



C2 Self-Synchronisation and Swarming

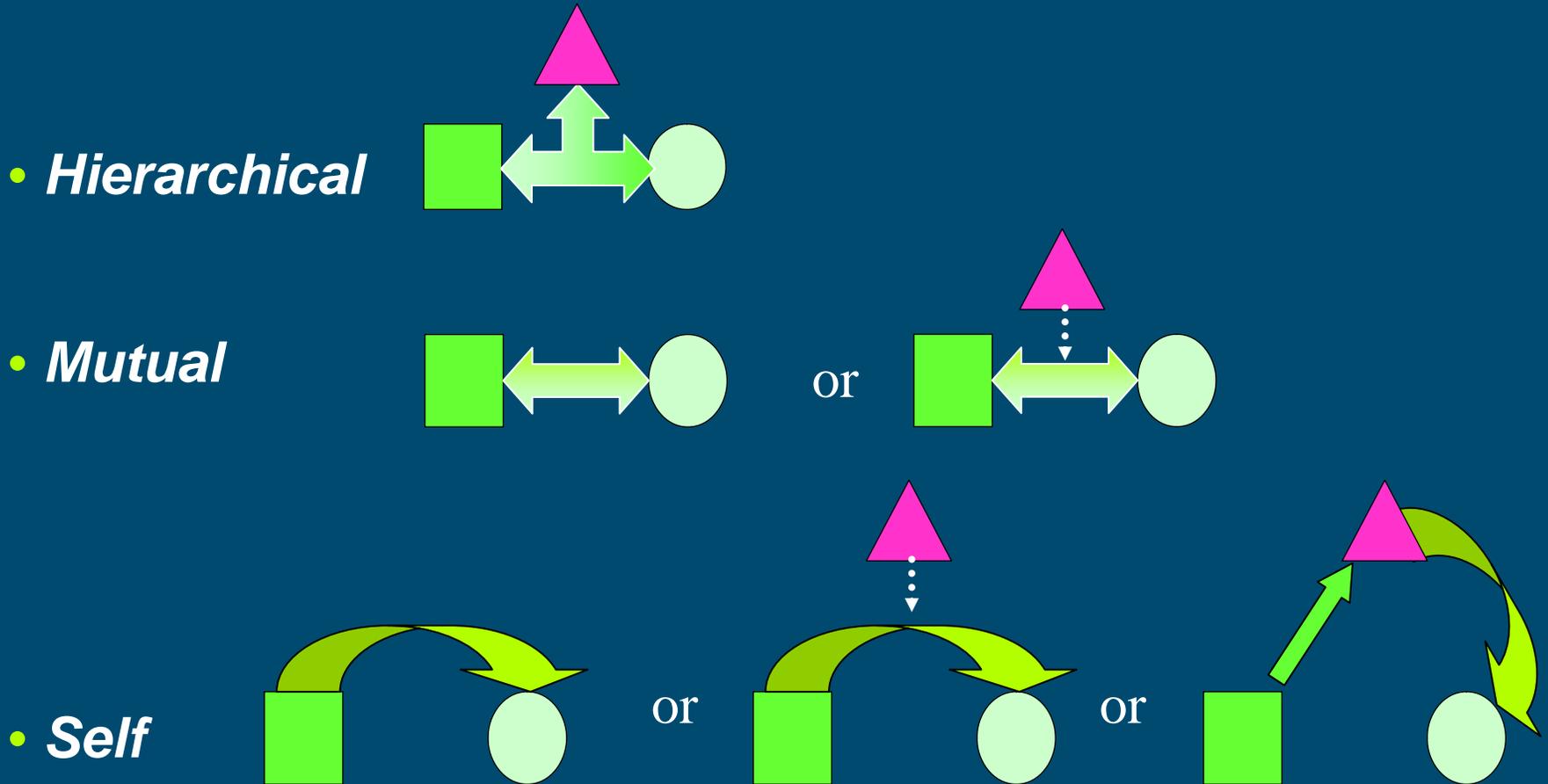
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