Gestión de la cadena de suministro mediante técnicas multicriterio. Una aplicación a la industria agroalimentaria.

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X Reunión del Grupo Español de Decisión Multicriterio

10 junio 2016, Madrid

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    - 4.3. Results
5. Discussion and conclusions

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MCDM for supplier evaluation and selection

- ***Literature reviews:***

  Ho et al. 2010

  Chai et al. 2013
- Zeydan et al. 2011
- Amid et al. 2011
- Chen, 2011
- Lin, 2012
- Ekici, 2013
- Chang et al. 2014

- DEA: efficient and inefficient suppliers
- LP, MIP, GP, MOP
- AHP: weights of criteria
- ANP
- TOPSIS
- SMART
- PROMETHEE
- Genetic Algorithms
- Neural Networks
- Fuzzy set theory: Fuzzy AHP,…

➢ The supplier selection problem: one product

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Objectives

1. To develop a system which allows evaluating suppliers by using multiple criteria methodology and group decision making in order to highlight the appropriate relationship with each supplier

2. Application to a real company

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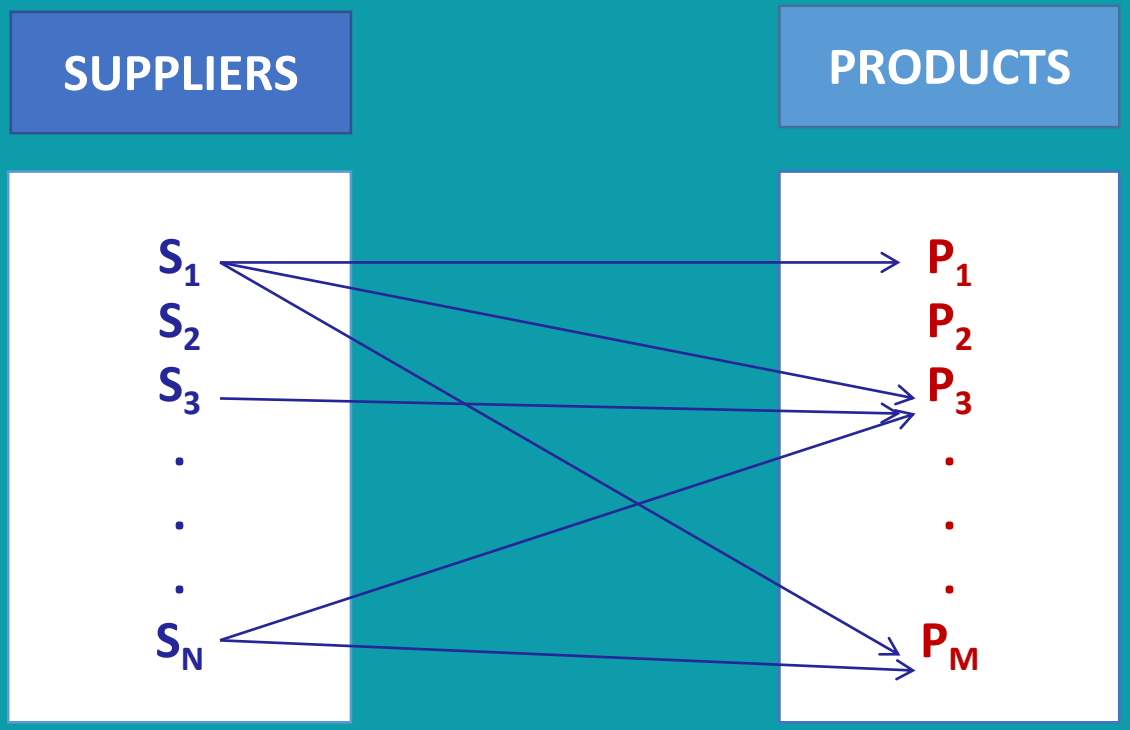
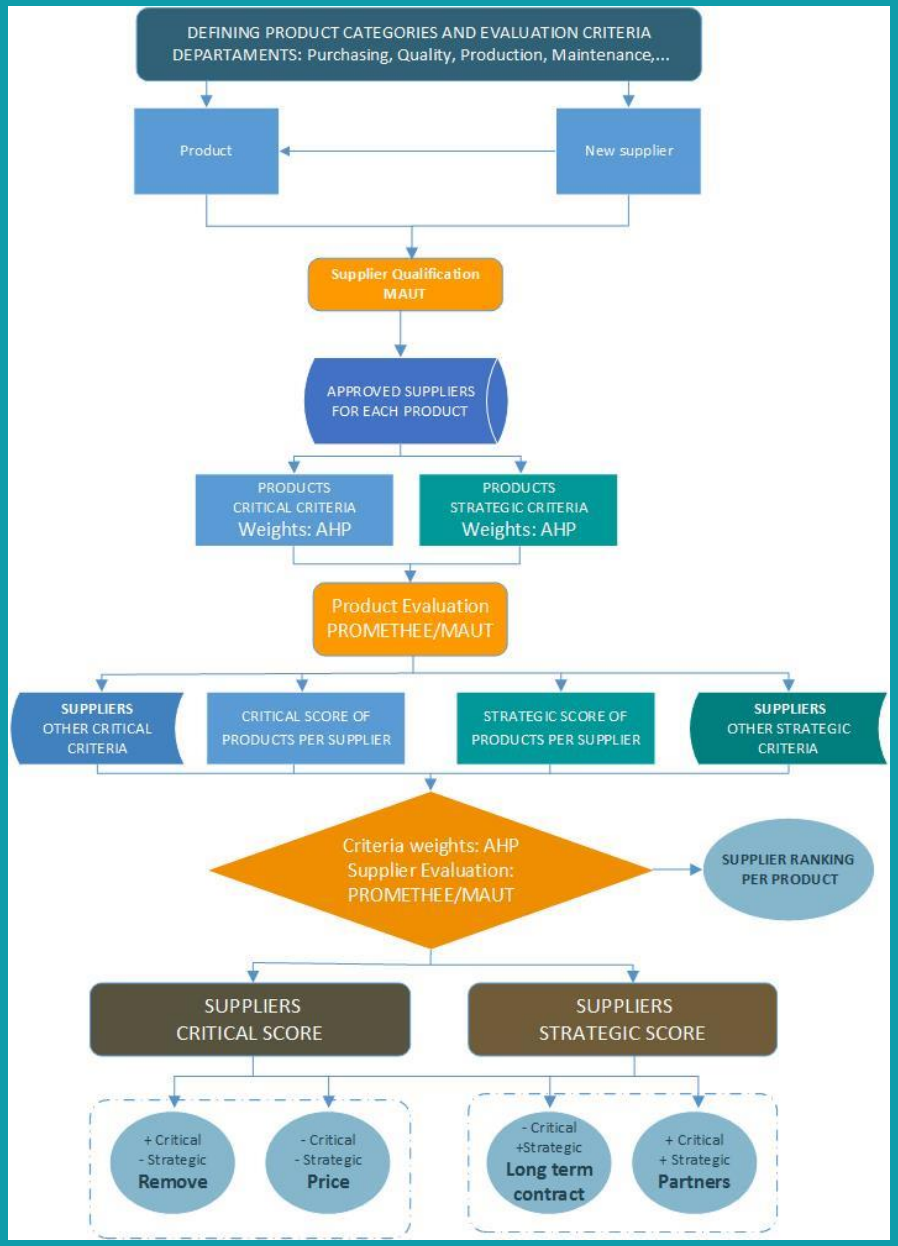
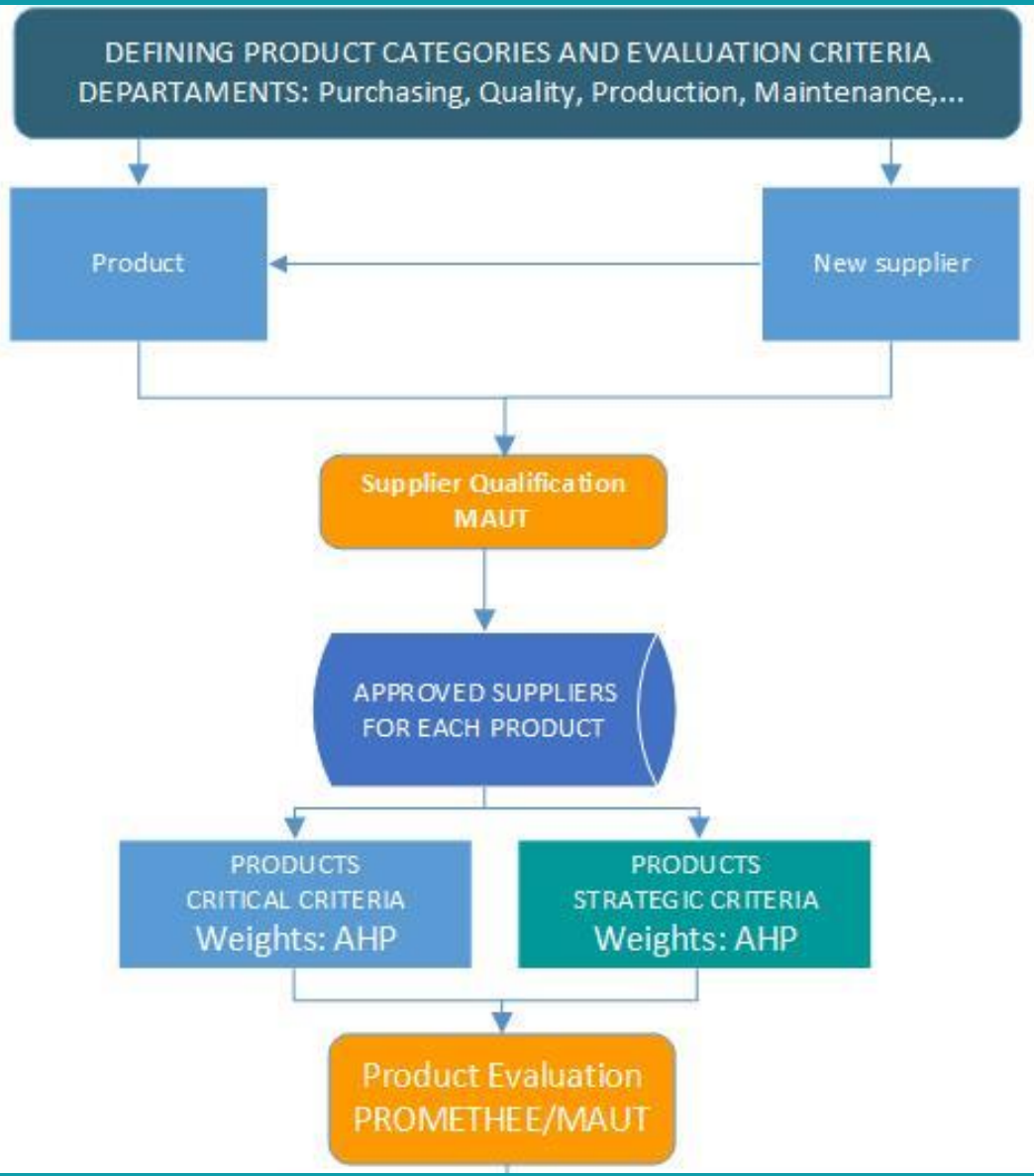
Products and suppliers



