

# **ASTRA**

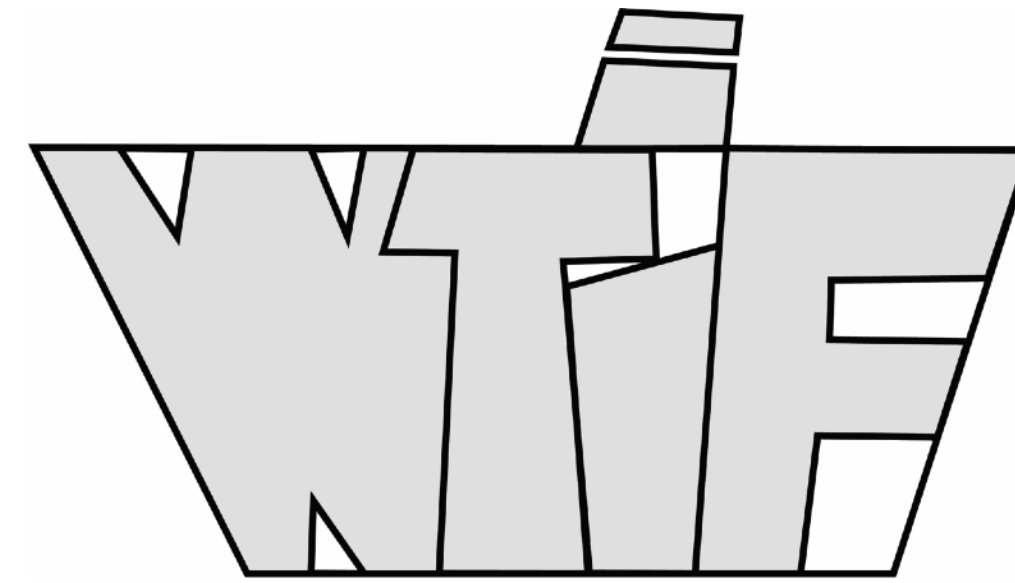
**A tool for Strategic Risk Assessment for the waterways based on the principles-driven method**

Jakub Montewka

**IWRAP Super user seminar, online 27.02.2024**

# Project consortium

- **Waterborne Transport Innovation - PL**
- **Gdynia Maritime University - PL**
- **NavSim Technology - PL**
- **Özyeğin University - TR**



<http://astra-project.wtif.pl/>

The presented research have been carried out in the context of two research projects under MarTERA ERA-NET Cofund, funded by The National Center for Research and Development in Poland A tool for STrategic Risk Assessment for the waterways based on the principles-driven method - ASTRA, contract no. MarTERA4/1/10/ASTRA/2023.



# Background

- Maritime authorities need to run periodic risk assessment ensuring the risk of accident remains within the acceptable boundaries.
- However, the majority of the methods used nowadays consider maritime traffic in a static or quasi-static manner, linking the accident probability with traffic density and individual ship characteristics.
- While often limiting the **influence of traffic or waterway complexity** and **environmental** factors **on human performance**, thus, accident probability. Additionally, they usually focus on open sea and coastal navigation, while they exclude inland and restricted navigation.

# Objective

- To bridge this gap, ASTRA develops **a novel method and tool for all parties interested in diagnostic assessment of maritime traffic.**
- The tool intends to measure the risk with the use of **the accident potential** for a given sea area based on relevant and observable variables.
- The latter, being the main drivers for **the human performance** in accident evasive actions, encompass: complexities of waterway, traffic and environment, as well as ship manoeuvrability.

