DHRTC Technology Conference 2021

Book of abstracts

Programme: Operations and Maintenance Technology

Contents

Improving Operational Situation Awareness Supported by an Intelligent Knowledge-based System

Jing Wu, Xinxin Zhang, Morten Lind

Department of Electrical Engineering, Technical University of Denmark, Kgs. Lyngby, 2800, Denmark

The research and application results regarding the operation support by an intelligent knowledge-based system to improve operational situation awareness in the first phase of the DHRTC Water management project are presented. The knowledge acquisition and representation is the key for building such knowledge-based system. The method, so-called multilevel flow modelling (MFM) is used for representing operational knowledge and reasoning the cause and consequence given operational situations. The effectiveness of intelligent operation support based on the MFM models of a water injection system in offshore fields and the dynamic reasoning engine is illustrated with case studies. It demonstrates that the procedure of knowledge acquisition and representation can facilitate the model builders, and ensure the quality of the models used for operational support. In addition, the dynamic reasoning capabilities are verified. The intelligent knowledge-based system can be extended and applied for other industrial sectors, e.g. sustainable energy, making efforts in energy transition for operational safety.

Reference

Wu, J., Lind, M., Zhang, X., Pardhasaradhi, K., Pathi, S.K., Myllerup, C.M., 2021. Knowledge Acquisition and Representation for Intelligent Operation Support in Offshore Fields. Process Saf. Environ. Prot. https://doi.org/https://doi.org/10.1016/j.psep.2021.09.036

Optimization of RCM/CBM Maintenance Strategy by Using Unified Functional Knowledge

Mengchu Song

The premise for designing a maintenance strategy is to understand clearly what functions are being demanded from the asset. Multilevel Flow Modeling (MFM) is a very methodology to provide unified functional knowledge for representing functions of assets and interactions. Using MFM for the maintenance decision support is twofold. One is to conduct the Reliability Centered Maintenance (RCM) analysis to determine the required maintenance should be corrective or preventive. For specific critical assets, meanwhile, MFM is used to develop a Condition-based Maintenance (CBM) approach to diagnose incipient failures before the functional failure occurs.

Research Prospects for the Application of Functional Models to System Safety

Jing Wu, Xinxin Zhang, Morten Lind

Department of Electrical Engineering, Technical University of Denmark, Kgs. Lyngby, 2800, Denmark

System safety is highly valued by process engineering in the era of industry 4.0. The new side-by-side challenges and opportunities also encourage researchers to solve the safety issues by using artificial intelligence techniques, which aims at improving the quality and efficiency in the safety analysis of process systems to bring the risk level down to a certain level that can be acceptable. The poster focuses on the research prospects for the application of functional models, multilevel flow models (MFM), to system safety. Fours aspects of research demands: safety analysis requirements, knowledge acquisition and representation from safety aspects, reasoning rules development regarding safety, and safeguard proposals in the functional model framework are pointed out. This poster presents the objectives of the second phase of the DHRTC water management project regarding system safety assessment in the next three years.

Improving efficiency through maintenance clustering

Reduce planned hours by up to 5%

Julie Krogh Agergaard, Kasper Barslund Hansen, Jingrui Ge, Niels Henrik Mortensen, Kristoffer Vandrup Sigsgaard

Maintenance of large, complex, continuous plants requires large amounts of supporting work and production shutdowns. This project focuses on helping decision makers identify opportunities for clustering of maintenance supporting work and shutdowns, to more efficiently utilize resources at the same maintenance output. The decisions are supported by data that is contextualized by and visualized directly on the physical connections and drawings of the plants.

Intelligent maintenance planning support

Faster, more accurate planning leads to better maintenance quality

Kasper Barslund Hansen, Jingrui Ge, Julie Krogh Agergaard, Niels Henrik Mortensen, Kristoffer Vandrup Sigsgaard

The labor-intensive process of planning maintenance activities for rectifying failures is troublesome, as only few activity alternatives are considered during the process, in part, due to planners being unable to evaluate all options and the impact of these. This results in the selection of sub-optimal activities in terms of overall operational costs, use of resources and asset availability and reliability. This study examines the applicability of a configuration system, known from the product domain, to support the process. The configuration system can handle dependencies between equipment, failures, procedures and resources, and include advanced decision-making and estimation methods, in order to generate complete work instructions with accurate time estimations.

Intelligent maintenance scheduling support

Scheduling 3000 maintenance operations in 2 hours

Waqas Khalid, Kristoffer Vandrup Sigsgaard, Jingrui Ge, Julie Krogh Agergaard, Kasper Barslund Hansen, Niels Henrik Mortensen

The research is focused on optimizing the scheduling of maintenance jobs in highly maintenance intensive offshore oil & gas platforms. Scheduling refers to the placing of the maintenance jobs in time slots when these can be carried out. Optimizing the schedule is a challenge because of the limited resource availability and dependencies of the maintenance jobs. This research proposes a mathematical programming model that optimizes the maintenance schedule in an Artificial Intelligent environment with the use of computational power. The proposed model leads to the optimized utilization of resources thus leading to the reduction in cost. Moreover, with the use of this model, it is expected that it will become easier to execute the maintenance jobs as planned without any changes.

Structured performance evaluation of maintenance

Selecting the right focus and scope for improvement areas

Jingrui Ge, Kasper Barslund Hansen, Niels Henrik Mortensen, Kristoffer Vandrup Sigsgaard, Julie Krogh Agergaard

Evaluation of maintenance performance has great importance for maintenance management. This project aims to develop a structured maintenance evaluation framework in order to support identification and reduction of non-value-adding elements in maintenance. The first part of framework provides rapid diagnostics for maintenance performance on overall level, enabling fast overview on key performance results for all equipment groups. For groups with undesired overall performance, the second part of framework provides in-depth diagnostics for different evaluation aspects under each maintenance process. The framework provides an approach to form case-specific performance indicators by establishing links between evaluation aspects and available data, making it possible to be applied without requiring specific data fields. The structured performance evaluation framework will support the decision-making process for future maintenance improvement.

Vision and implementation of modular maintenance

Unleashing the power of data

Kristoffer Vandrup Sigsgaard, Julie Krogh Agergaard, Kasper Barslund Hansen, Jingrui Ge, Niels Henrik Mortensen

The Oil and Gas industry in the North Sea has experienced an increase in OPEX of 10% from 2003 to 2013. Maintenance cost is a big part of the OPEX and the Oil and gas industry is facing big challenges with an increasing maintenance cost. both academia and industry identify one of the main challenges in maintenance to be the high complexity due to old platforms there have been highly modified over time and is now operating close too or beyond the expected lifetime.

We are developing a Maintenance Architecture that can handle the complexity in maintenance and still look across and understand the full maintenance process: Identify, plan, schedule, and execution of the maintenance.

With a Maintenance Architecture, it is possible to systematic rationalize maintenance activities and reducing OPEX cost by using advanced computer algorithms, smart configurations systems and systematic use of historical data to improve strategies as well at the day to day decisions.