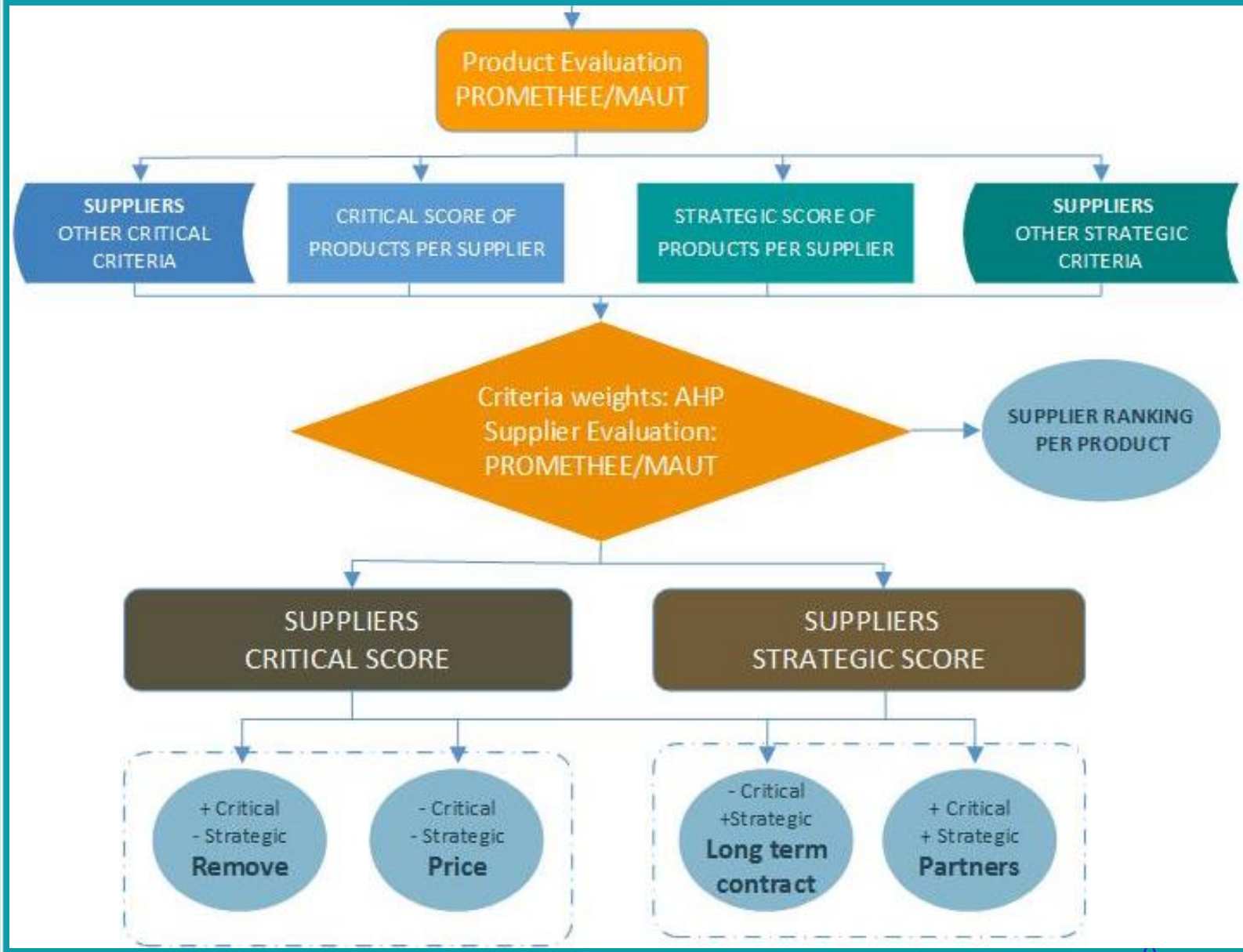
A collaborative multiple criteria system for supplier evaluation



A collaborative multiple criteria system for supplier evaluation



A collaborative multiple criteria system for supplier evaluation



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The company

Raw materials:

More than 700 Products:

the leader in the production, technology and application of polyols (sugar alcohols)

Applications:

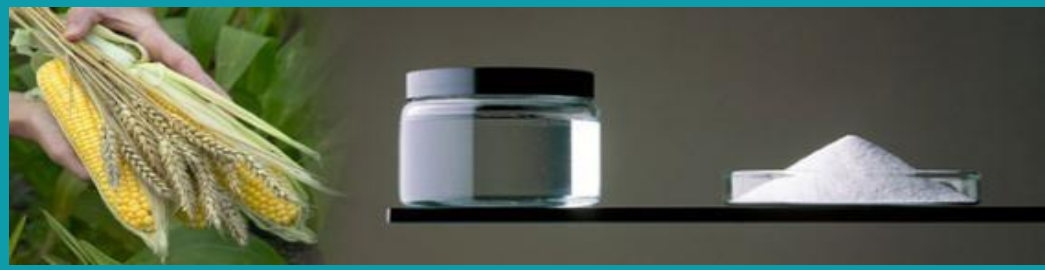
Human nutrition

Pharmacy-cosmetology

Paper/board

Chemistry-bioindustry

Animal nutrition



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Valencia (Spain)