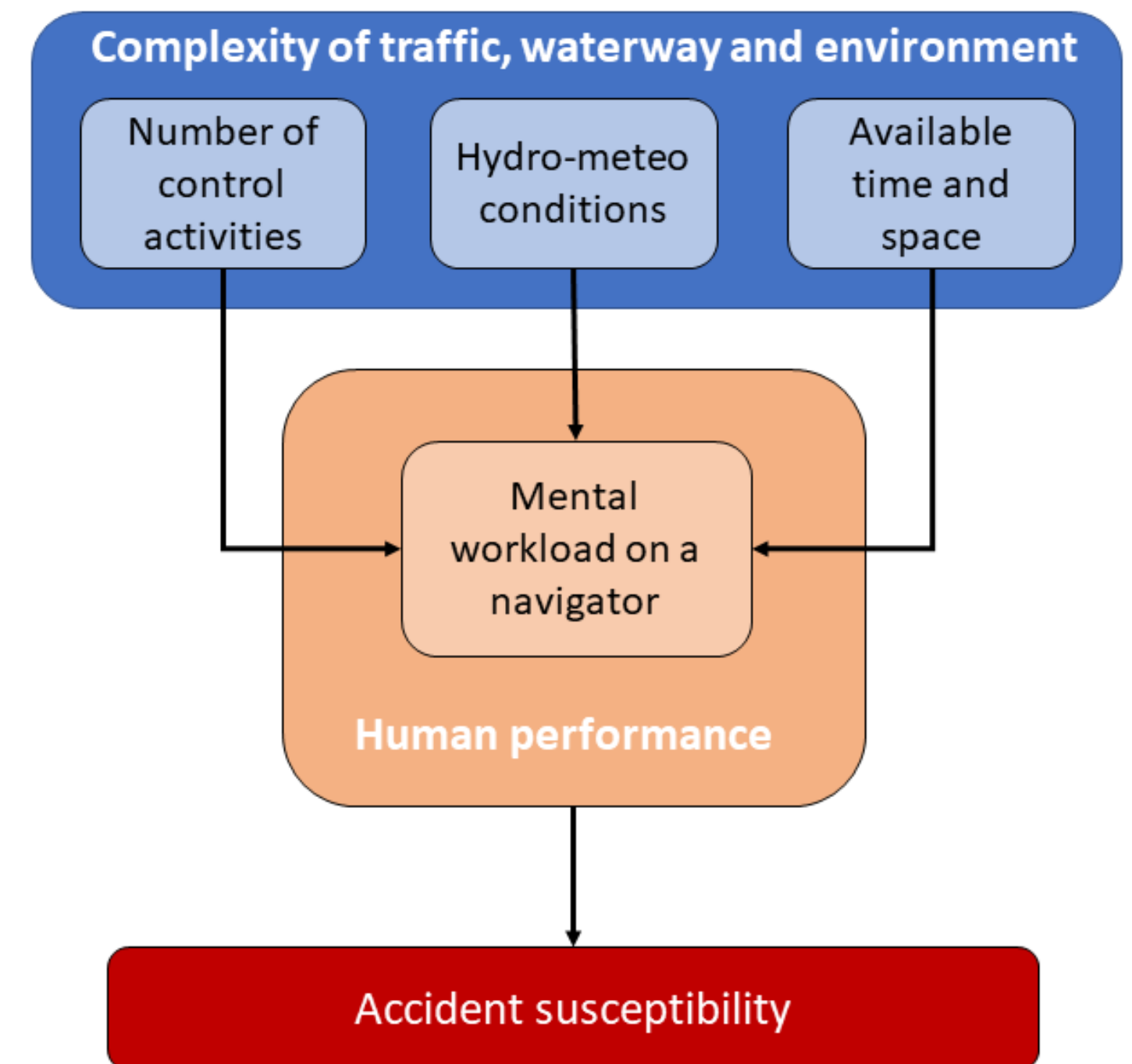
# Methods

## The overall framework

It evaluates accident susceptibility for a ship in operation in a semi-qualitative manner, **based on human performance** and underlying factors.

The literature on Human Reliability Analysis (HRA) presents an inverse relation between human performance and accident probability. While the human performance is affected by the so-called performance shaping factors (PSF).

Two PSFs are considered in the accident susceptibility framework presented here: **a number of simultaneous tasks** and **available time**.



A causal chain explaining the relation between PSFs, mental workload, human performance and accident susceptibility

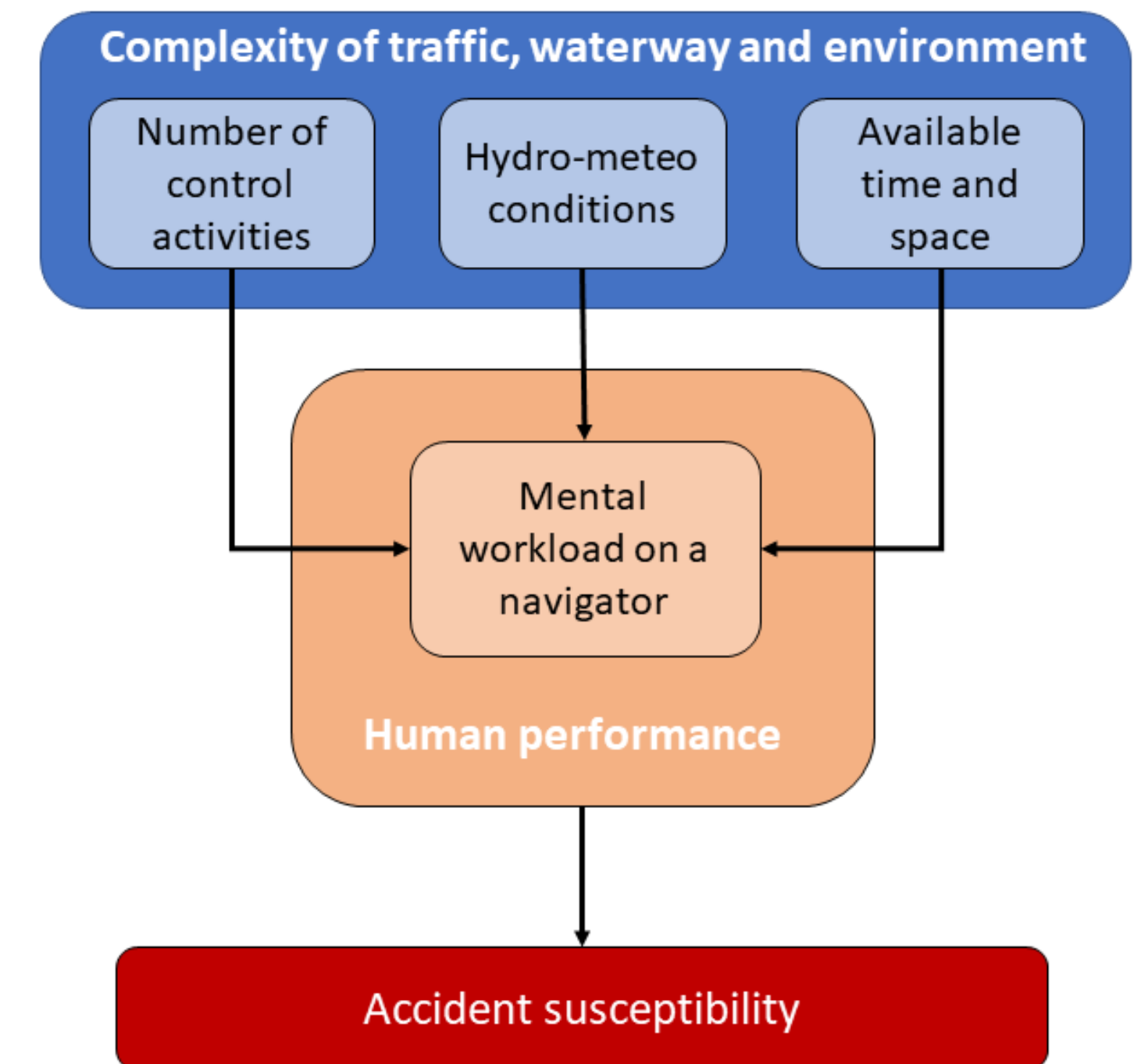
# Methods

## The overall framework

The higher number of control activities that need to be performed simultaneously, or in a short time span, and the smaller maneuvering space available for the ship, **the higher is the workload.**

This in turn **increases the probability** of navigation errors and an accident happening.

**These chances are further amplified** by the presence of unfavourable hydro-meteorological conditions, which require additional tasks, such as monitoring and adjusting the response of a ship to wind and wave action or anticipating the effect of those during evasive maneuvers.



