

# From text analysis to influence graphs: approaches based on LLM, fuzzy logic, and Bayesian networks

Project : IMMOTEP<sup>1</sup>

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## Context and motivation

Facility Management (FM) encompasses all activities aimed at improving the efficiency of the working environment (building management, energy consumption, employee comfort, safety, etc.). These practices directly influence a company's economic, environmental, and societal performance [1, 2]. However, the relationships between these indicators are complex, often implicit, and rarely described in clear quantitative terms. In addition, company executives need to identify these relationships and their influence on the overall work environment.

The emergence of Large Language Models (LLMs) and qualitative reasoning approaches (qualitative influence diagrams, fuzzy logic, Bayesian networks) paves the way for more detailed modeling of dependencies between indicators, facilitating analysis and strategic decision-making.

## Goals

- Automatic extraction of indicators from Quality of Life and Working Conditions (QLWC) documents (scientific publications, reports, CSR documents, audits).
- Identification of qualitative relationships of influence between these indicators using LLM (e.g., "better air quality improves employee productivity").
- Construction of an influence graph representing these relationships in the form of Qualitative Influence Diagrams (QID) [3], using two different approaches :
  - Fuzzy Logic [4]
  - Bayesian Networks [5]
- Analysis of the graph to detect key indicators (those that strongly influence others) and their influences linking FM practices to overall performance (economic, environmental, societal).
- Prototype decision-making tool for visualizing these graphs and simulating the impact of a change in indicators.

## Expected Skills

- Good knowledge of **Python 3** and interest in LLMs.
- Basics of *Semantic Web* (ontologies, RDF, OWL, SPARQL).
- Interest in fuzzy set theory and probabilistic reasoning.
- Strong motivation for collaboration and teamwork.

## Bibliography

1. AFNOR, "NF EN 15221-1 : Facility Management — Part 1 : Terms and Definitions," French Standard, Association Française de Normalisation, Dec. 2006. Withdrawn on Jul. 13, 2018.

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1. This work was supported by the Normandy Region (France) and the European Union through the European Regional Development Fund (ERDF/FEDER)

2. Mouvement des Entreprises de France (MEDEF), “GUIDE RSE – Introduction à la Qualité de Vie et des Conditions de Travail (QVCT),” Paris, France : MEDEF, 2023.
3. Renooij, S., & van der Gaag, L. C. (1998, May). Decision Making in Qualitative Influence Diagrams. In FLAIRS (pp. 410-414).
4. Klir, G. J., & Yuan, B. (1995). Fuzzy Sets and Fuzzy Logic : Theory and Applications. Prentice Hall.
5. Koller, D., & Friedman, N. (2009). Probabilistic Graphical Models : Principles and Techniques. MIT Press.