500 suppliers

500 clients

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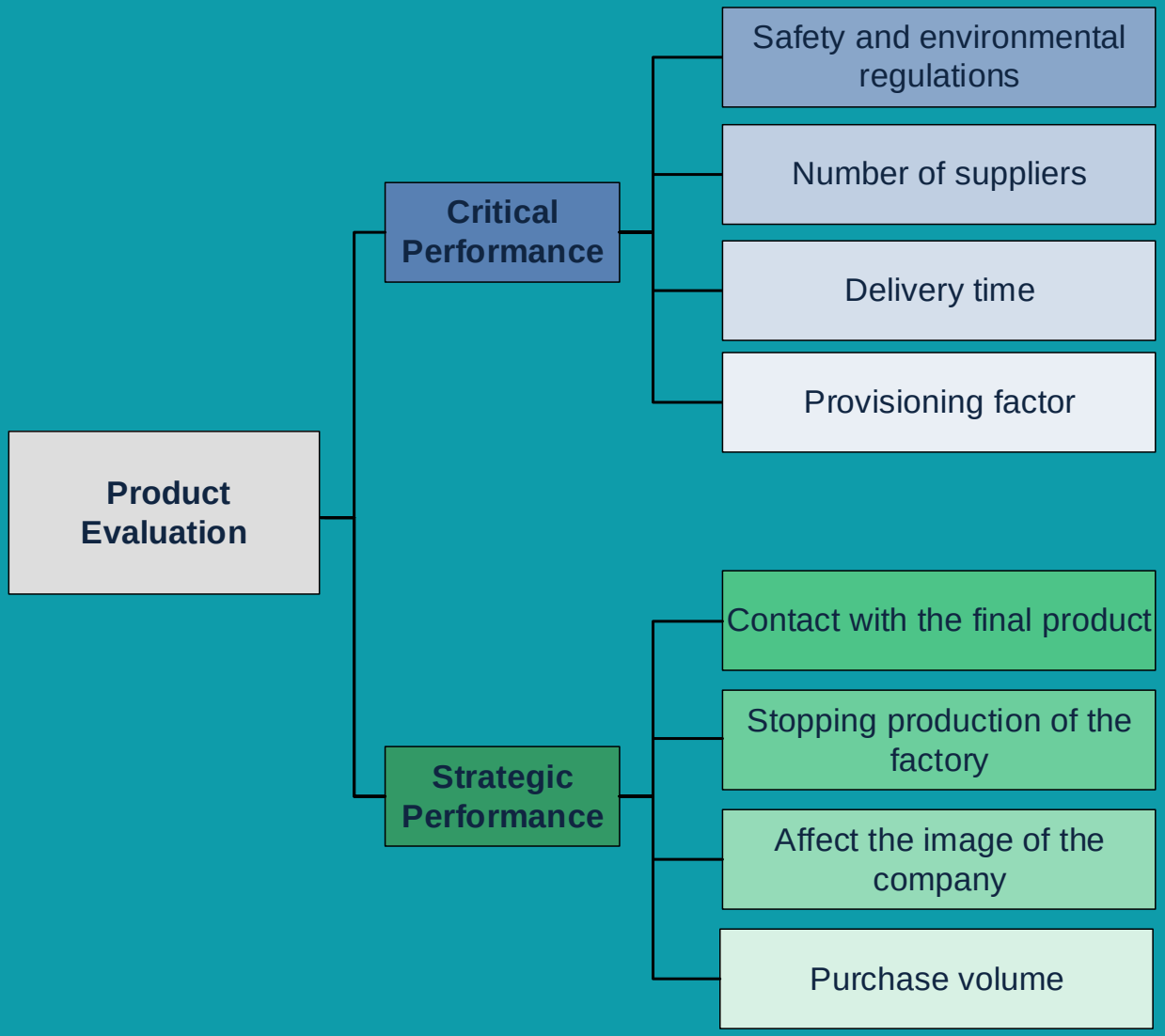
Modelling preferences for product criteria

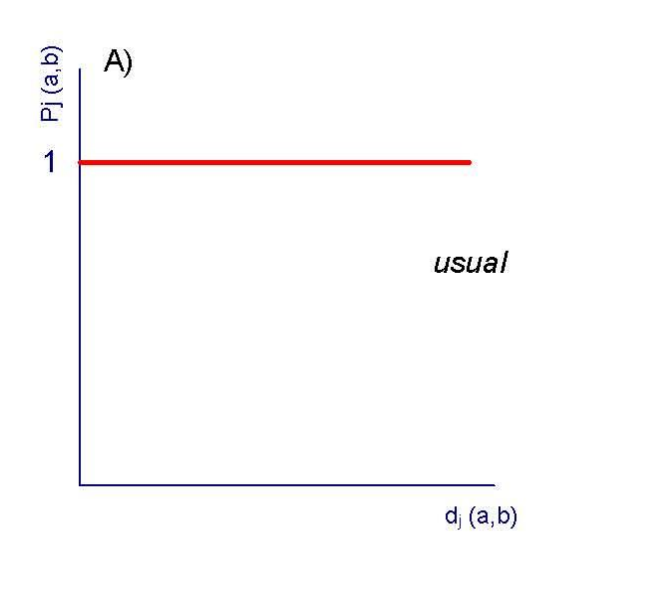


- **AHP:**
  - **Weights of criteria**
  - **Geometric mean**
  - **Eigen vector**

- **PROMETHEE**

- **MAUT**

PROMETHEE II: Preference functions



Scales 1-5

- Contact with the final product
- Stopping production of the factory
- Affect the image of the company

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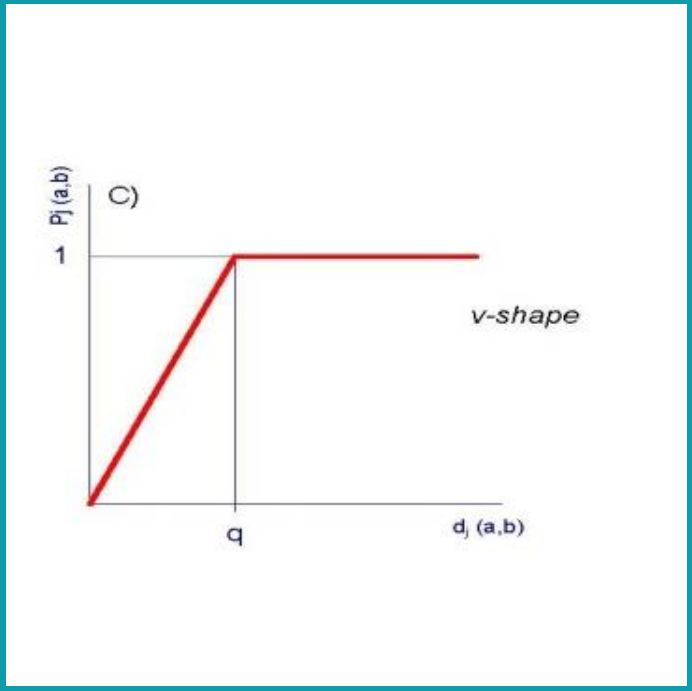
PROMETHEE II: Preference functions