A causal chain explaining the relation between PSFs, mental workload, human performance and accident susceptibility

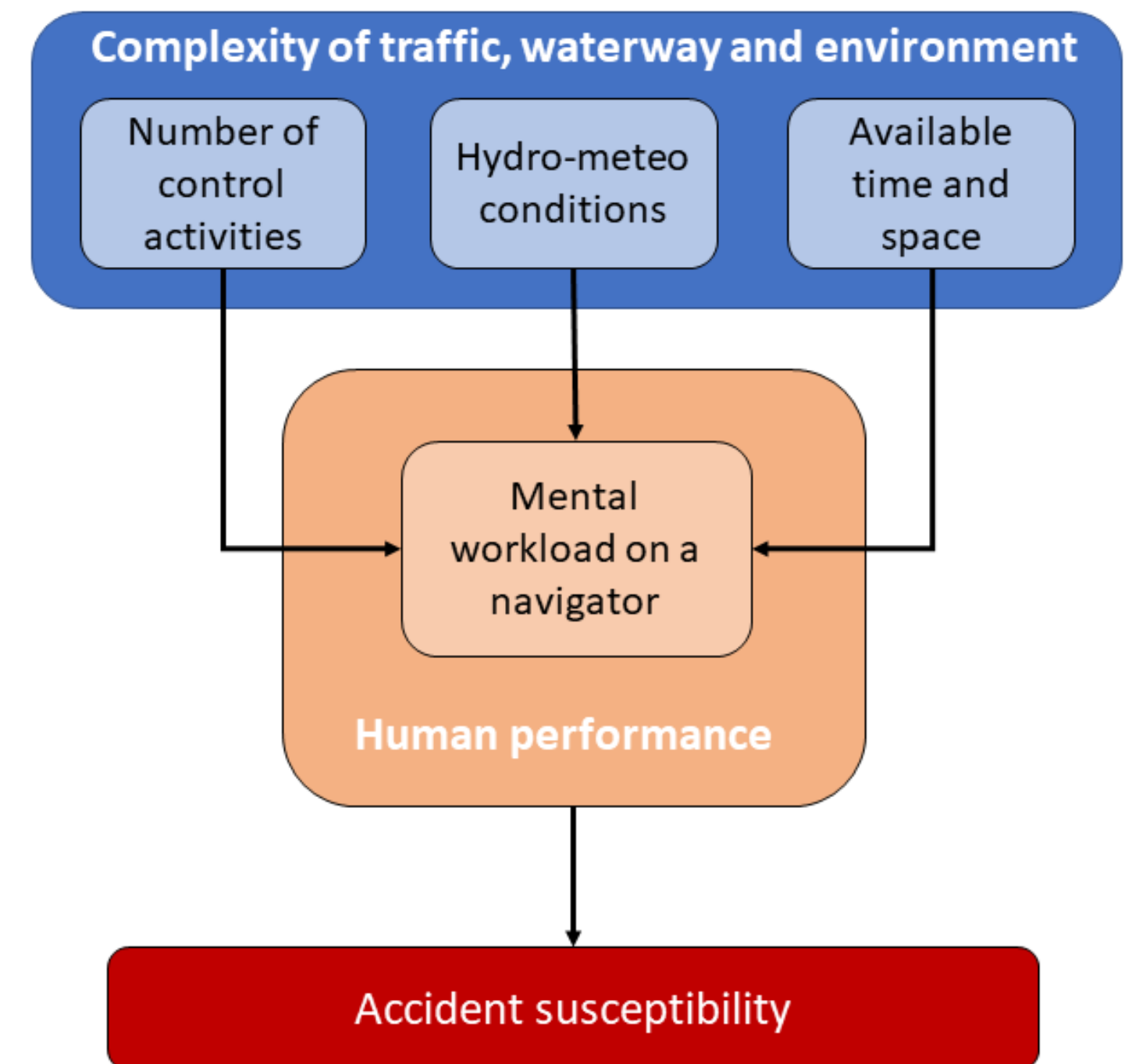
# Methods

## The overall framework

The two PSFs - **the number of simultaneous tasks** and **available time** are governed by the following three distinctive characteristics of an encounter at sea:

- available maneuvering space with respect to navigable waters;
- number and types of encounters with objects on collision courses;
- hydro-meteorological conditions.

The three distinctive characteristics of encounter situation affecting a navigator's workload and performance are referred to as **complexities**, related to waterway, traffic and environment.

