First Synchronisation Meeting

CASCADe/CyClaDes/FAROS

Hamburg, 13.03.2013

Partner Projects: CyClaDes & FAROS

From DoW – Cooperation between CASCADe, CyClaDes and FAROS:
"The CASCADe consortium will cooperate with the projects FAROS and CyClaDes. Initial contacts have been established already in the negotiation phase. The three projects will hold a specific workshop in the first half of their projects in order to specify the concrete form of collaboration.

- a **separate workshop** will be **organised between FAROS, CyClaDes and CASCADe** in month 12 (or around this time) about information on bridge systems as well as
- a **separate workshop between FAROS and CASCADe** in month 28 (or earlier but not later) on virtual reality models addressed in both projects"

First workshop in Jan. 2014 and **second workshop between Jan-March 2015**

CASCADe Project Partner

Collaborative Project in 7th Framework Programme: Transport
SST.2012.4.1-1. Human element factors in shipping safety

CASCADe
Model-based Cooperative and Adaptive Ship-based Context Aware Design

Duration: 01.01.2013 – 31.12.2015

Advisory group:
- Maritime Cluster Northern Germany
- Nautilus International
- NSB Niederelbe Schifffahrtsgesellschaft
- Australian Maritime College

Rationale

"The ability of ship's personnel to co-ordinate activities and communicate effectively with each other is vital during emergency situations. During routine sea passages or port approaches the bridge team personnel must also work as an effective team."

Development of bridge workstations, displays and controls on the one hand and procedures on the other hand is characterized by being **non-harmonious**:

- equipment from different manufacturers is combined within ad-hoc bespoke environments,
- existing standards and guidelines are unspecific and ambiguous,
- disconnect between guidelines for system design and the guidelines for procedure design,
- bridge design should involve cognitive capacities of humans and nature of the tasks at hand

⇒**Near misses, groundings and collisions are still commonplace**

CASCADe Objective

Improve safety of maritime transport through:

- bridge system that considers human errors by increasing cooperation between crew and machines on the bridge
- human-centred design methodology supporting analysis of crew performance at early development stages