- **Number of suppliers** N

  Indicator =100/N
- **Delivery time**
  - q= 50 days
- **Provisioning factor**

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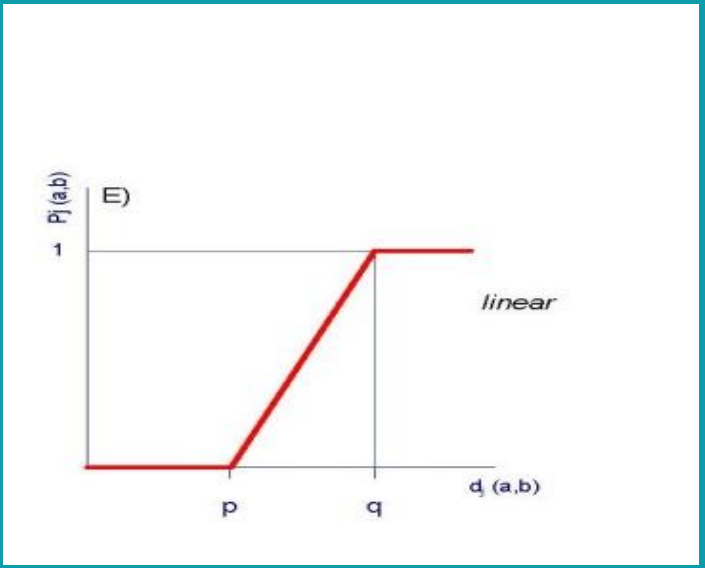
PROMETHEE II: Preference functions



- **Purchase volume**

  p= 50000 euros

  q= 1000000 euros

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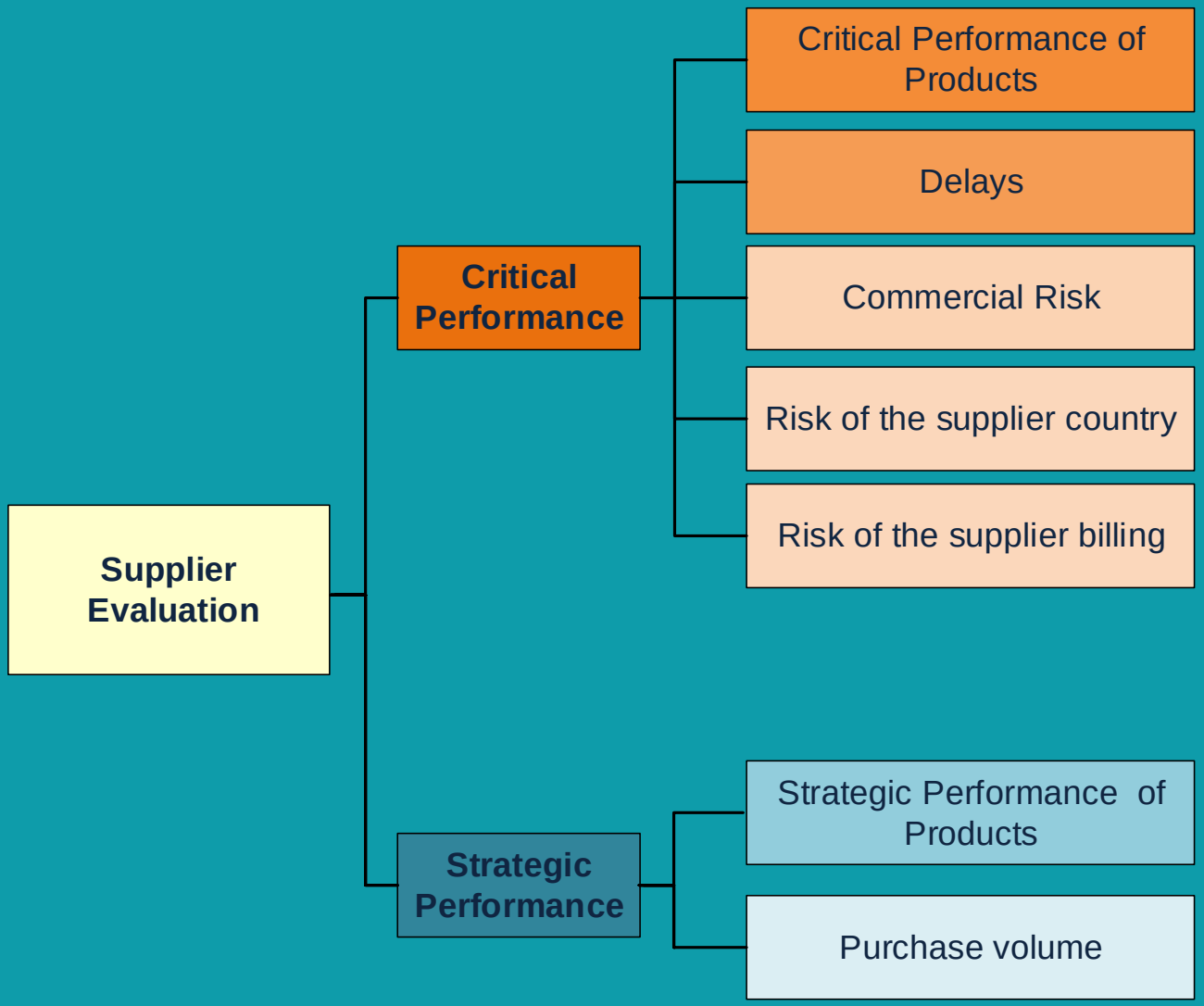
Modelling preferences for supplier criteria



