Measuring Behavior in Complex Maritime Operations

Heidi Seljestad **John Ferkingstad** **Tone Sydnes**

Gisle Kleppe **Vidar Frette**
vidar.frette@hsh.no

Stord/Haugesund University College
Bjoernsons gate 45, N-5528 Haugesund, Norway

ABSTRACT
We deal with complexity in maritime operations, through data collection that allows analysis of human behavior and interaction. We have focused on bridge systems, in particular those that incorporate equipment for Dynamic Positioning (DP). Our empirical study has been based on simulator training of professional operators. The training set-up included stress-causing factors, with increased demands on the operators' situation awareness. The imposed situation variables as well as the resulting behavior and performance were recorded by qualitative and quantitative methods.

Author Keywords
Maritime operations, simulator training, offshore vessels, complex tasks and processes, MTO.

INTRODUCTION

On board advanced ships used in fields such as offshore oil exploration, operators are faced with increasingly more complex bridge systems. Most bridge systems today have equipment for Dynamic Positioning (DP).

Dynamic Positioning

DP is a method to keep ships and semi submersible rigs in a fixed position using the propulsion systems instead of anchors. It may also be used for sailing a vessel from one position to another along a predefined route. Like an autopilot on a plane, DP may operate without human interaction. The method relies on accurate determination of position from external reference systems such as the Global Positioning System (GPS).

Some offshore operations involve long standby periods on DP without active participation from the operators. This can lead to passivity and fatigue, a well-known phenomenon in the sector. Periods of mental underload may reduce the operators' ability to handle demanding situations [3].

Simulator Training

Due to the large risks involved, compulsory simulator training is an integrated part of education for DP operators. We have studied the behavior of participants in regular DP simulator courses. These course participants all had experience from offshore operations. Simulator sessions are what Salas et al. [1] call Synthetic Task Environments, simplified situations that are more accessible to research than the complex real-life cases.

RESEARCH TOPIC

We are interested in the complex interaction between Man, Technology, and Organization (MTO) in demanding situations on a ship's bridge. These situations may arise due to the complexity of the operations, short distance to other vessels or installations, weather and sea conditions, and equipment failures. The information processing perspective, applied to both individual and team behavior, is important in our approach [2].

We have studied how DP operators handle situations with loss of position reference systems during simulator training. The exercise given to the course participants were to take

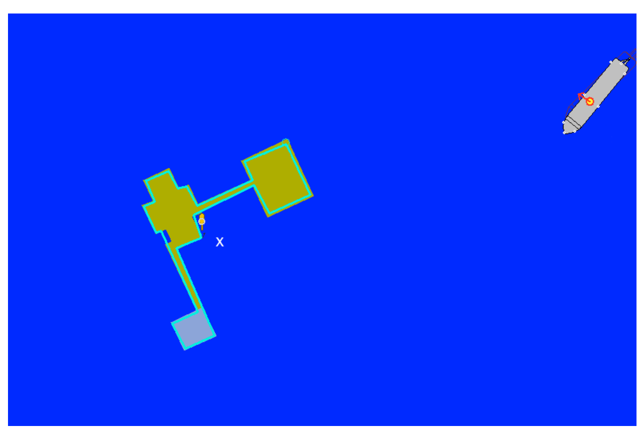

Figure 1. The figure shows three platforms connected by bridges (in the middle) and an approaching ship (to the right).