Socio-Technical System: Ship Bridge

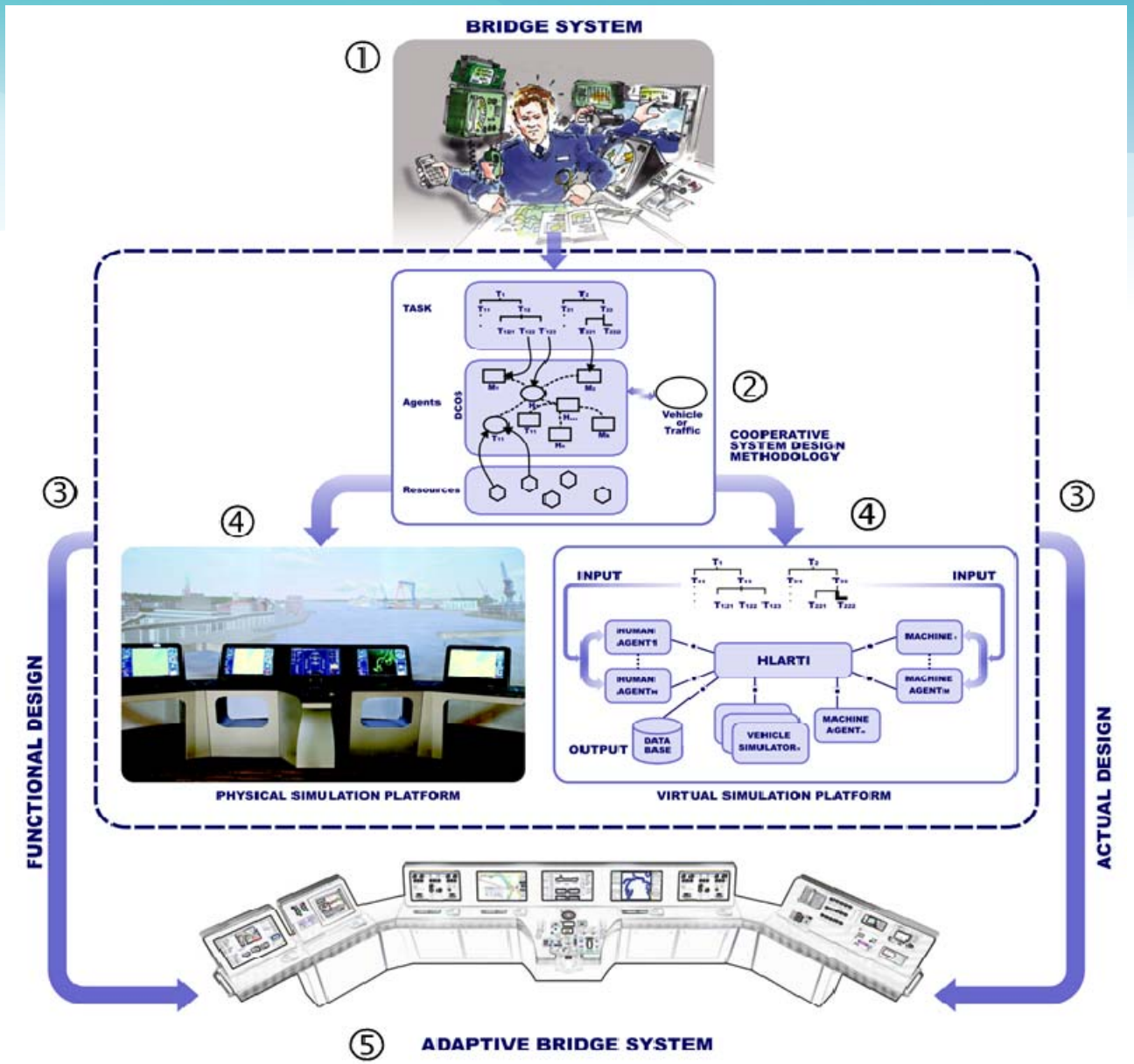
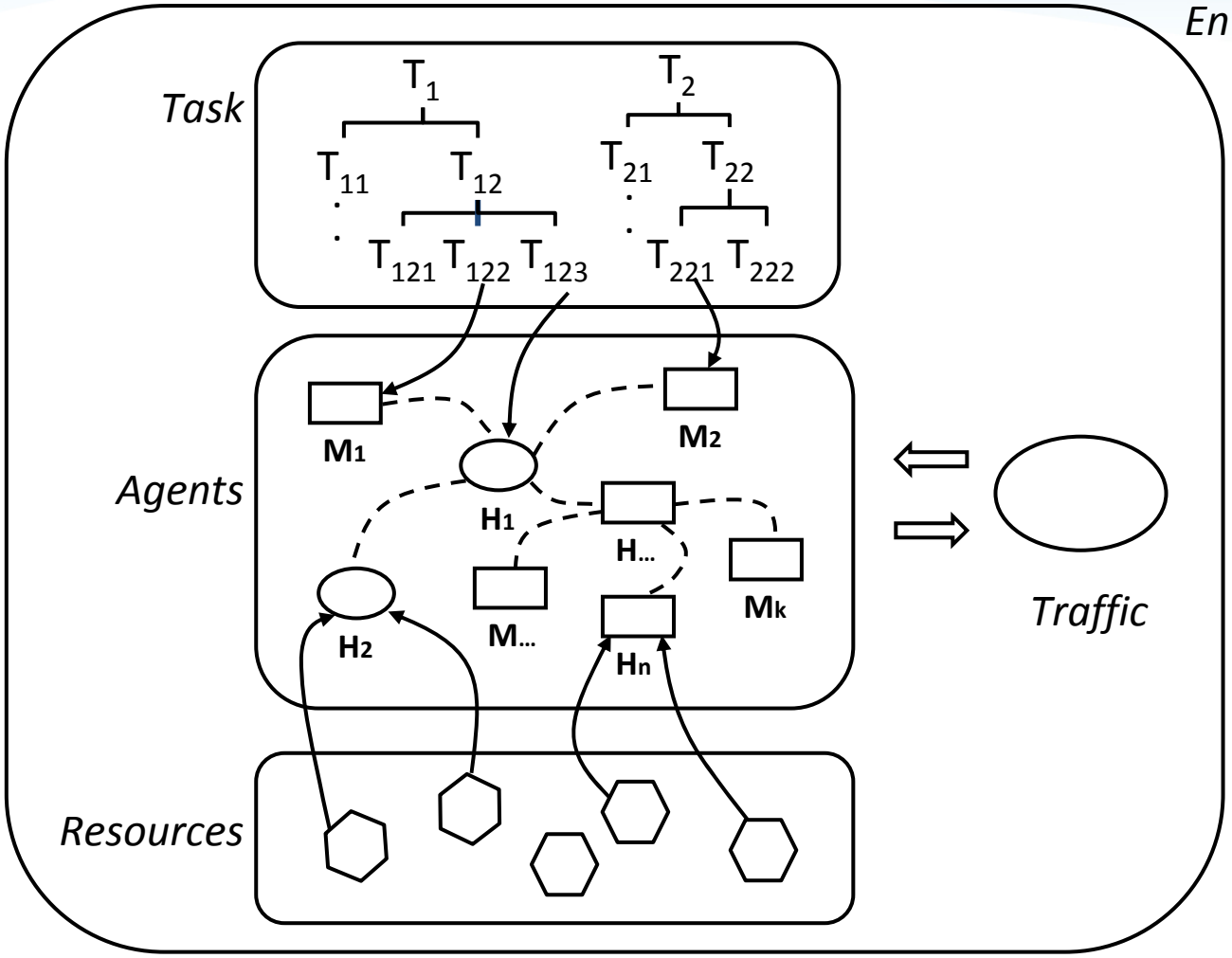