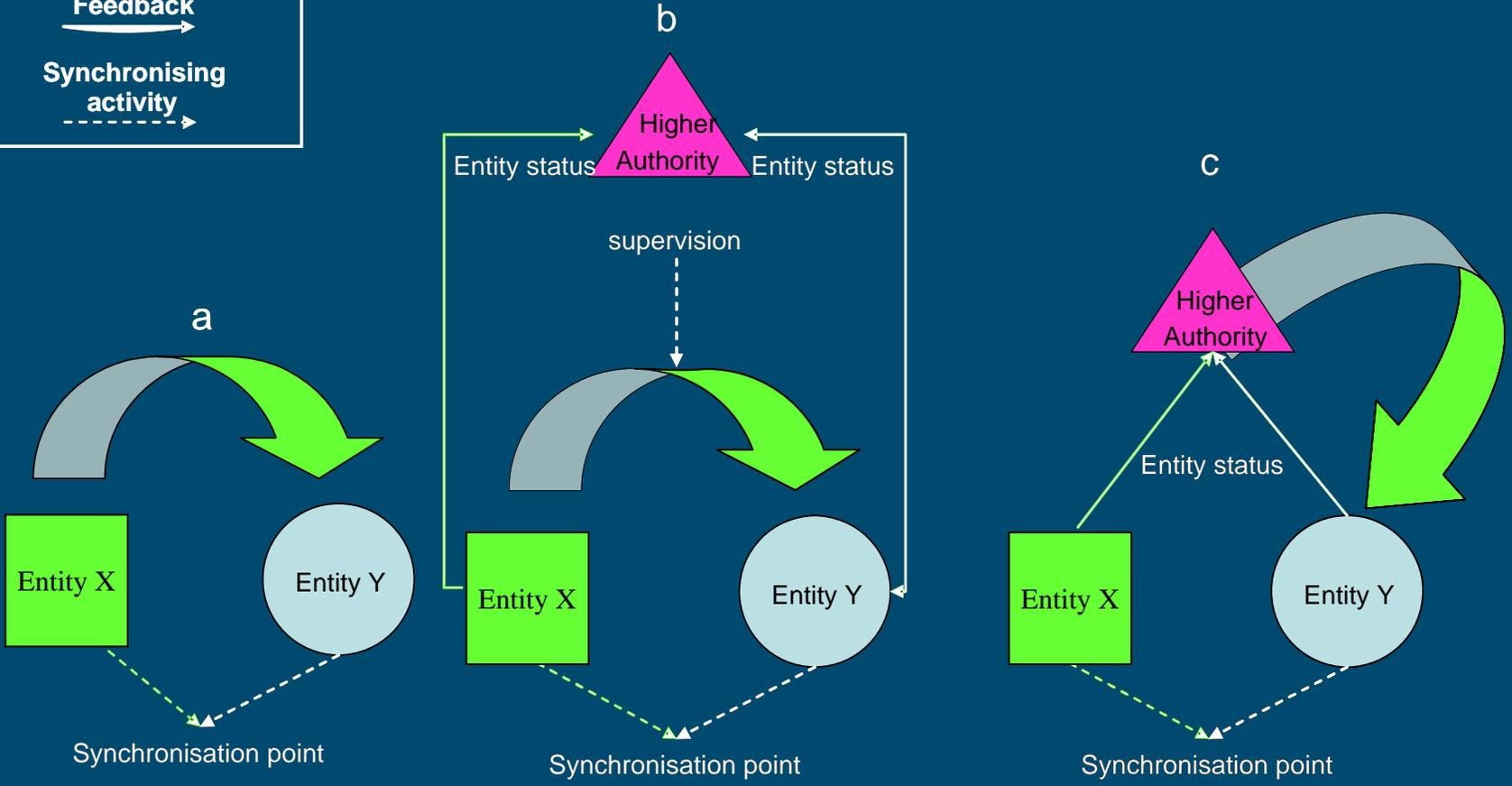
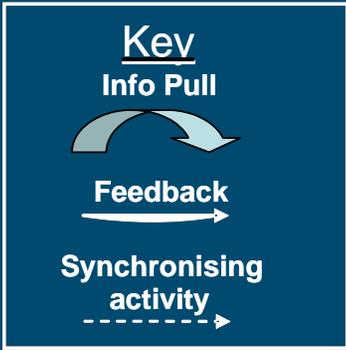
June 2008