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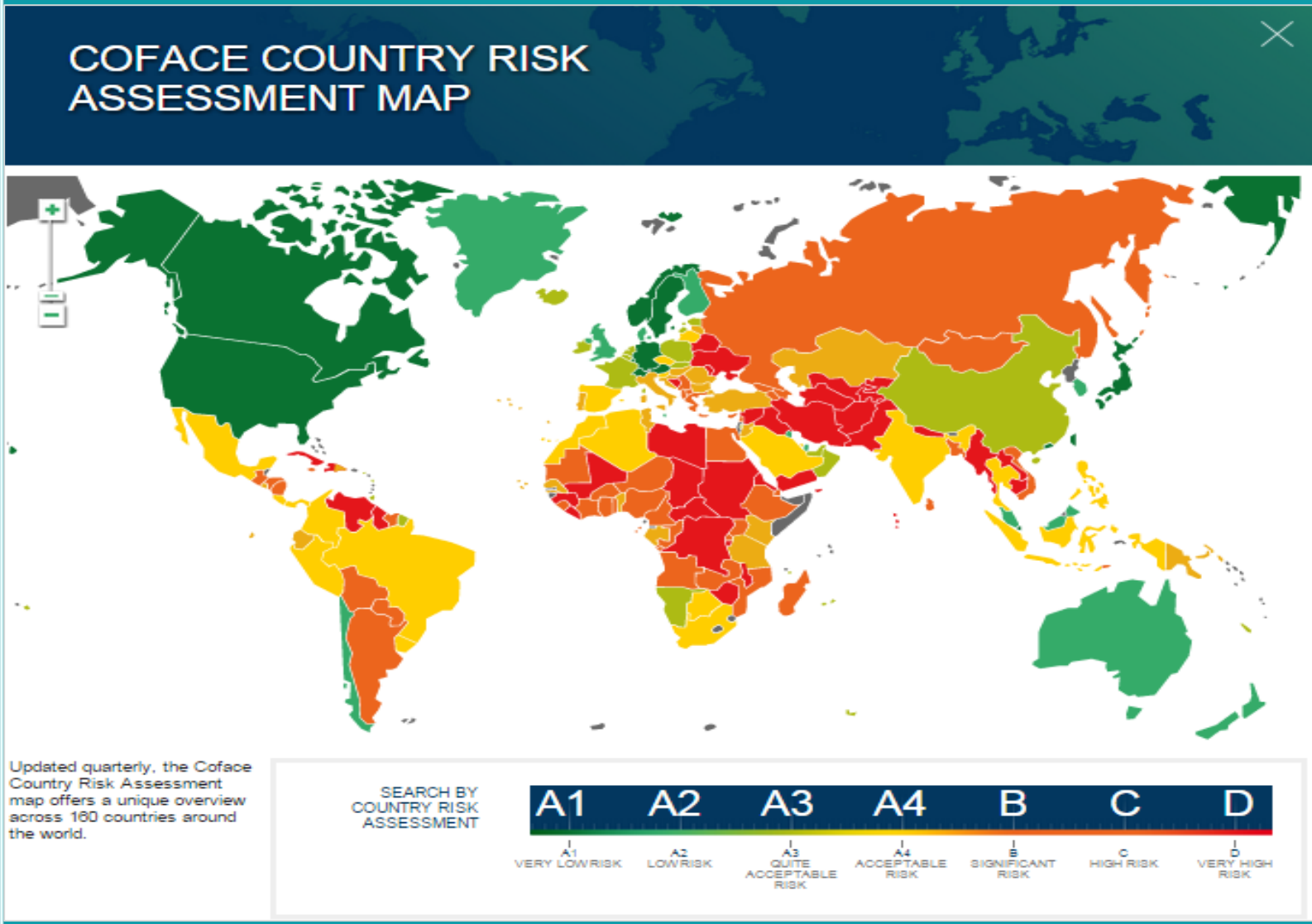
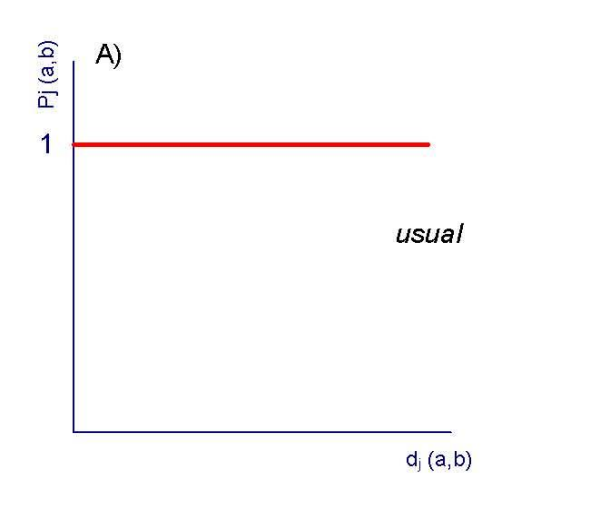
Risk of the supplier country



PROMETHEE II: Preference functions



- **Commercial Risk**
- **Risk of the supplier country**

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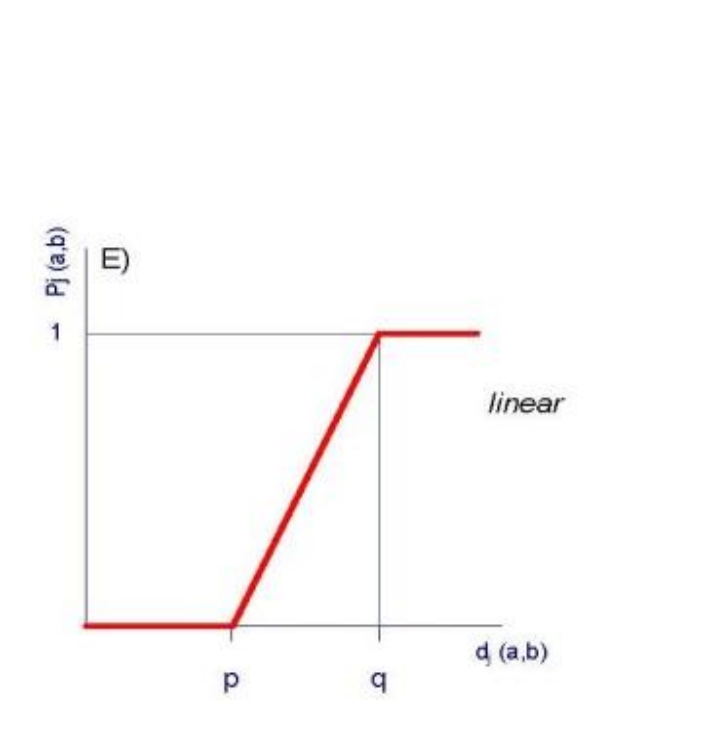
PROMETHEE II: Preference functions



