AUTOMATED NAVIGATION

Definition of levels of automation in inland navigation

PRELIMINARY DEFINITIONS

"DYNAMIC NAVIGATION TASKS"

are understood as the set of tactical vessel operations, such as operation of rudder apparatus, propulsion, anchor winches or elevating wheelhouse. The complexity of these tasks is dependent upon the context considered (for example, the manipulation of anchor winches can be excluded from a context, where the use of anchors is forbidden anyway).

"NAVIGATIONAL ENVIRONMENT"

is understood as fixed and dynamic conditions such as the waterways' shape, water level, weather, visibility, vessel crossing, ... The navigation automation system can use only part of the information available (for example, under level 1, rate-of-turn indicators do not use information on vessel crossing). The response to the navigational environment includes the radiocommunication with boatmasters of other vessels.

"CONTEXT-SPECIFIC"

is understood as confined navigational conditions such as navigation on specific river waterway sections or lock crossing, as well as vessel arrangements with convoys or platooning. The context includes infrastructure relevant for automation, for example type and capacity of radio transmission networks.

"COLLISION AVOIDANCE"

is the critical task in responding to the environmental conditions (other vessels, bridges, ...).

https://automation.ccr-zkr.org

CCNR
CENTRAL COMMISSION
FOR THE NAVIGATION OF THE RHINE

	Level	Designation	Vessel command (steering, propulsion, wheelhouse, …)	Monitoring of and responding to navigational environment	Fallback performance of dynamic navigation tasks	Remote control
BOATMASTER PERFORMS PART OR ALL OF THE DYNAMIC NAVIGATION TASKS	0	**NO AUTOMATION** the full-time performance by the human boatmaster of all aspects of the dynamic navigation tasks, even when supported by warning or intervention systems *E.g. navigation with support of radar installation*				No
	1	**STEERING ASSISTANCE** the context-specific performance by a steering automation system using certain information about the navigational environment and with the expectation that the human boatmaster performs all remaining aspects of the dynamic navigation tasks *E.g. rate-of-turn regulator* *E.g. trackpilot (track-keeping system for inland vessels along pre-defined guiding lines)*				
	2	**PARTIAL AUTOMATION** the context-specific performance by a navigation automation system of both steering and propulsion using certain information about the navigational environment and with the expectation that the human boatmaster performs all remaining aspects of the dynamic navigation tasks				Subject to context specific execution, remote control is possible (vessel command, monitoring of and responding to navigational environment and fallback performance). It may have an influence on crew requirements (number or qualification).
SYSTEM PERFORMS THE ENTIRE DYNAMIC NAVIGATION TASKS (WHEN ENGAGED)	3	**CONDITIONAL AUTOMATION** the sustained context-specific performance by a navigation automation system of all dynamic navigation tasks, including collision avoidance, with the expectation that the human boatmaster will be receptive to requests to intervene and to system failures and will respond appropriately				
	4	**HIGH AUTOMATION** the sustained context-specific performance by a navigation automation system of all dynamic navigation tasks and fallback performance, without expecting a human boatmaster responding to a request to intervene[1] *E.g. vessel operating on a canal section between two successive locks (environment well known), but the automation system is not able to manage alone the passage through the lock (requiring human intervention)*				
	5	**AUTONOMOUS = FULL AUTOMATION** the sustained and unconditional performance by a navigation automation system of all dynamic navigation tasks and fallback performance, without expecting a human boatmaster responding to a request to intervene				

[1] This level introduces two different functionalities: the ability of "normal" operation without expecting human intervention and the exhaustive fallback performance. Two sub-levels could be envisaged.