Figure : Key innovation provided by CASCADe

Bridge as a cooperative system > Task Analysis



Holistic perspective to investigate overall safety and resilience already during design time:

- potential conflicts (incl. human errors),
- inconsistencies and
- redundancies (e.g. of information presented on screens)

Simulation Platforms

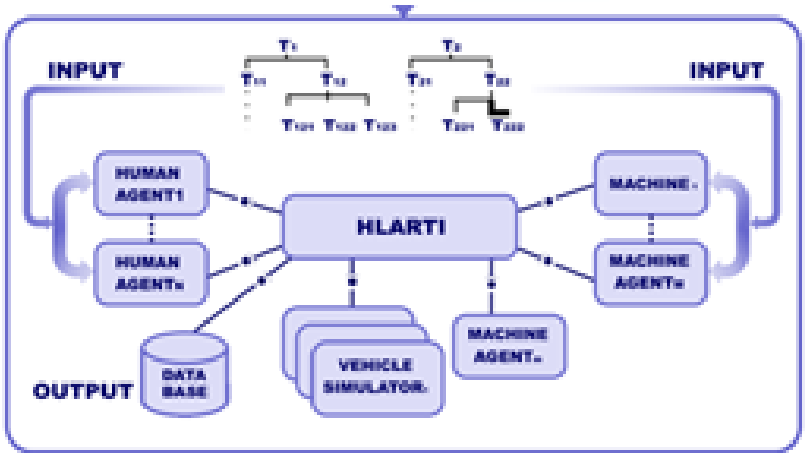
Physical Simulation Platform

hardware, software and humans
based on the full-scale bridge simulator

≈

behaviourally equivalent

Virtual Simulation Platform



purely based on models of the human and machine agents, tasks, resources

The **Virtual Simulation Platform** will allow:

- to evaluate bridge designs at early design stages using cognitive models,
- in many more scenarios than the Physical Simulation Platform,
- investigation of extreme scenarios that would be difficult to evaluate on the physical platform.

Adaptive Bridge System (ABS)

- Adapt the whole cooperative system to the (1) current situation, (2) relevant procedures and (3) the needs of the individual seafarer
- Automatic or manual adaptation: e.g. information content, presentation, distribution
- Attention: adaptation brings benefits (e.g. increased situation awareness) but may add extra cost (e.g. cognitive disruption).
- Provide the most important information, in the most effective way at the most useful time, based on context awareness.