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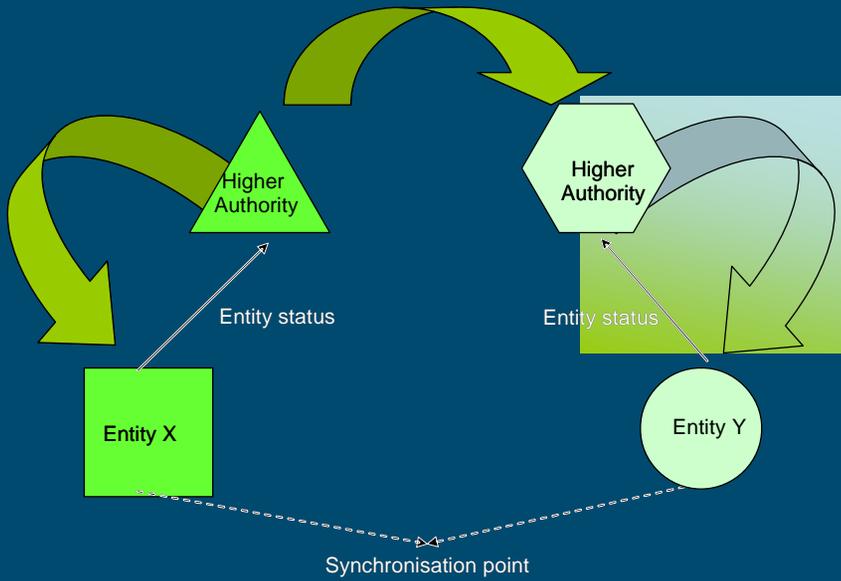
- Discussion regarding alternative forms of synchronisation
- Characteristics of swarming
- Historical examples of swarming behaviour
- The appropriateness of self-synchronisation and swarming behaviour in the context of the maritime environment

