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VOYAGE PLANNING IN ECDIS

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1. INTRODUCTION

The **aim** of this paper is to emphasize the need for a structured approach to the development of tools for navigation support in ECDIS. To this purpose this paper focuses on voyage planning in ECDIS, outlining a more formal approach, to provide a basis for the development of tools for automated navigation support.

The outline of this paper is as follows:

First it will present some considerations regarding the development of ECDIS functionality,

- then it will get into a definition of voyage **planning,**
- followed by a conceptual framework of **integrated navigation**, which is then used as
- the basis for a more detailed look into the **voyage-planning** process.
- This is followed by an impression of what could be envisaged as automated support tools for voyage planning.
- Some concluding remarks are made in the final paragraph.

2. ECDIS AND NAVIGATION SUPPORT

The electronic chart development started with the sole purpose of replacing the paper chart. Soon it was realised that the electronic chart functionality

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could be expanded to a navigation information system; the name changed from electronic chart into electronic chart display and information system, ECDIS. However, the term 'information system' can still be interpreted as a system which is simply able to display the stored data. In that case the discussion is reduced to the selection of data to be stored, the data structure and the symbology or display format. This basic interpretation does not lead to much added value. The added value improves significantly when the system integrates the available data into improved information products. This synergistic approach usually requires the data to be structured into objects and attributes which can be used in processing algorithms. The real value of ECDIS is determined by its synergism.

When designing support tools we tend to ask the practitioner what he requires. Often however the practitioner is focused on the current procedures and the workload involved. The result may easily be the development of a support tool which in essence is an automated replica of the manual procedure, thus failing to improve the solution because the underlying issue was not identified. Development of support tools should therefore be based on a thorough analysis of the problem to be solved. It should also be borne in mind that the tool should fit into the logical process it is supposed to support, i.e. the tool should provide the required information with the information available in that phase of the process.

The latest report of the workshop on development of Marine Information Objects (MIO) for ECDIS [ECDIS/MIO] showed some of the aforementioned in the resulting recommendations.

The point that is made here, however, is that the development of navigation support tools for ECDIS is rather a result of individual ideas than the results of a structured analysis of the navigation process. It is the author's view that the development of new ECDIS functionality should be founded on some reference-model of the navigation process, identifying logical structure and processes eligible for automated support, possibly including agreed priorities. Manufacturers could then focus their efforts to substantiate the identified functionality, standardisation forums could concentrate on the required data structures, and data suppliers could focus on providing the required data in the required structure in order of the agreed priorities.

The next paragraphs will focus on voyage planning as an area eligible for automated support by ECDIS.

3. VOYAGE PLANNING

3.1 Voyage Planning defined

Voyage planning can be defined as:

the systematic process in which a sailing order is translated into an optimal navigation plan and detailed navigation scenario to fulfil the mission, having considered all relevant information.

The sailing order may differ for the different user groups: transport, fishery, offshore, navy, coastguard et cetera, but there will generally be a mission element and a constraints element that are to be satisfied by the voyage plan. Often the constraints are defined in terms of time, or economy, but they may also include criteria such as ship's motion or temperature constraints.

Voyage Planning is meant to provide:

- Prevention of potential conflicts or dangerous situations;
- Optimisation of planning for specific planning factors;
- A detailed scenario for the execution;
- A reference to compare the actual voyage progression with the planned progression.

Typical of voyage planning is the great diversity of data to be collected, consulted and integrated into both the overall voyage plan, and the detailed navigation scenario for every watch.

3.2 Voyage Plan and Integrated Navigation

This paragraph aims to identify voyage planning in the context of an integrated navigation system. Navigation can be defined as the process of controlling the movement of a craft from one state (position, course, speed, etc.) to another state, under predefined conditions.

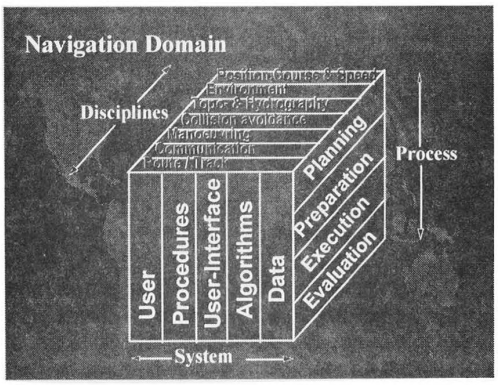

Fig. - 1: The Navigation Domain

From the perspective of elementary **navigation disciplines** (Fig. 1), this definition encompasses a broad variety of subjects, ranging from positioning, meteorology, tides, tidal stream, ocean current, hydrography and topography to anti-collision regulations, communication and ship manoeuvring .