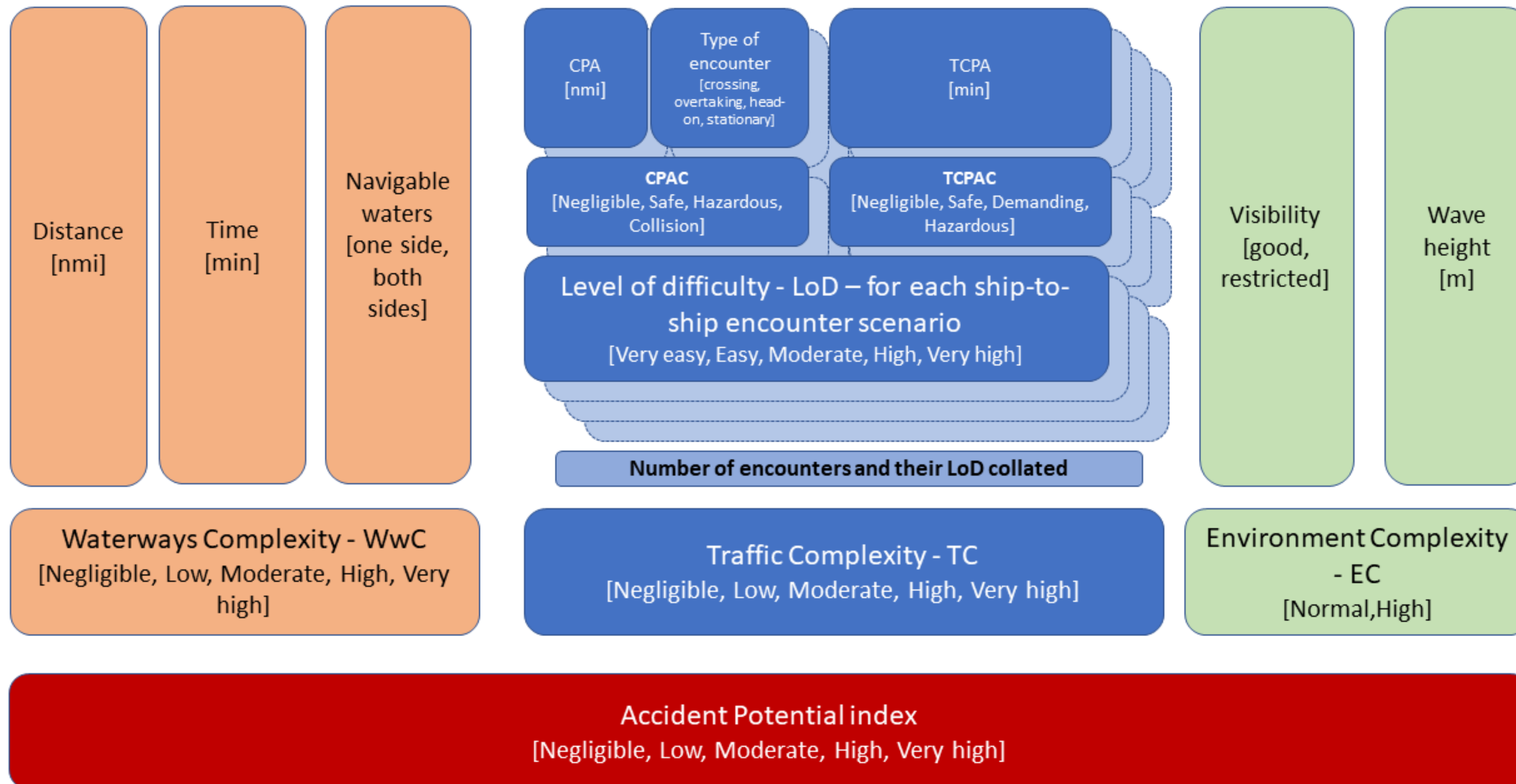


A causal chain explaining the relation between PSFs, mental workload, human performance and accident susceptibility