Alternative forms of synchronisation

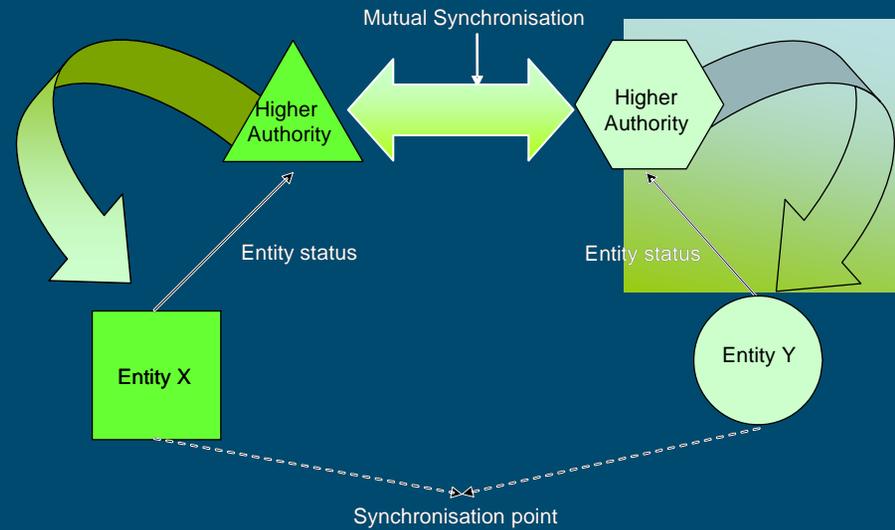


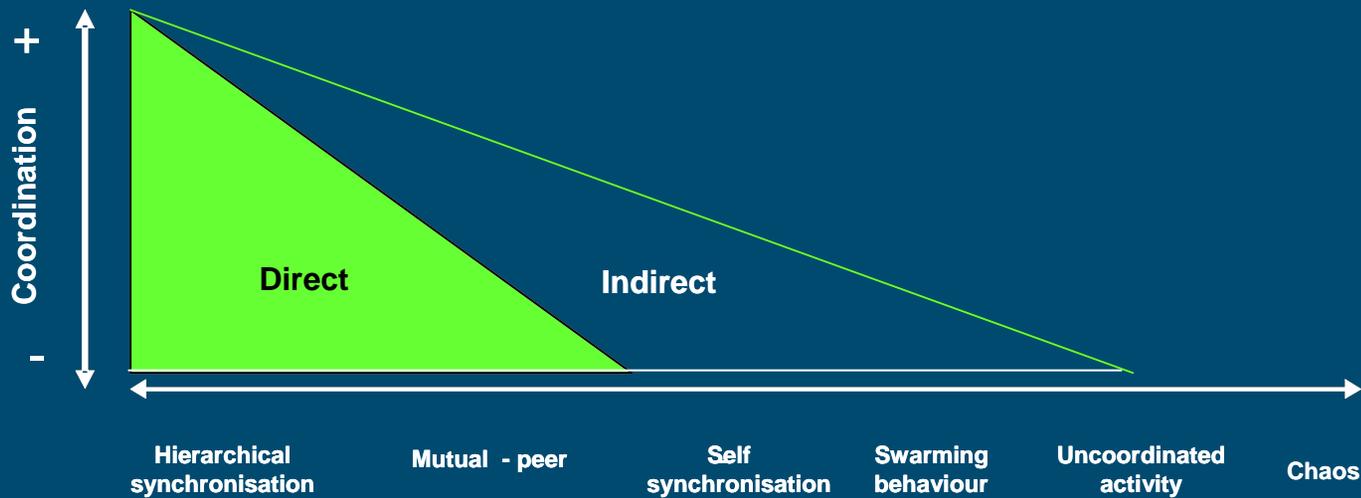
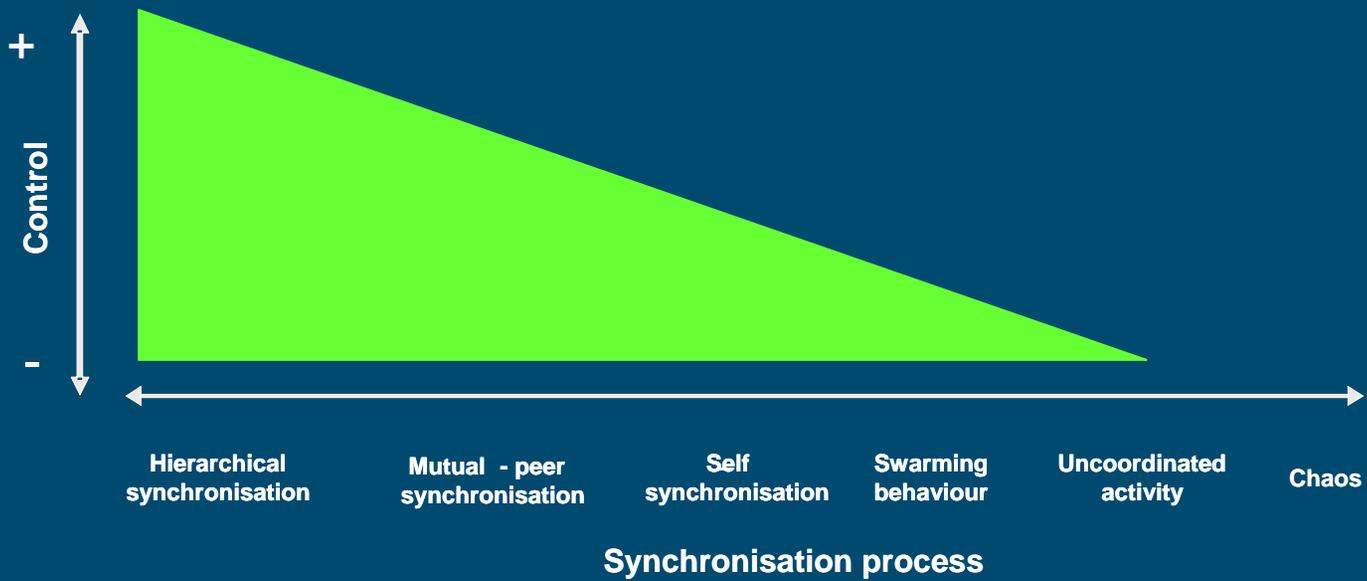


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Swarming

- An extreme form of self-synchronisation
- *"The systematic pulsing of force and / or fire by dispersed networked units, so as to strike the adversary from all directions simultaneously."*¹
- The 'emergence' of macro-behaviour - based on the totality of self-synchronised micro-behaviour.

¹ (Arquilla, Ronfeldt, Swarming and the future of conflict, RAND Corporation 2000)

Swarming Characteristics

- A number (usually many) of low-level components with specialised functions;
- multistability – flexible agile capability through clustering of function;
- Bifurcation – rapid change of function
- Coordination achieved through indirect interaction – very localised SA;
- Survival of the collective takes precedence over individual components.

Military swarming

- ***Massed Swarm***, *implies a convergent attack as a primary manoeuvre*
 - Convergent attack
 - *Encircling and surrounding an adversary*
 - *cuts off the adversary's lines of supply*
 - *destroys morale*
 - *prevents any possible retreat*

