**Read Goerlandt et al (2017), Hugo et al (2018) and Çelikbilek & Tüysüz (2020) and answer the following questions:**

1. **How do Goerlandt et al (2017) suggest that the validity of QRA approaches can be validated? What did they posit was the most effective approach?**

Goerlandt et al. (2017) argue that the validity of Quantitative Risk Analysis (QRA) approaches can be validated through methods including benchmark exercises, reality checks, independent peer reviews, and quality assurance assessments. Among these, they posit that quality assurance is the most effective approach, as it focuses on the adequacy of the processes behind the production of a QRA. They particularly emphasise that the integrity of the processes underpinning QRA—spanning planning, organization, and execution—is crucial to ensuring reliable and meaningful results.

1. **Which techniques did Hugo et al (2018) should be applied to project management? What were their recommendations to increase the use of QR analysis in Projects?**

Hugo et al. (2018) recommended the application of quantitative risk analysis (QR analysis) techniques such as Monte Carlo simulation in project management, to improve risk assessment and decision-making. Their study found that the use of QR tools in project management was relatively low compared to general project management tools, and they identified several factors influencing this, including project size, availability of risk management resources, individual competence, and organizational risk management maturity.

To increase the use of QR analysis in projects, the authors suggested improving individual competence in risk management through training and exposure, aligning organizational risk management approaches with project execution, and ensuring the availability of adequate resources for both qualitative and quantitative risk management. They also recommended further research to explore the adoption and effectiveness of specific QR tools, including structured interviews with risk personnel and trials of software solutions to enhance practical implementation.

1. **The last paper reviews various Multi-Criteria Decision Methods (MCDMs) and considered the relative accuracy and validity of the techniques. Which did they find was the most accurate of the methods compared? What were the failings of the general TOPSIS approach?**

The study found that among the Multi-Criteria Decision Methods (MCDMs) compared, the MOORA (Multi-Objective Optimization on the Basis of Ratio Analysis) method demonstrated the highest accuracy, particularly in ranking alternatives correctly, achieving a success rate of 88.9% when tested against GPA rankings. In contrast, TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) showed significant inconsistencies, with accuracy fluctuating based on data distribution. When data was spread along the ideal decision line (from the Negative Ideal Solution (NIS) to the Positive Ideal Solution (PIS)), TOPSIS performed relatively well, reaching 91.8% accuracy. However, when data was distributed perpendicularly to this line, accuracy dropped to just 61.0%, revealing its sensitivity to data structure​.

The main failings of conventional TOPSIS stem from its reliance on Euclidean distance calculations and its flawed ranking index. The method assumes that an alternative far from the Negative Ideal Solution (NIS) is necessarily close to the Positive Ideal Solution (PIS), which is not always true in multi-dimensional decision problems. This leads to rank reversal issues, misleading rankings, and instability in results when additional alternatives or criteria are introduced. Additionally, TOPSIS does not account for correlations between criteria, meaning that alternatives may be ranked higher or lower than they should be due to overlapping information between decision factors. The study’s simulations confirmed that TOPSIS only provides reliable rankings when data is evenly distributed along its idealized decision space, but becomes highly erratic when data is scattered in multiple directions