# Methods



## The overall framework - the complexities

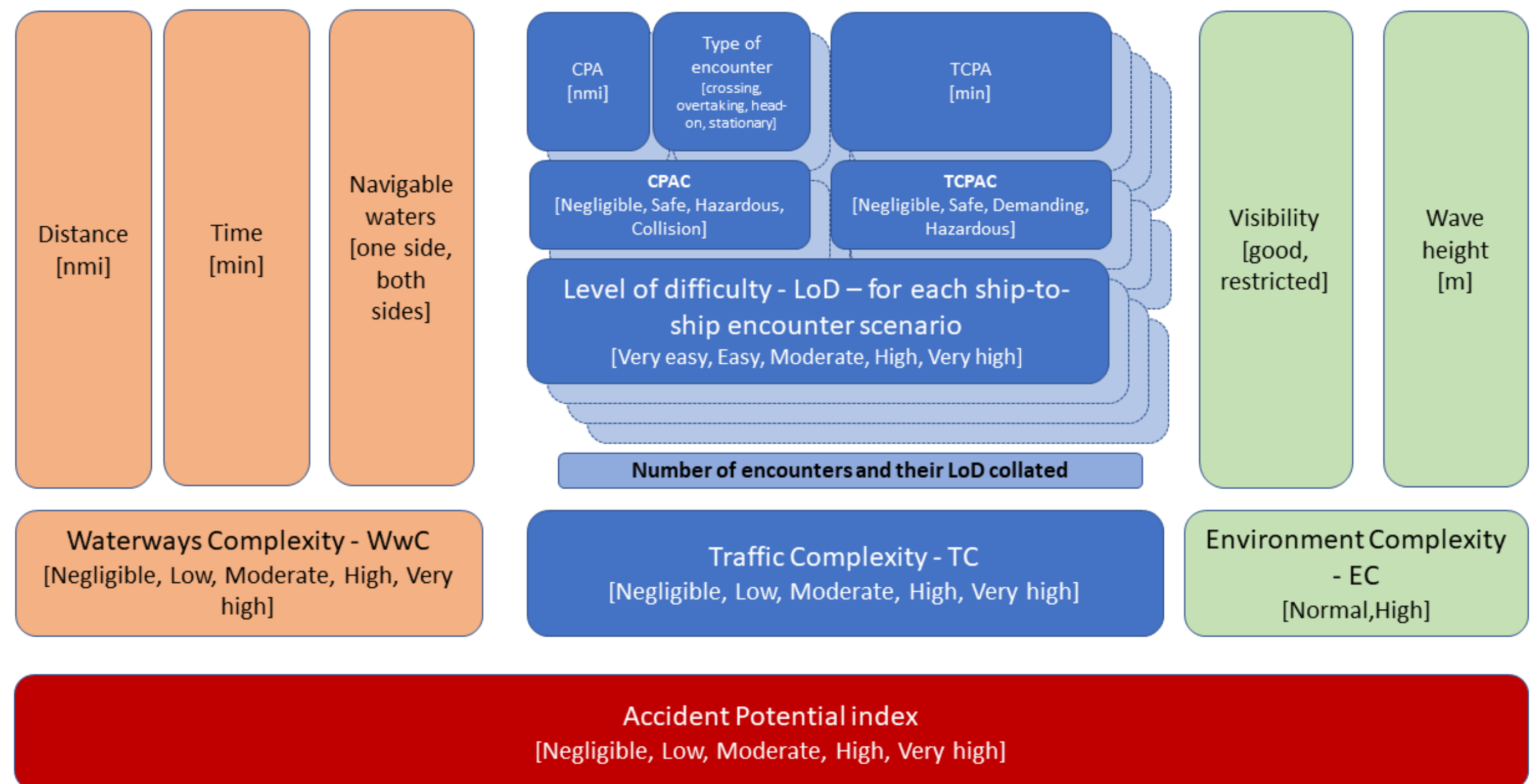




# Methods

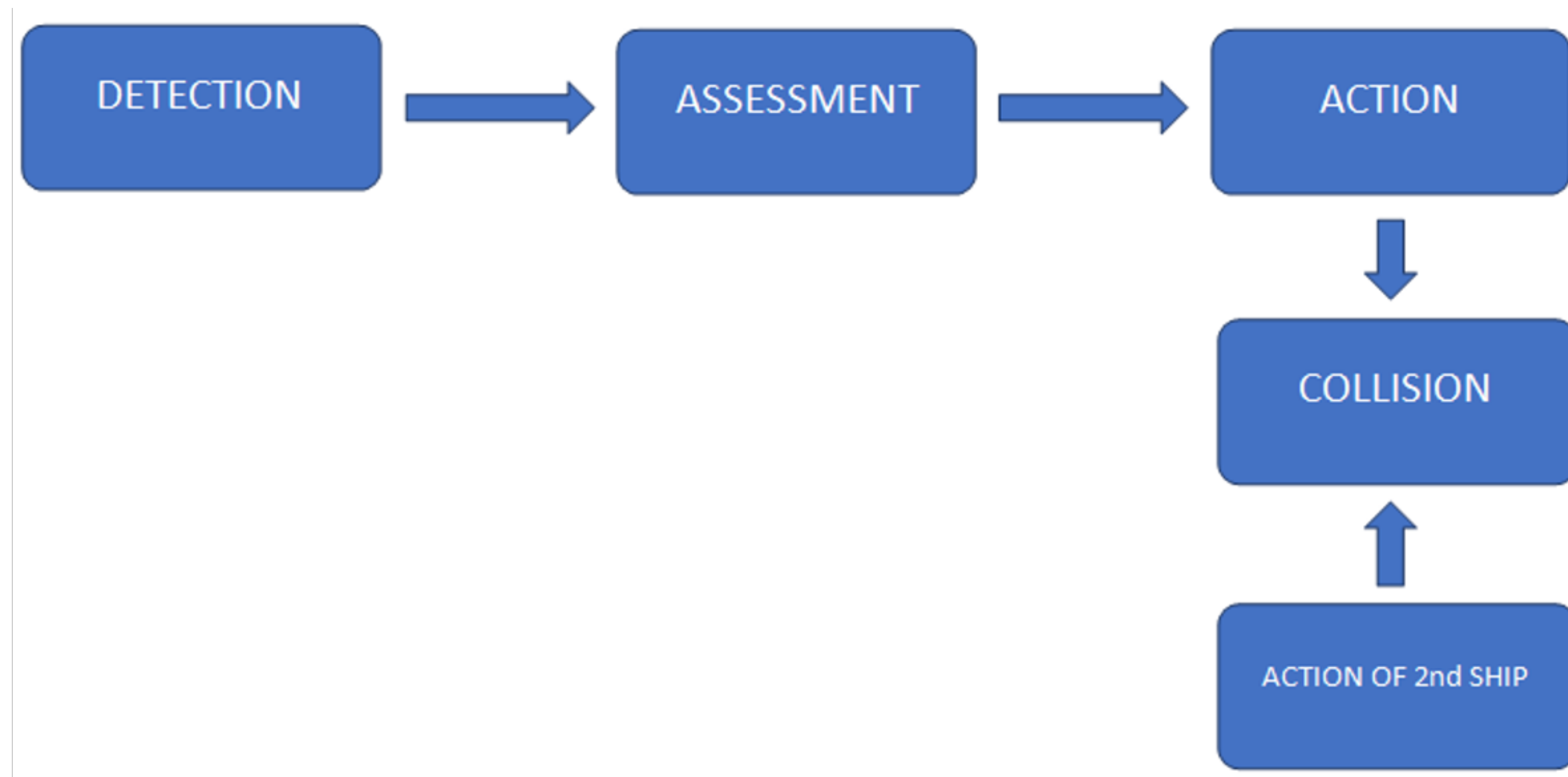
## The overall framework

Since the literature supports the presence of compensatory strategies for increasing complexity through individual differences and cognitive strategies or quality of equipment, the proposed framework allows for those through adjustments of the parameters and application of probabilistic tools for reasoning, such as Bayesian Networks.