From the **process perspective** navigation is comprised of the consecutive phases of planning, watch preparation, watch execution, and evaluation.

There is also the **system perspective** where we can discern the elements of data, algorithms, user-interface, procedures and the navigator.

With this cube-like model (Fig.1) of the navigation domain in mind we can discern various sorts of system integration. First there is integration of different navigation disciplines, which we could refer to as synergistic integration. Then there is the integration across the various phases of the navigation process, where the products of each navigation phase could be transferred to the next phases. In the system dimension integration is concerned with the allocation of tasks to either the system or the user, based on human factors methodology. In the data segment integration is concerned with data models, data standards and data quality.

In view of the focus of this presentation I will not go into a detailed discussion of integrated navigation. The remainder of this presentation will focus on voyage planning, being the first two phases of the navigation process, across all the disciplines and all segments of the system perspective.

3.3 Voyage Planning Process

The present standard for voyage planning is laid down in the IMO Guide to the Planning and Conduct of passages. This standard discerns the phases of Appraisal, Planning, Execution and Monitoring. Reading this document provides a good impression of the factors to take into consideration. However, the document does not provide a clear picture of the logical structure of the process, the interrelationships of the various aspects to consider, the questions to be answered, and the products resulting from each phase. It is a listing of reminders and things-to-do without logical structure or sequence. Therefore the document does not provide a basis which is sufficient for the development of coherent automated support tools for voyage planning.

Voyage planning is not a straightforward process which leads to the correct answer. It is much more a search through a wide variety of, often time-variant, information in many different publications. The navigator's task is to identify and comprehend the most important aspects to develop his voyage plan. In doing so he is repeatedly revisiting these aspects at an increasing level of detail while at the same time the voyage plan develops.

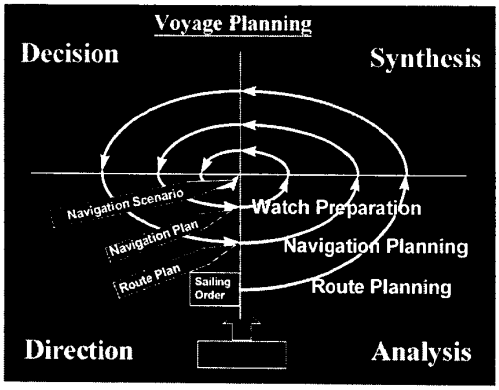

Fig. - 2: Voyage Planning Process

Voyage planning can be seen as an iterative cyclical process, (Fig.-2) as represented by a spiral model, with a standard logical structure and a clearly defined product for every cycle. Each product serves as a directive for the next cycle. The first cycle, *route planning*, is concerned with selecting the best route; the product is the **route plan**, an outline description of the route which is feasible within the constraints provided in the sailing order.

The second cycle, *navigation planning*, is concerned with the question how to navigate the selected route: the precise track to follow, the associated safety margins, track deviation tolerances, the overall time schedule and the navigation procedures for the different phases of the voyage (Fig.2).

The resulting **navigation plan** should provide guidance for every officer of the watch to independently carry out his *watch preparation* resulting in a fully detailed **navigation scenario** for his watch.

Theoretically speaking each cycle as aforementioned consists of the consecutive phases of *analysis*, *synthesis*, *decision*, and *direction* for the next cycle. The analysis-phase starts with the basic issues such as: what is required, within which constraints, which information is required, what does that information indicate. In the synthesis-phase options are generated and considered. Next the plan is finalised in the decision-phase and worked out to the required detail in the direction phase in order to serve as a reference directive for the next phase.

This formal description of the voyage planning process may seem very theoretical to the navigation practitioner. However, the experienced navigator may well recognise the essential ingredients in the procedure he personally developed over the years. This theoretical procedure is not meant to be formally implemented in full detail in the daily navigation practice. It is meant to provide the basis for development of automated tools to support the voyage planning process.

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