ID contributo: **57** Tipo: **Presentazione orale**

Development of a parametric model to perform predictive Life Cycle Assessment of baseplate for Oil&Gas applications

mercoledì 3 settembre 2025 15:15 (15 minuti)

Objective
The Oil & Gas industry represents a fundamental pillar of the global energy system, providing essential resources for various sectors. Its highly complex processes can interact with the environment at various stages, from extraction to refining, transportation, and final use. In a context where sustainability is becoming increasingly relevant, Life Cycle Assessment (LCA) is a well-established and valuable method for analyzing environmental impacts and identifying areas for improvement. This study focuses on assessing the environmental impact of baseplate structures, which provide support for various systems in Oil&Gas applications during both operation and transportation. The main objective is to identify the key factors influencing environmental impact calculations and to develop a predictive model that can assist engineers in estimating LCA outcomes already in the design phase.
Methodology
The data foundation for the predictive model is the Life Cycle Assessment (LCA) of various baseplates used in Oil & Gas applications. The study was conducted using a "cradle-to-gate" approach, which considers the entire production cycle up to the point of leaving the manufacturing site, encompassing raw material extraction, manufacturing processes, assembly, and transportation. Environmental impact was quantified using the Global Warming Potential (GWP) indicator. Based on LCA results, key parameters influencing environmental impact were identified, including baseplate mass, material type, transportation distance, geographical scenario, and recycling rate. Subsequently, a sensitivity analysis was performed on five out of six available structures, using these parameters as input factors for a Design of Experiment (DoE) analysis based on a full factorial (FF) design. The remaining baseplate was used as a reference configuration, as its characteristics establish various and reliable benchmark conditions.
Results
The analysis systematically assessed the influence of various parameters on the environmental performance of the baseplates. The results highlight that the combination of factors, rather than individual parameters, plays a crucial role in determining the impact on Global Warming Potential. In particular, baseplate mass and recycling rate emerged as the primary determining factors, followed by transportation distance and geographical scenario.
This analysis led to the development of a robust predictive model capable of estimating the environmental impact of new baseplate configurations. The model provides a valuable tool for designers, allowing them to evaluate design choices in terms of sustainability from the early stages of product development.
Conclusions
The results provide a clear understanding of the key parameters influencing the environmental impact of baseplates, offering strong support for sustainable design in the Oil & Gas sector. The implementation of the predictive model enables designers to estimate the LCA of structures from the initial phases of product development, facilitating more informed decisions aimed at reducing environmental impact. This approach not only enhances the decision-making process but also promotes the adoption of more sustainable practices within the Oil & Gas industry, providing practical support and an additional perspective in design choices to achieve significant environmental benefits.

Autori principali: BARBANI, Daniele (Università degli Studi di Firenze); DELOGU, Massimo (Dipartimento di Ingegneria Industriale, Università degli Studi di Firenze); Dr. ARENA, Viola (Università degli Studi di Firenze)

Relatore: BARBANI, Daniele (Università degli Studi di Firenze)

Classifica Sessioni: Circular Design

Classificazione della track: Circular Design