Automatisch Tonen

MK isoleren

Automatisch Tonen

Zeewaterlekage

Automatisch Tonen



## Stability Interface

Interface between the Interactive Electronic Incident Board and the (3rd Party) Stability Software.

- Comprehensive 'Traffic Light' User Interface
- Plotted information is automatically evaluated by the Stability Calculator







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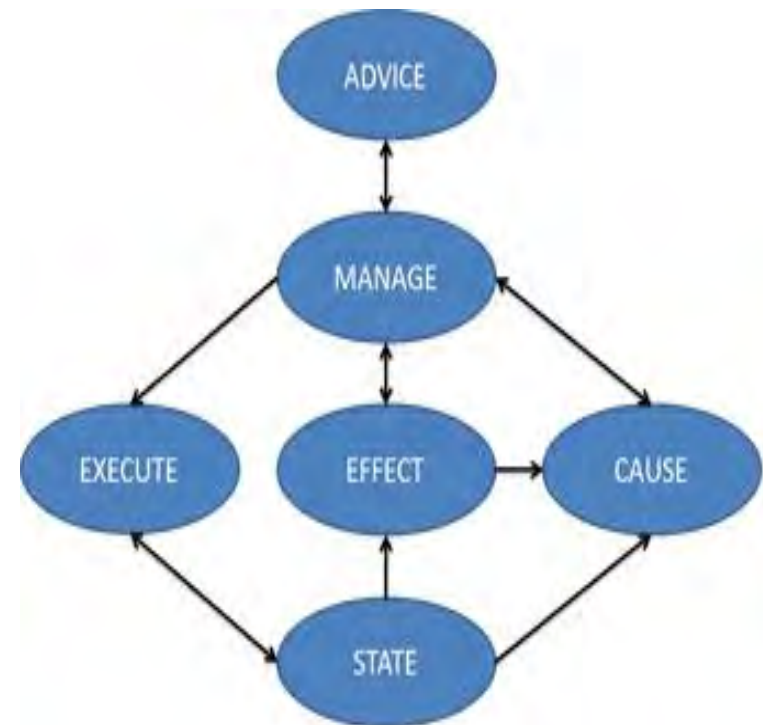
# RNLN Operational Maintenance Support Model

Top Down approach to project Operational Capabilities and Management processes on:

- Payload / Weapon Systems
- (Platform) Support Systems and
- BDR activity cycle

## Implementation:

- Integration of CMS and IPMS
- Sufficient (diagnostic) I/O
- Functional Chain Analysis





# Distributed Intelligent Networked Control Systems

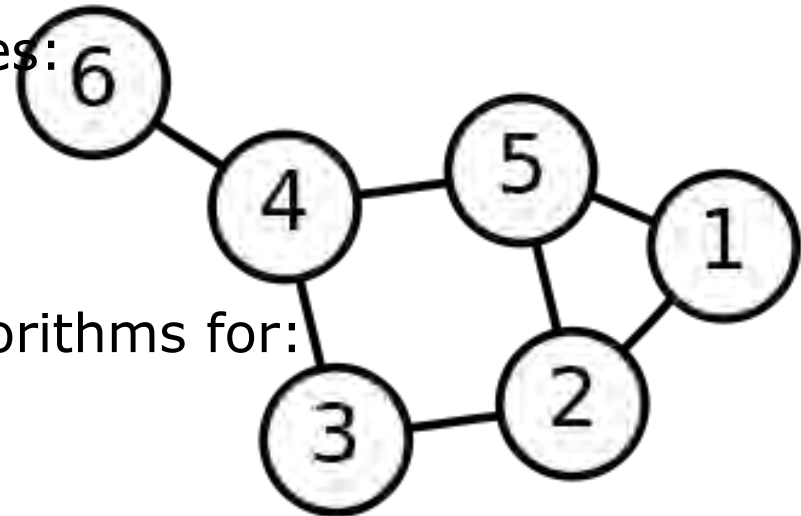
Mathematical representation of Platform Systems by Devices and Connections as Edges and Nodes in a 'Graph'

Properties of Edges / Nodes:

- Cost
- Capacity
- Priority

Mathematics provided algorithms for:

- Shortest path
- Maximum flow
- Minimum cost





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## 6 Conclusion

The Holland Class Patrol Vessel is able to perform its' operational tasks with a complement of 50, which could not have been achieved without increasing automation level, in particular for Battle Damage Repair.

A further reduction of the Workload of the Battle Damage Repair Organization is possible when Human Centered Engineering principles are applied and combined with available technologies.

Navy involvement and rapid prototyping are essential to Design & Develop Task oriented applications for Battle Damage Repair.





# Thank you for your Attention

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