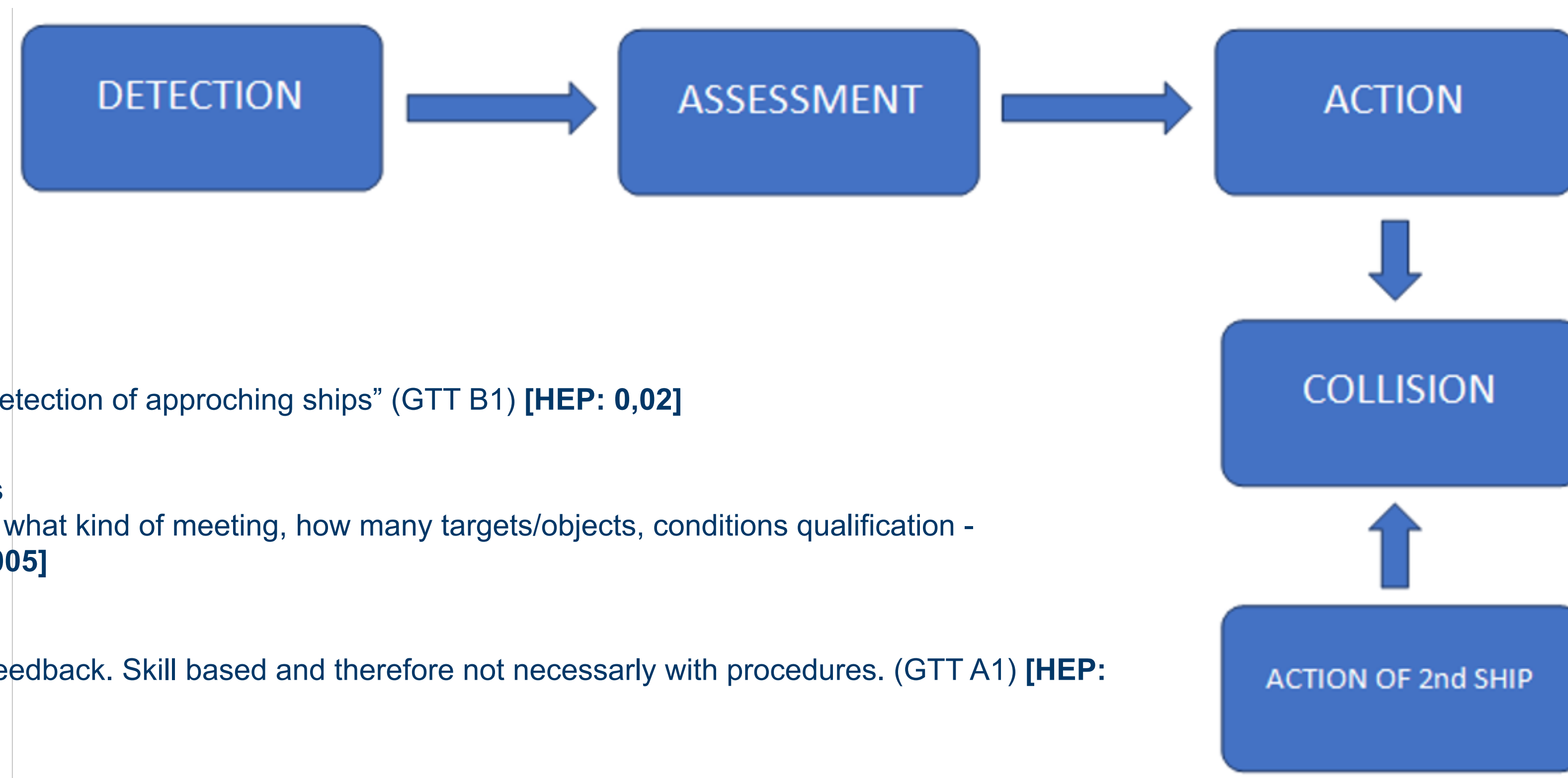
# Model

Stages of encounter with another ship or stationary object – based on NARA guidelines



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Stages of encounter with another ship or stationary object – based on NARA guidelines



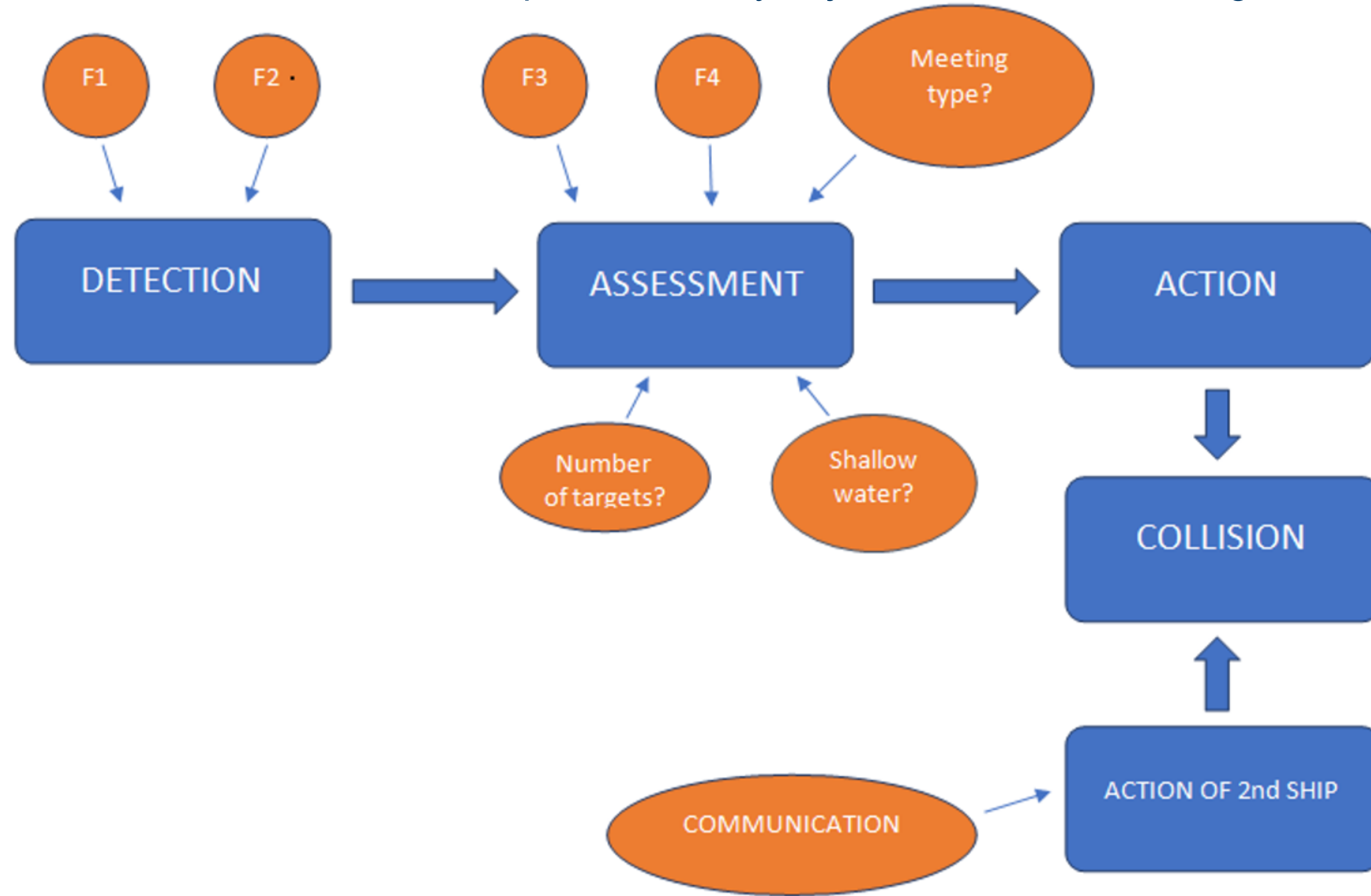
**Detection –**  
„routine check of ship „status”, detection of approaching ships” (GTT B1) [HEP: 0,02]

**Assessment –** simple diagnosis  
„response to alarms/indications, what kind of meeting, how many targets/objects, conditions qualification - complexity (GTT C1) [HEP: 0,0005]

