Case Study – Hoist System Design

Design

- **Modeling and Analysis**:
  - Used Mathcad to model the complex arrangement of the loader arm system.
  - Incorporated a dynamic pivot link mechanism that altered the axis of rotation of the loader arm depending on tower angle and loader arm hoist angle.
  - Factored vessel accelerations and dynamic effects into the dynamic system analysis.
  - Produced a dynamic analysis in Mathcad to determine:
    - The maximum winch rope tension expected, which defined the performance specification for the steel wire rope and winch.
    - The maximum expected pressures experienced by the pivot link cylinders, which were used to define the technical specification for the cylinders.
- **Gas Strut Integration**:
  - Designed the system to include 500t gas struts to prevent the loader arm from clashing with the tower during approach.
  - Modelled the variable pushback force from these gas struts as a function of gas temperature and pressure, ensuring accurate predictions under different operating conditions.

Field Testing

- Conducted extensive field testing during sea trials in Norway to validate the loader arm's performance under real-world conditions.
- Utilised the vessel's real-time data logger (Historian) to review key performance metrics, including:
  - Rope line-out encoders.
  - Load cell readouts.
  - Cylinder LVDT (Linear Variable Differential Transformer) readings.
  - Pressure transducer outputs.
  - Temperature probe data.
- Assessed the accuracy of the Mathcad model created during the design phase by comparing predicted and actual measurements for winch rope tensions, cylinder pressures, and dynamic responses.
- Adjusted system parameters based on field test data to fine-tune performance and reliability.