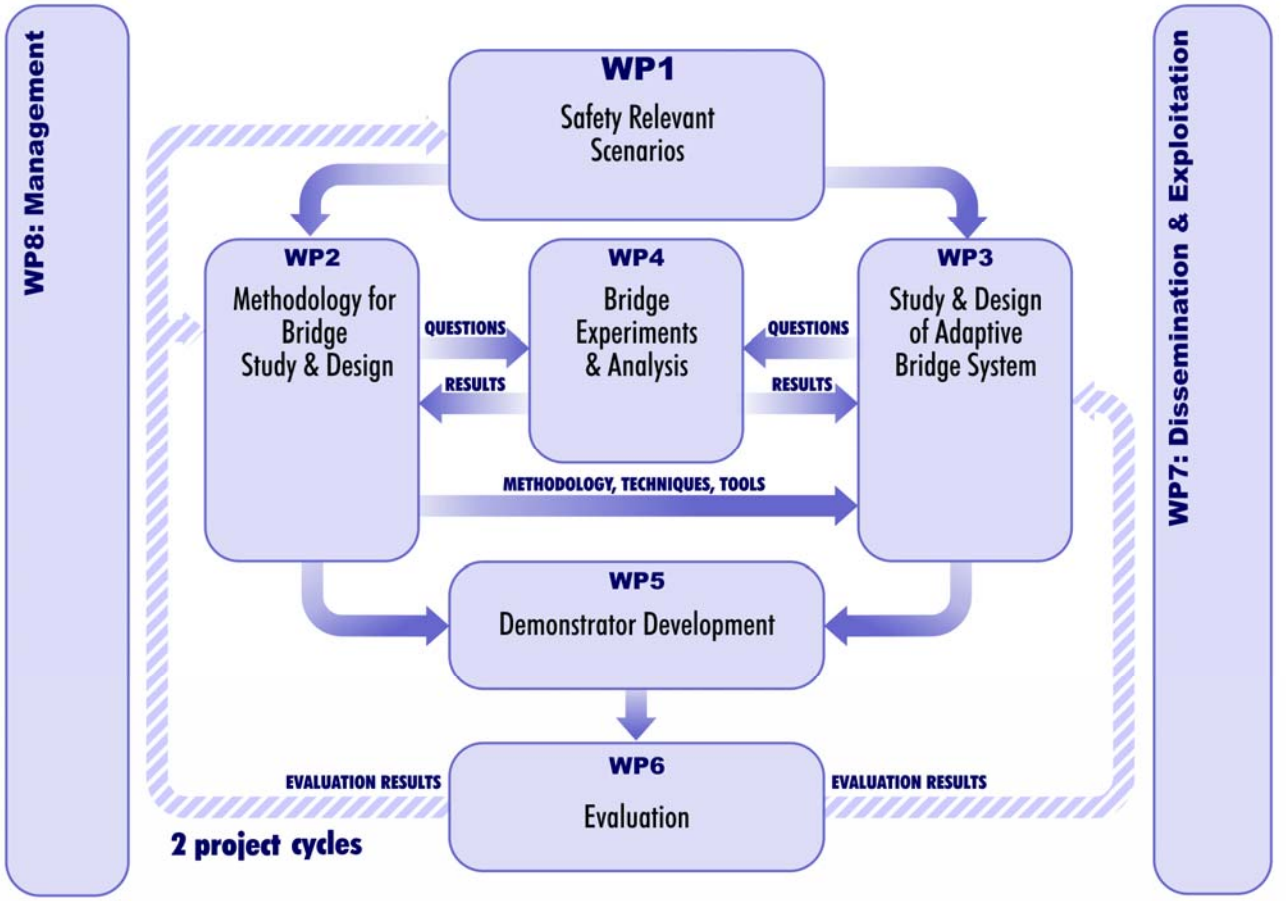
Expected results

Develop, demonstrate and evaluate a new **methodology** enabling the **design of a highly Adaptive Bridge System** from a cooperative system perspective.

1. **Functional and actual design of an Adaptive Bridge System (including adaptive Pilot systems)**
2. **Demonstrated and evaluated Adaptive Bridge System prototype**
3. **Demonstrated and evaluated human-centered design methodology**
4. **Fully implemented Cognitive Seafarer Models**
5. **Fully implemented Virtual Simulation Platform for bridge design evaluation**

The methodology will integrate techniques and tools for harmonization of **system development, procedure development** and **human factors** fostering a holistic and affordable human-centred approach to ship bridge design.

WP Structure



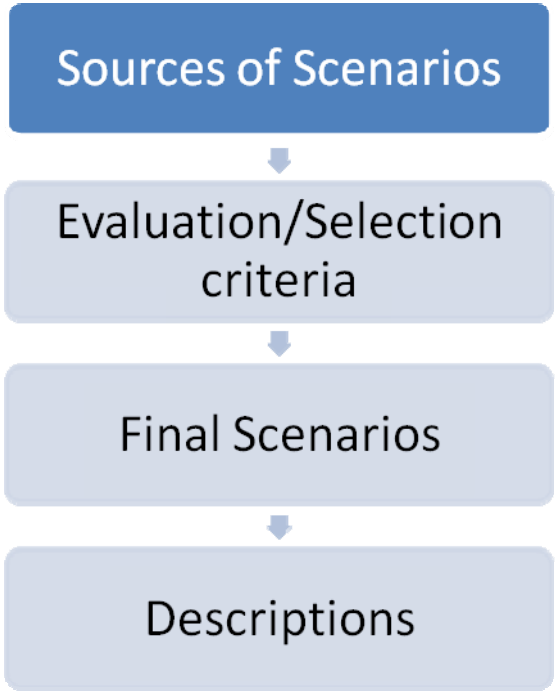
Bridge simulation: Criteria for selection of the tasks for the crew to perform

Scenario Selection Methodology

a)Analysis of **accident reports** (such as MAIB) and interview seafarer/domain experts about accidents