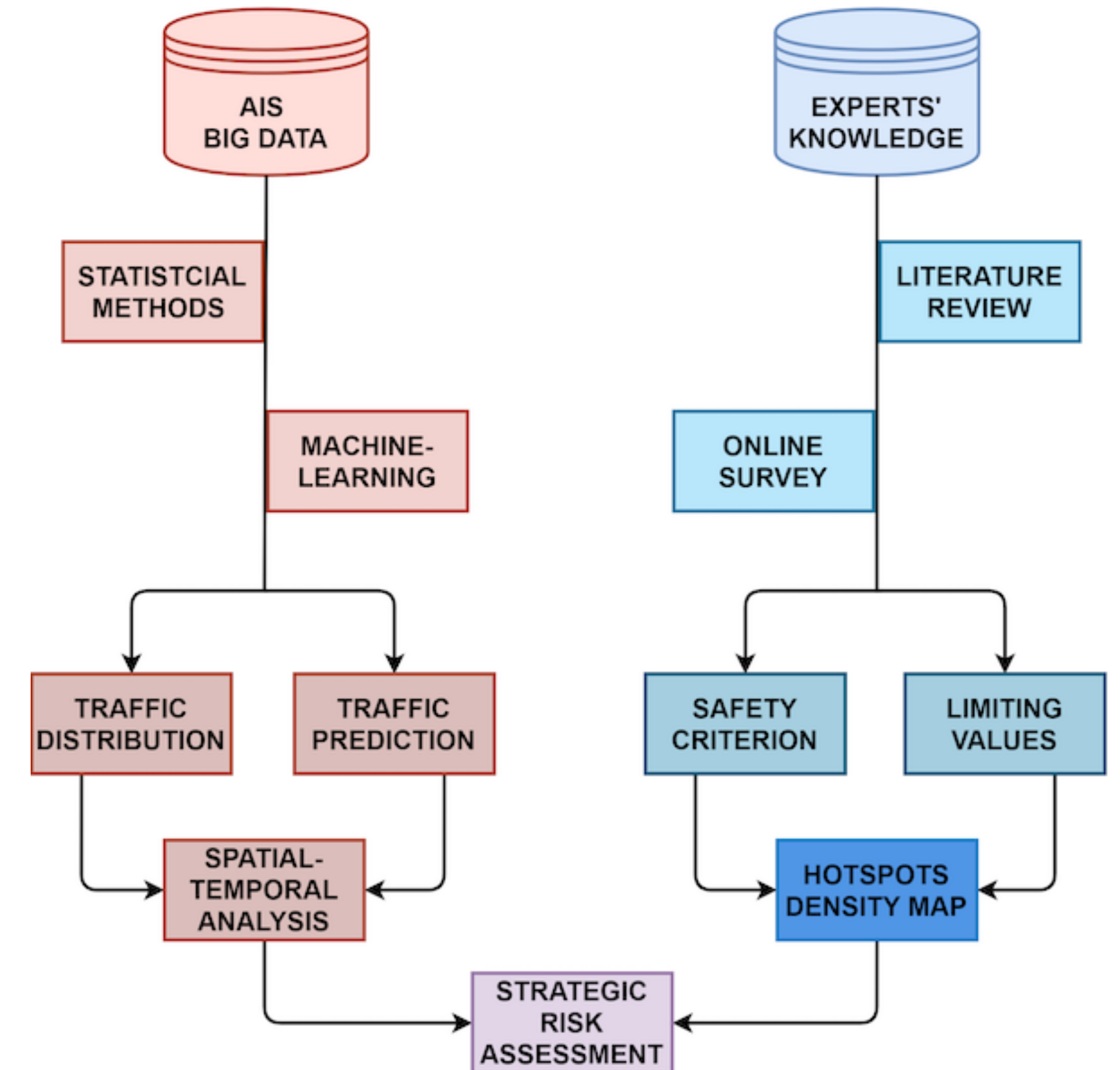
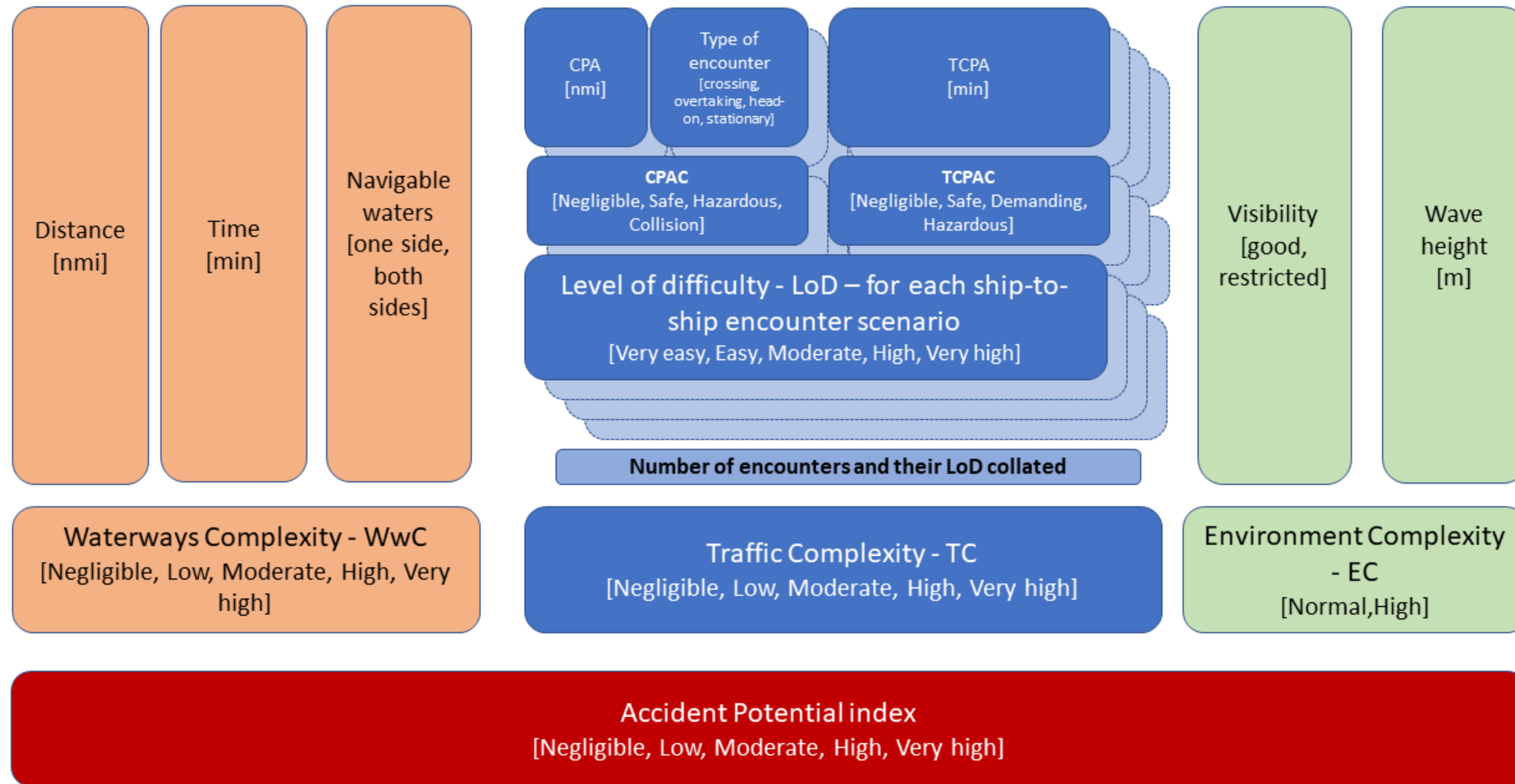
**Action –**  
„Carry out a simple action with feedback. Skill based and therefore not necessarily with procedures. (GTT A1) [HEP: 0,005]