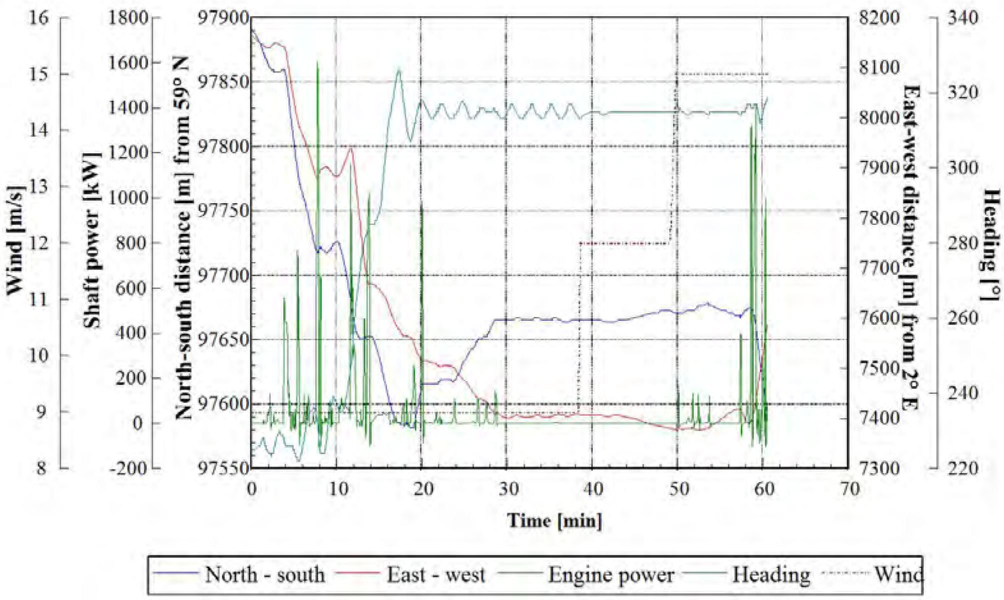

Figure 2. Example of maneuvering history.

the vessel from one given position to a new one close to platforms (marked by a cross in Figure 1). At this new position, a subsea survey was carried out. However, the position reference systems were at this point intentionally blocked by the instructor. Simultaneously, the wind speed was increased. The operators needed to keep the vessel in position during the survey. We monitored, qualitatively and quantitatively, how the operators handled this emergency situation.

DATA COLLECTION

The operators' reactions to the position reference fall-out and changed weather conditions were recorded by three methods: qualitative observations, post-session interviews, and maneuvering history recorded by the simulator software. Only course participants that gave their consent, were included in the experiments.

Observations

During each simulator session (approximately 1 hour) we observed continuously the bridge team. We looked for changed behavior as the new, demanding conditions were introduced: In some cases, communication in the team was reduced, in others we observed reduced small-talk and more professional discussions. We also observed changes in body language, for instance, one participant repeatedly lifted his cap.

Interviews

After the simulator session, we carried out interviews with the participants. We asked how they evaluated their own performance and the problem-solving process. Their evaluation of simulator training, as compared to real-life situations, was also of interest. Furthermore, we asked them to describe their subjective experience of stress. In addition, we interviewed the simulator instructors. We asked them, as experts, to evaluate the quality of the job performance of each group.

All interviews were recorded and transcribed, provided that informed consent was given.

Maneuvering History

The simulator software continuously recorded vessel position, heading, instantaneous engine power, speed, rudder direction etc; as well as environmental parameters like speed and direction of wind and current.

An example is shown in Figure 2, where position, engine power and wind speed are shown. Horizontal position curves correspond to the period when the vessel conducted a subsea survey near the platforms, see Figure 1.

DATA PROCESSING

The different kinds of data described above give information about several aspects of the exercise process.

The recorded maneuvering history shows objectively the series of choices taken by the team, but not the strategic thinking behind. The observations, on the other hand, indicate the intentions inherent in the actions taken.

The interview with participants reflects their subjective understanding of the process as well as the performance of the team. A different view may be obtained from the interview with instructors. These interviews form a basis for a more objective expert evaluation of the task performance.

From the data both independent variables (how demanding was the task?) and dependent variables (how well was the task performed?) were extracted. The difficulty of keeping the vessel in position during the subsea survey was varied for instance through the wind speed increase imposed. Measures for the quality of performance were obtained from expert interviews, duration of the various stages in the operation, and various observations.

CONCLUSION

While human behavior under demanding situations has been studied extensively in the context of air traffic and nuclear power plant operation, less has been done in the maritime sector.

A combination of qualitative and quantitative methods was used to shed light on the man-machine relations in complex maritime operations. Participants at simulator sessions were used as study objects. Video recordings of the sessions will be considered in the future.

REFERENCES

1. Salas, E., Cooke, N. J., Rosen, M. A. On Teams, Teamwork, and Team Performance: Discoveries and Developments. *Human Factors, 50*, 3 (2008), 540-547.
2. Wickens, C. D. and Hollands, J. G. Engineering Psychology and Human Performance. Prentice Hall, Upper Saddle River, NJ, 1999.
3. Young, M. S. and Stanton, N. A. Attention and Automation: new perspective on mental underload and performance. *Theor. Issues in Ergon. Sci., 3,* 2 (2002), 178-194.