b)Develop **selection criteria**

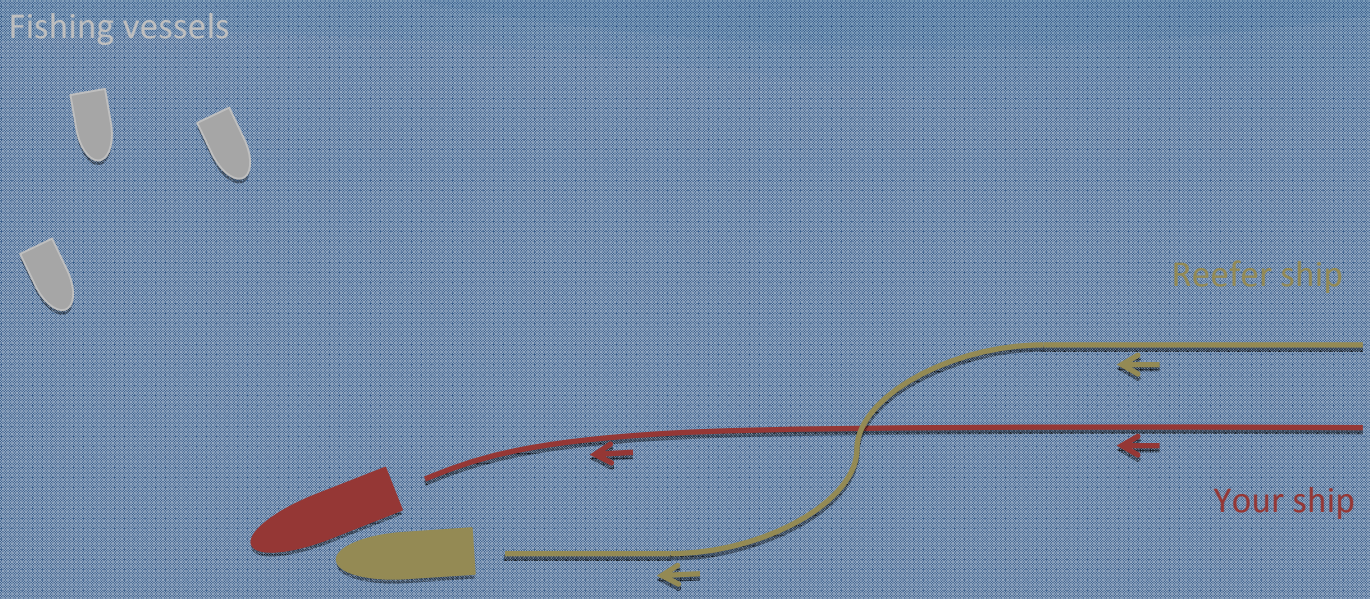
c)Filter **scenarios** to provide a feasible baseline and evaluation metrics (situation awareness, fatigue, collaboration, deviation from regulation, etc..)