# Model

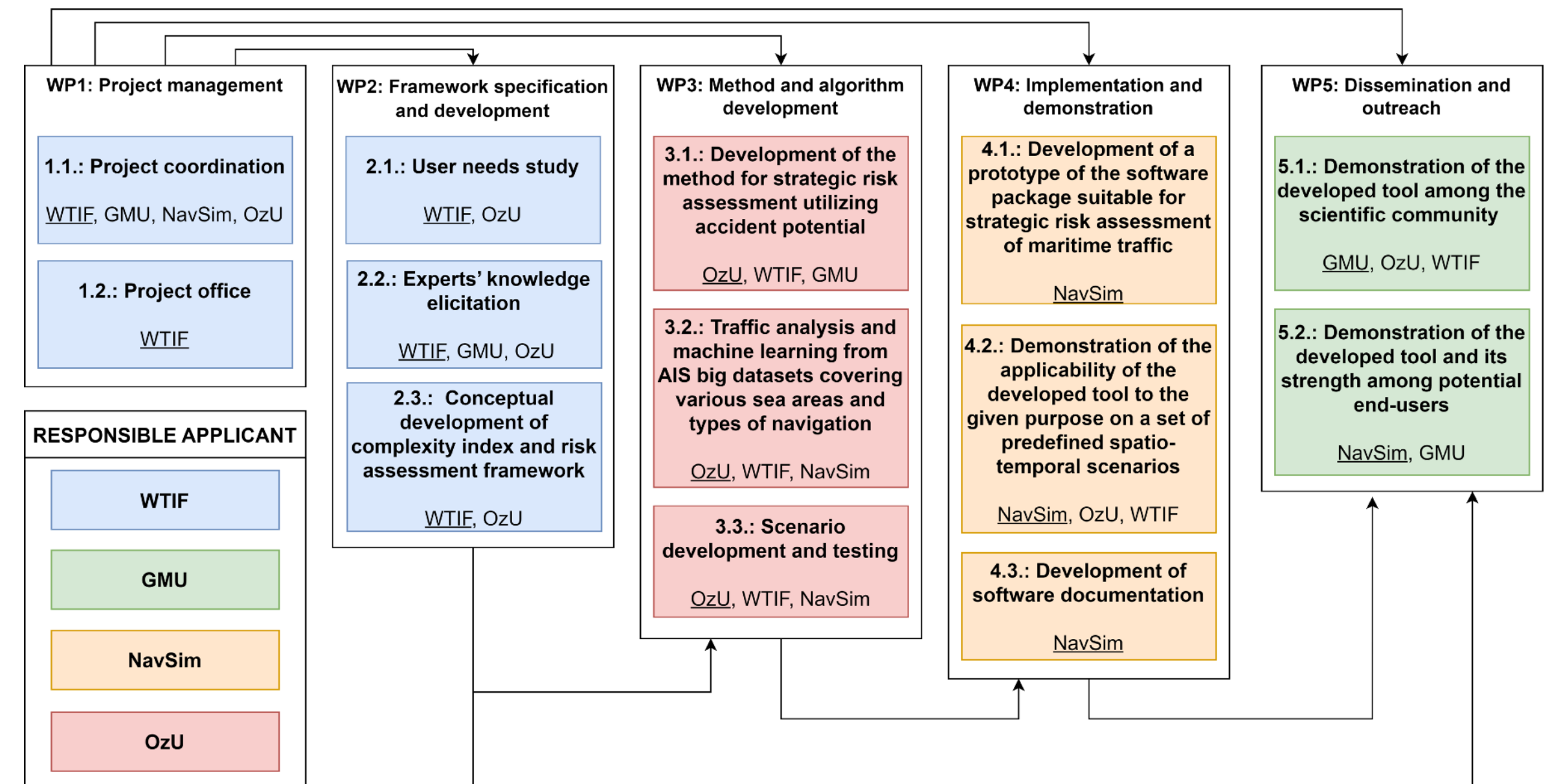
Stages of encounter with another ship or stationary object – based on NARA guidelines



# Workplan



# Work packages distribution



We are here

## Gantt chart



# Exploitation plan

- The newly developed product that is expected as an outcome of this project will extend the application, as well as methods offered by tools and software currently available on the market.
- Turning this project results into a commercial product is an important element of the consortium's exploitation plan. NavSim Poland Ltd. (NavSim), in close cooperation with other members of the consortium, will be leading the commercialization efforts, which will include implementation of the developed algorithms and methods into an operational tool and eventually preparing it as a complete and marketable product.
- Based on the consortium members' market experience, we believe that the results of the ASTRA project are characterized by high commercialization potential. We are strongly committed to prepare a marketable solution, which could be used by maritime authorities, port authorities, manufacturers of the maritime autonomous surface ships, insurers, and other agents concerned with vessel traffic risk assessment and management.

# Dissemination activities

- At least two papers will be published in renowned scientific journals, such as Reliability Engineering and System Safety, Ocean Engineering or The Journal of Navigation. The results of the ongoing work will be presented during renowned and relevant scientific conferences such as European Safety and Reliability Conference (ESREL), TransNav.
- The developed tool will be presented to relevant authorities, such as Polish Register of Shipping, national maritime authorities or international organizations such as IALA. Professional promoting campaign for the ASTRA tool will be developed and made worldwide available through the dedicated internet channel.
- The tool will be promoted equally in scientific and industrial communities, since both will benefit from the developed method, algorithm and product.



# Thank you

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