- **Critical performance of products** (p=0)
- **Delays** (p=0)
- **The risk of supplier billing**
- **Strategic performance of products**
- **Purchase volume**

Weights of criteria

Evaluation	Category	Criterion	Weight
Products	**Critical**	Safety and environmental regulations	55.2
		Number of suppliers	32.7
		Delivery time	7.4
		Provisioning factor	4.7
		Total	100.0
	Strategic	Contact with the final product	45.0
		Stopping production of the factory	32.1
		Affect the image of the company	14.2
		Purchase Volume	8.7
		Total	100.0
Suppliers	**Critical**	Critical performance of products	49.10
		Delays	22.6
		Commercial Risk	11.1
		Risk of the supplier country	6.5
		Risk of the supplier billing	10.7
		Total	100
	Strategic	Strategic performance of products	85.0
		Purchase Volume	15.0
		Total	100.0

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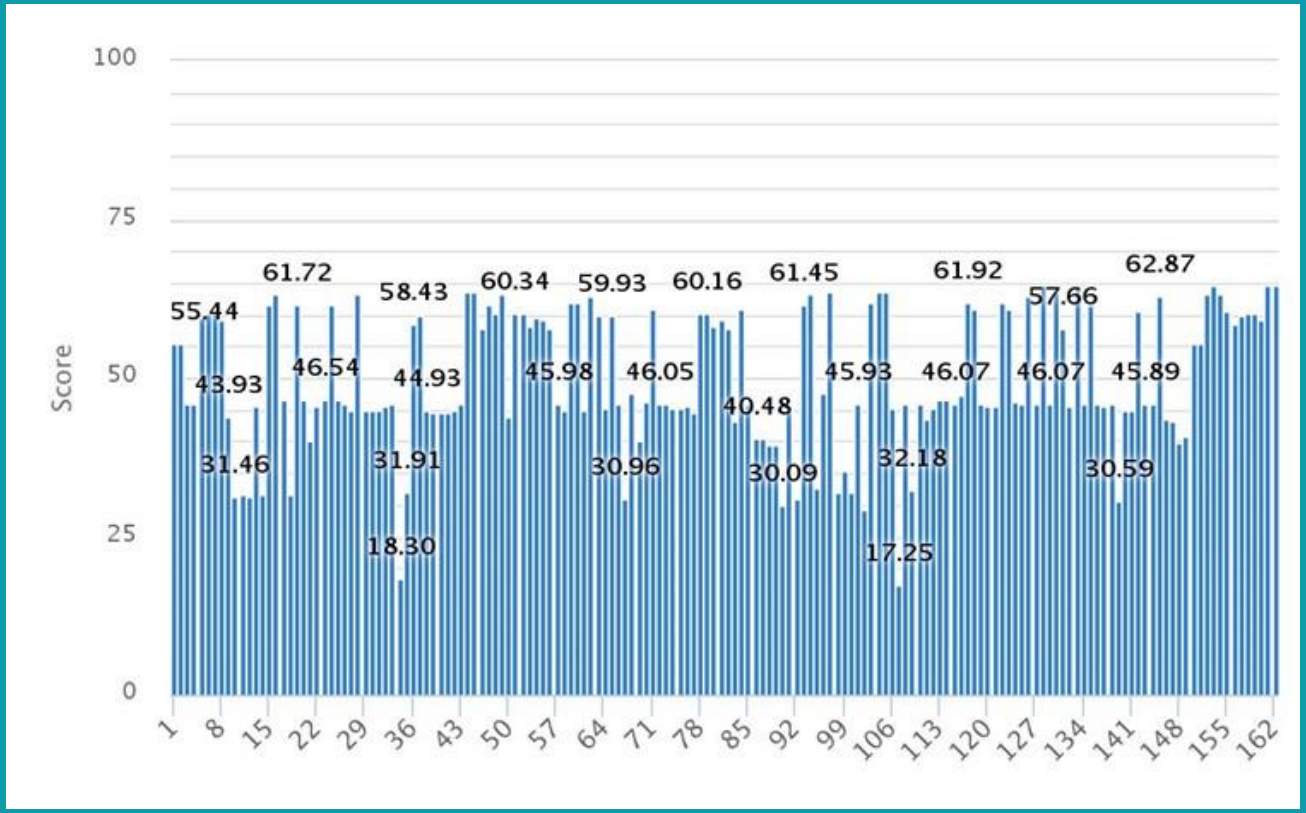
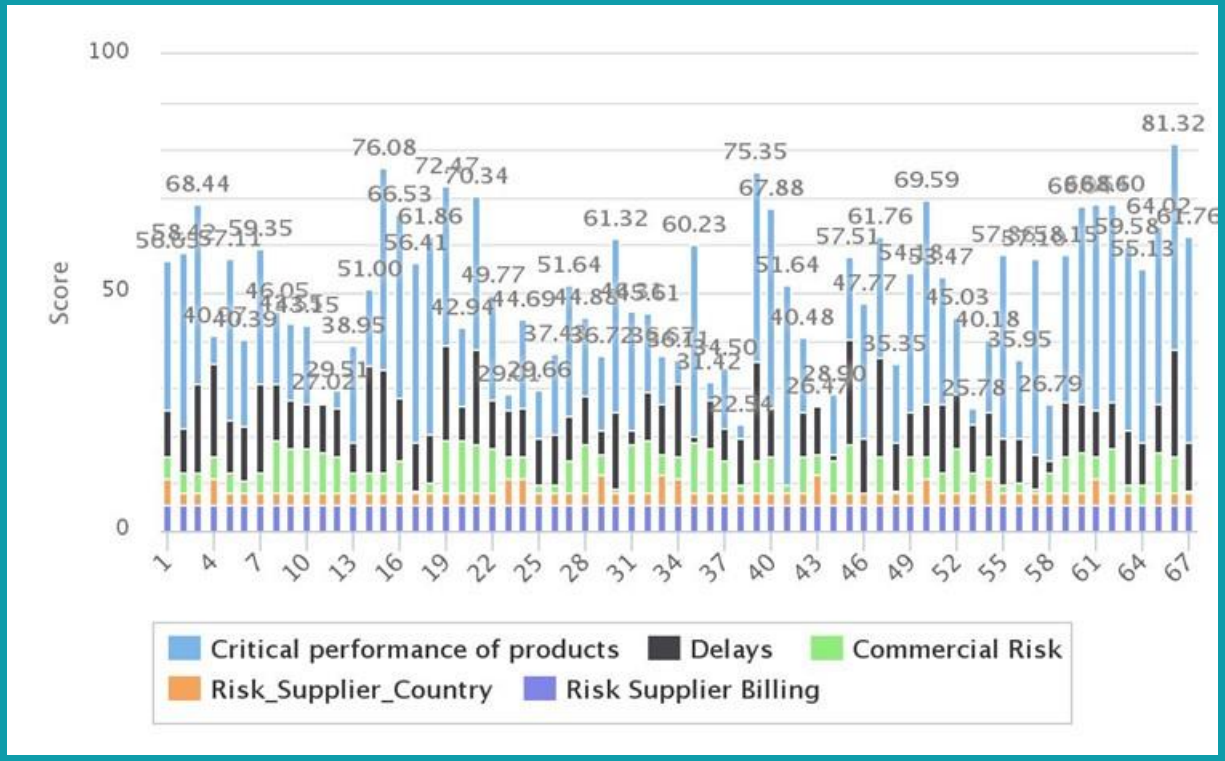
Critical performance of products: PROMETHEE