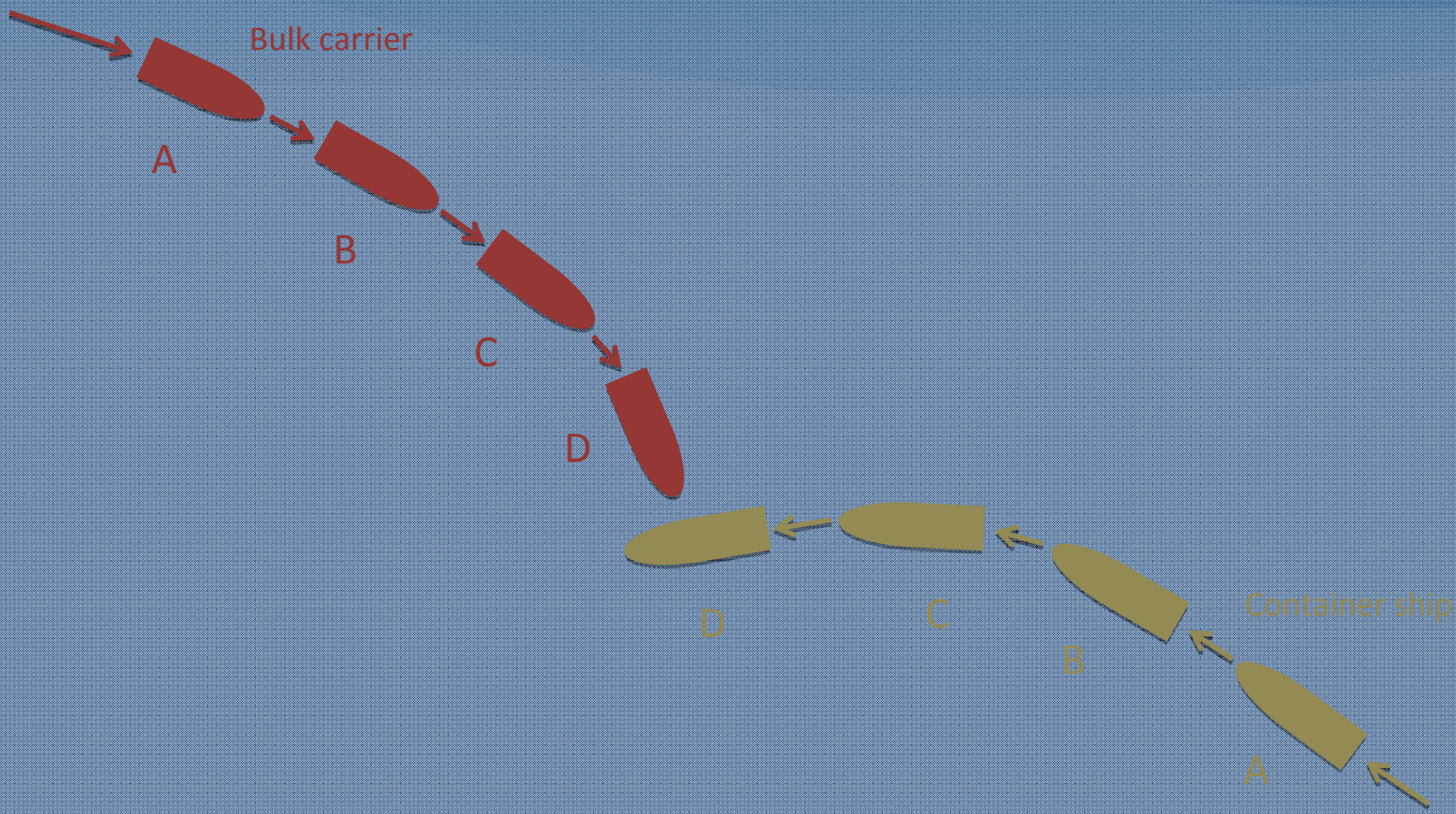
Scenario Selection Methodology

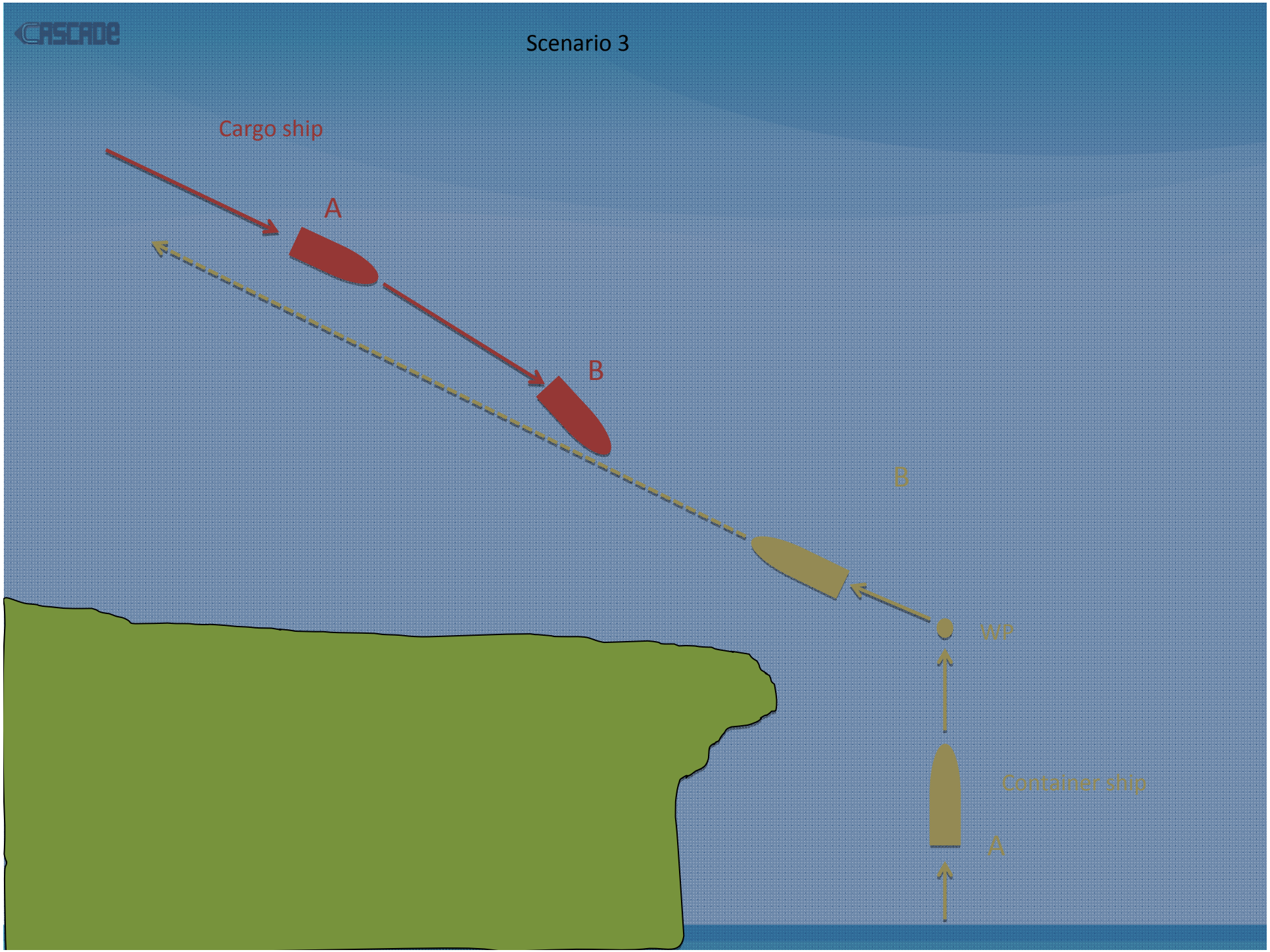
- scenarios must support experiments, modelling, evaluation and must be ones in which we can show improvement
- they must be relevant to the consortium and reproducible
- need to be extended through time to address the factors we are interested in (fatigue, communication breakdown, situation awareness, etc.)
- So far: **collision, grounding and full sea passage scenarios** (Emden-Leopolddok, Felixtowe-Oostende)

