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Optimizing Industrial Systems with Hybrid Information Quality

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Industry 4.0 contexts generate large amounts of data holding potential value for advancing product quality and process performance. Current research already uses data-driven models to refine theoretical models, but integrating mechanistic understanding into data-driven models is still overlooked. This represents an opportunity to harness extensive data alongside fundamental principles.
We propose a framework for hybrid modeling solutions in industry, by combining Information Quality (InfoQ) principles with hybrid modeling insights. Such Hybrid Information Quality approach (H-InfoQ) aims to enhance industrial problem-solving, to improve process modeling and understanding of non-stationary systems.
The H-InfoQ framework evaluates a given hybrid model, f_H, the available process information, X_H, the specific analysis goal, g, and the adequate utility measure, U. Despite its thoroughness, the framework's reproducibility and practical application remain challenging for practitioners to navigate autonomously. The main goal is to optimize the utility derived from applying f_H to X_H, in the scope of the goal $g : Max\,H\text{-}InfoQ = U\{f_H(X_H)|g\}$. To improve its practicality, an eight-dimensional strategy is proposed, focusing on data granularity, structure, integration, temporal relevance, data and goal chronology, generalizability, operationalization, and communication (see also Kenett & Shmueli, 2014).
To illustrate the practical application and effectiveness of the H-InfoQ framework, two industrial case studies are analyzed and explored through the lens of this methodological construct. These instances were selected to showcase the tangible benefits and real-world applicability of the framework in industrial contexts.

References

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