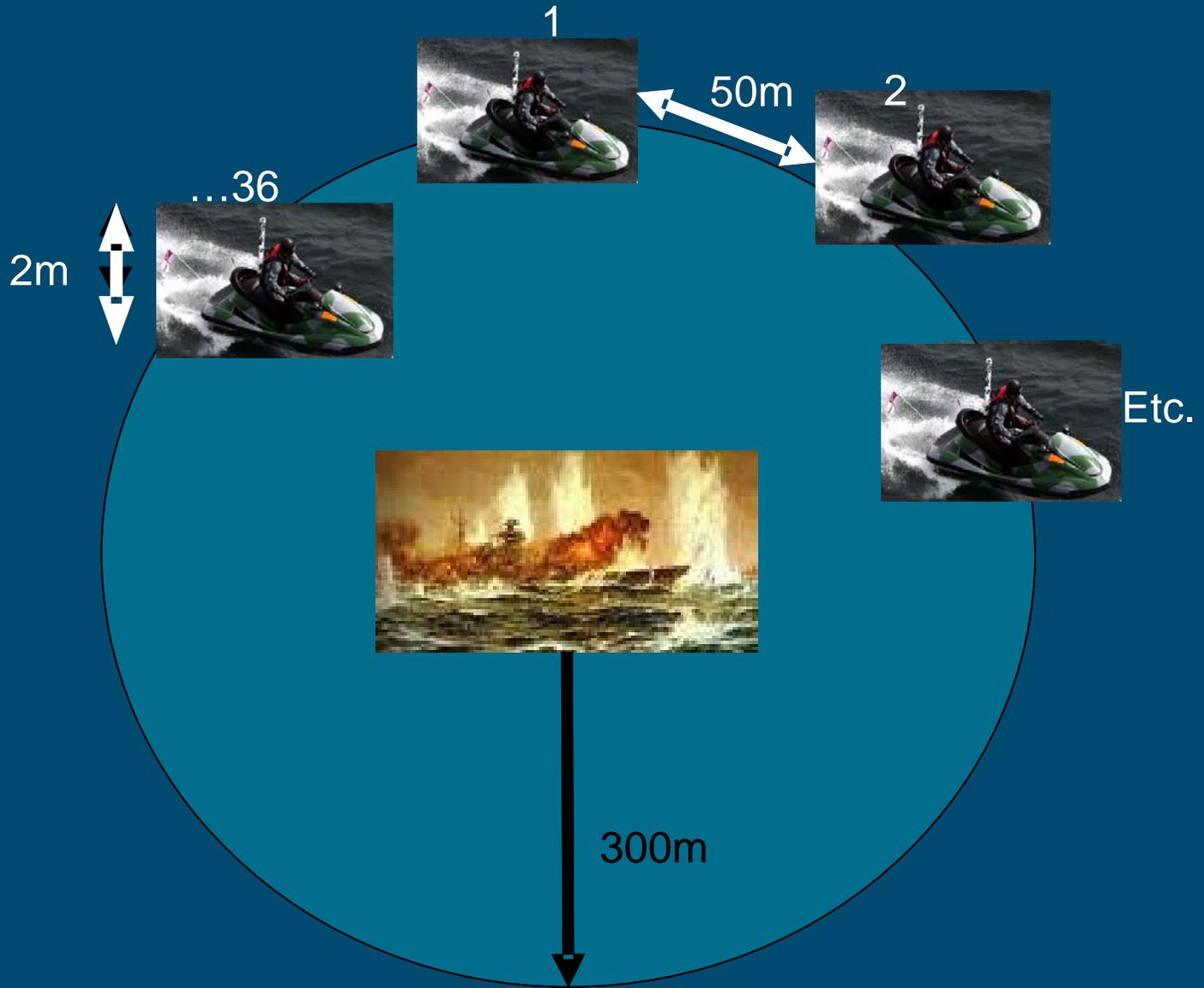
Examples of swarming behaviour

- **Battle of the Atlantic – U Boat “Wolf Pack” operations (1939–1945)**
- **RN Coastal Defence Force (1939-45)**
- **Battle of the Pacific, kamikaze air attacks (1944-45)**
- **FIAC swarms (present day)**
- **Other applications e.g. social swarming**

Appropriateness of swarming behaviour in Military Operations

- behaviour cannot be controlled, only influenced through prior communication of Command Intent and ROE.
- non-linear process – very short-term prediction of behaviour
- Large numbers of platforms





Constraints

- Small platforms not “ocean-going”
- Transport assistance from larger platforms
- Sustainment requirements:
 - sufficient crew numbers for the force to operate 24/7;
 - Maintenance 24/7;
 - Therefore difficult to achieve sufficient numbers of maritime swarm components in the zone of operations

Conclusions

- Much NCW / NEC literature / discussion is phrased as though this is a blank canvas and self-synchronisation is a new concept. This is not the case.
- The swarming concept needs to accept :
 - large numbers of units
 - less direct control of the self-synchronising / swarming force
 - less detailed plans
 - self-synchronising / swarming SA is different from conventional SA
- difficult to see how a future maritime force could apply offensive swarming in expeditionary operations
- if maritime aircraft and UXVs were to be included in the force then the potential for swarming operations increases.

[dst1] Questions