Scenario 1

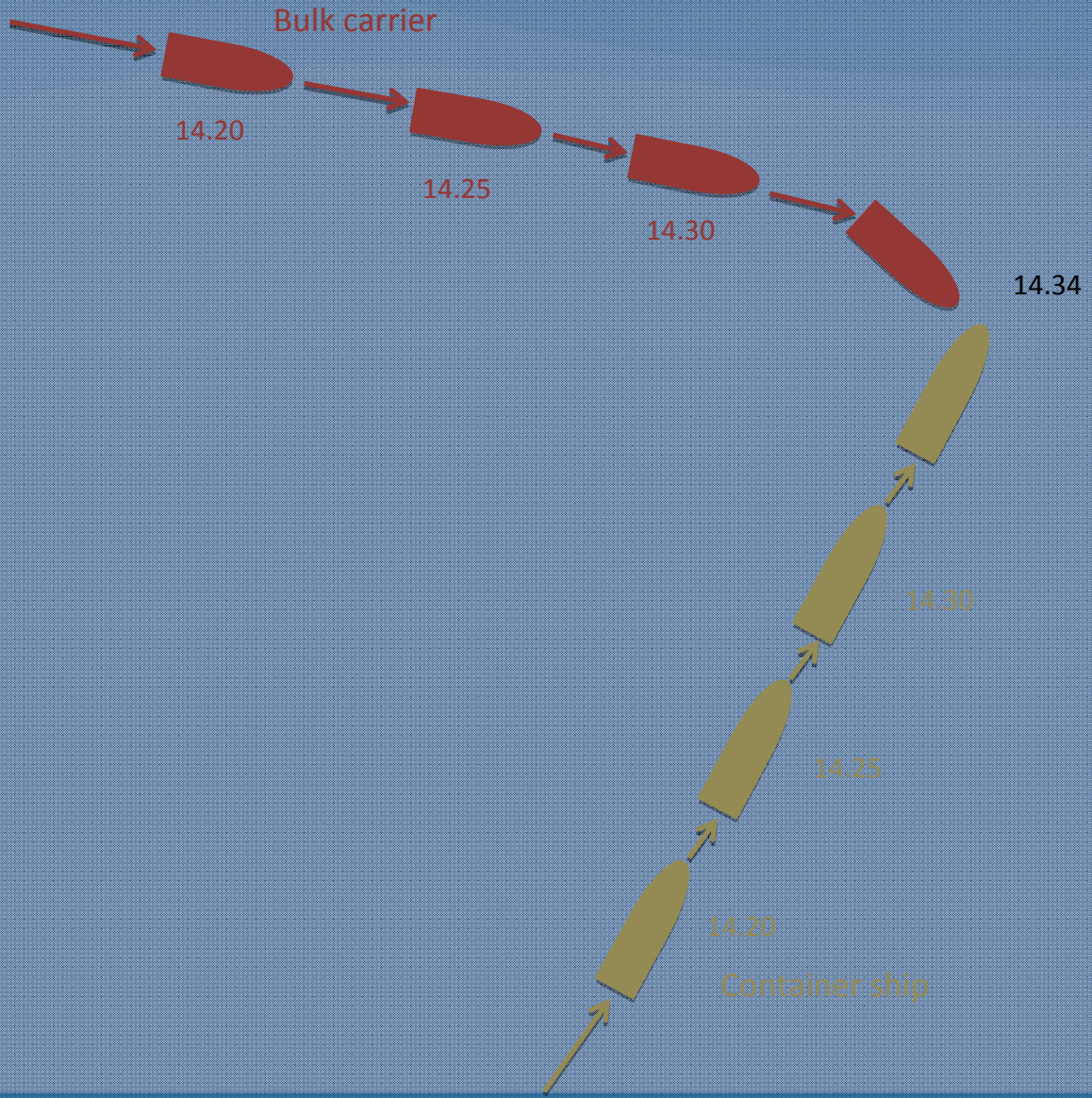


Scenario 2




Scenario 3
Cargo ship
A
B
B
WP
Container ship
A

Scenario 4


Bulk carrier
14.20
14.25
14.30
14.34
14.30
14.25
14.20
Container ship

Crew performance: Means and methods of assessing the crew performance

We will evaluate safety on the bridge by means of a compound metric consisting of:

- accuracy of seafarers' actions i.e. levels of absolute human error
- timeliness of seafarers' actions
- comparison of seafarers' knowledge about the current context compared to a more objective prioritisation of context information
- confidence levels of seafarers i.e. do they think they did the right thing?
- fatigue level of the seafarer
- situation awareness and collaboration on bridge (e.g. by number of simulated near misses or near collisions or deviation from regulations)

Fatigue, Experiments and Evaluation

- Exact methodology for experiments (WP4) and Evaluation (WP6) still to be decided upon. We are at a ‘fact finding’ stage in order to find the best methods for the domain.
- Ship visit (tomorrow) will help decide and focus methodology choices.
- At present, there are various directions we could go.

Fatigue, Experiments and Evaluation

- Ways of assessing fatigue:
  - **Performance tasks**: Simple reaction tasks, conducted on laptops or smart phones can indicate fatigue e.g. slower responses. These tasks can be performed at intervals during testing, or before and after. Before and After testing allows you to assess the demand of a task.
  - **Subjective reporting**: Questionnaire measures provide a valuable measure of fatigue. Scales such as the Profile of Fatigue Related Symptoms (PRFS) or the Karolinska Sleepiness Scale (KSS) can be used.
  - **Physiological measurement:** Parameters such as eye blinking can be used to assess fatigue.
  - **Situational Awareness:** When fatigued, peoples' situational awareness decreases. Various tasks exist to assess situational awareness e.g. vigilance / memory tasks.

Fatigue, Experiments and Evaluation

- The work packages (as currently envisioned):
  - **WP4: Bridge Experiments**

    Likely to be task-analysis orientated. We will use a full-mission simulator to answer questions relevant to the design of the new bridge e.g. how often do seafarers check ECDIS per hour when crossing a busy shipping lane?

  - **WP6: Evaluation**

    This is where we will assess the new adaptive bridge design against a standard baseline design. Fatigue could feature in one of three ways:

1. Simply a way of increasing realism (many seafarers are tired)
2. A means of increasing errors so that the bridges can be compared.
3. As an outcome measure to indicate level of work demand.

Risk models: Adopted methodology for development of risk models

Evaluation in CASCADe will be perfomed in a parallel process:

- evaluate the new Adaptive Bridge System with real seafarer in simulator experiments according to the scenarios
- evaluate the predictive capability of the Virtual Demonstrator with Cognitive Seafarer Models and simulation of the bridge as a cooperative system
  - cognitive models of human agents: formalised characteristics of cognitive processes involved in safety critical task performance
  - design support can be created by using accurate models of cognitive (normative and non-normative) behaviour

Simulation Platforms

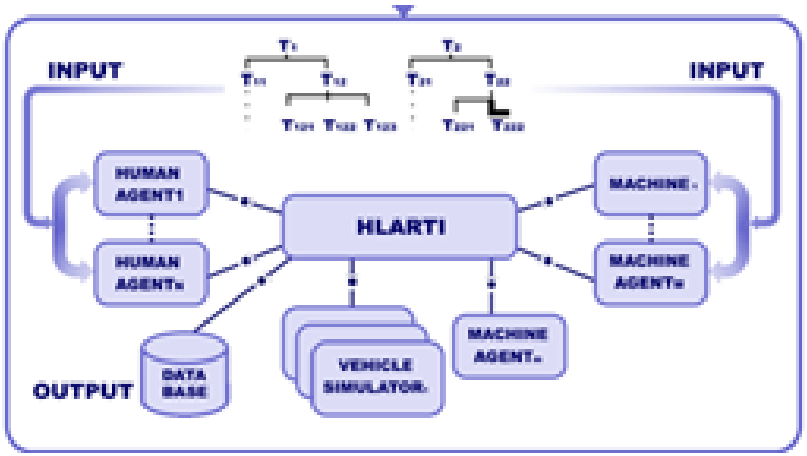
Physical Simulation Platform

hardware, software and humans
based on the full-scale bridge simulator

≈

behaviourally equivalent

Virtual Simulation Platform



purely based on models of the human and machine agents, tasks, resources

The **Virtual Simulation Platform** will allow:

- to evaluate bridge designs at early design stages using cognitive models,
- in many more scenarios than the Physical Simulation Platform,
- investigation of extreme scenarios that would be difficult to evaluate on the physical platform.

Cognitive Models as Virtual Seafarer