Scores for **critical performance of products** obtained by **PROMETHEE**. Products from 1 to 162.

Critical performance of suppliers: PROMETHEE



Criteria contribution to the **score for critical performance of suppliers** obtained by **PROMETHEE**. Suppliers from 1 to 67

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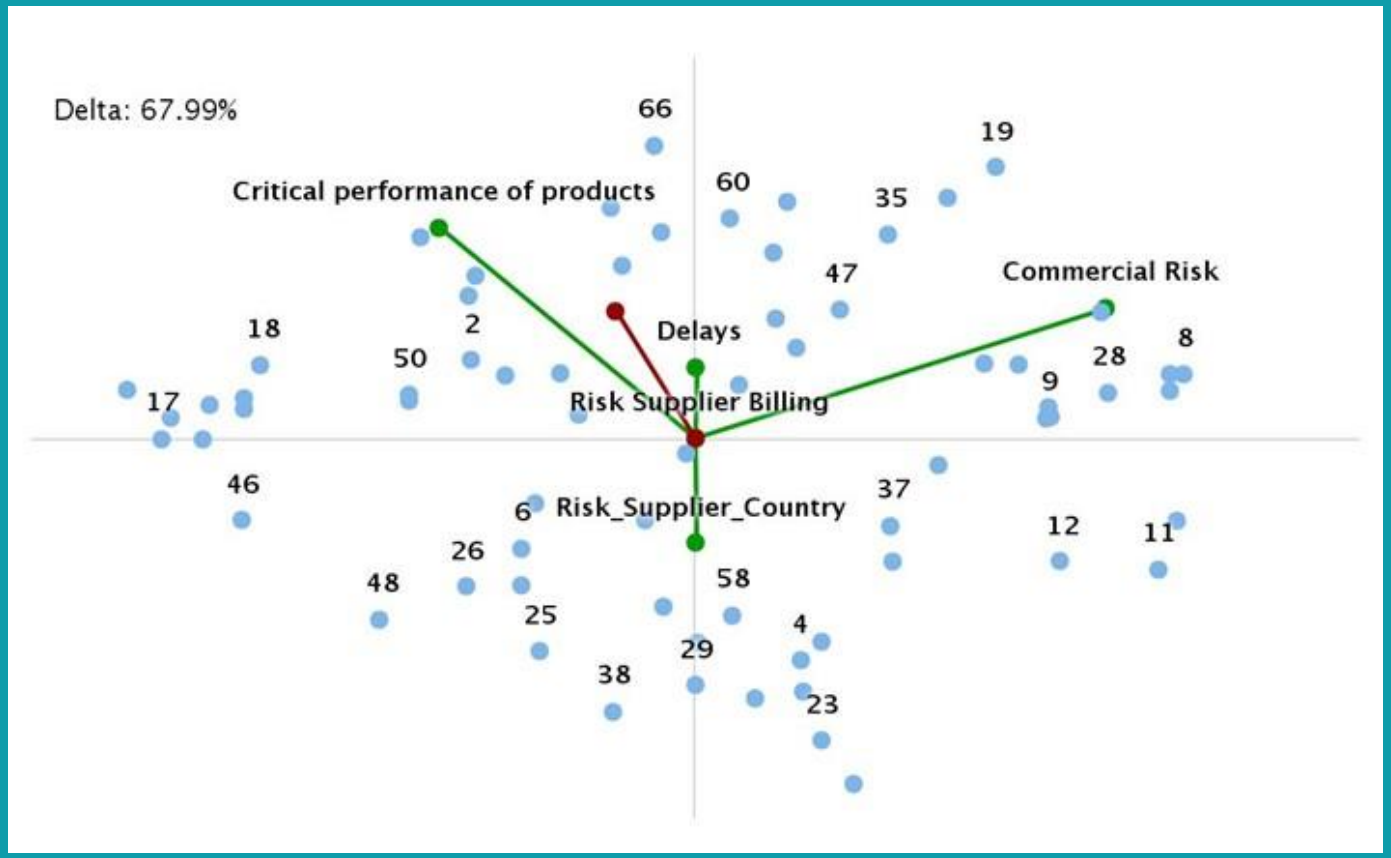
GAIA plane of suppliers: PROMETHEE



Global visual analysis for critical performance of suppliers obtained by PROMETHEE. Suppliers from 1 to 67.

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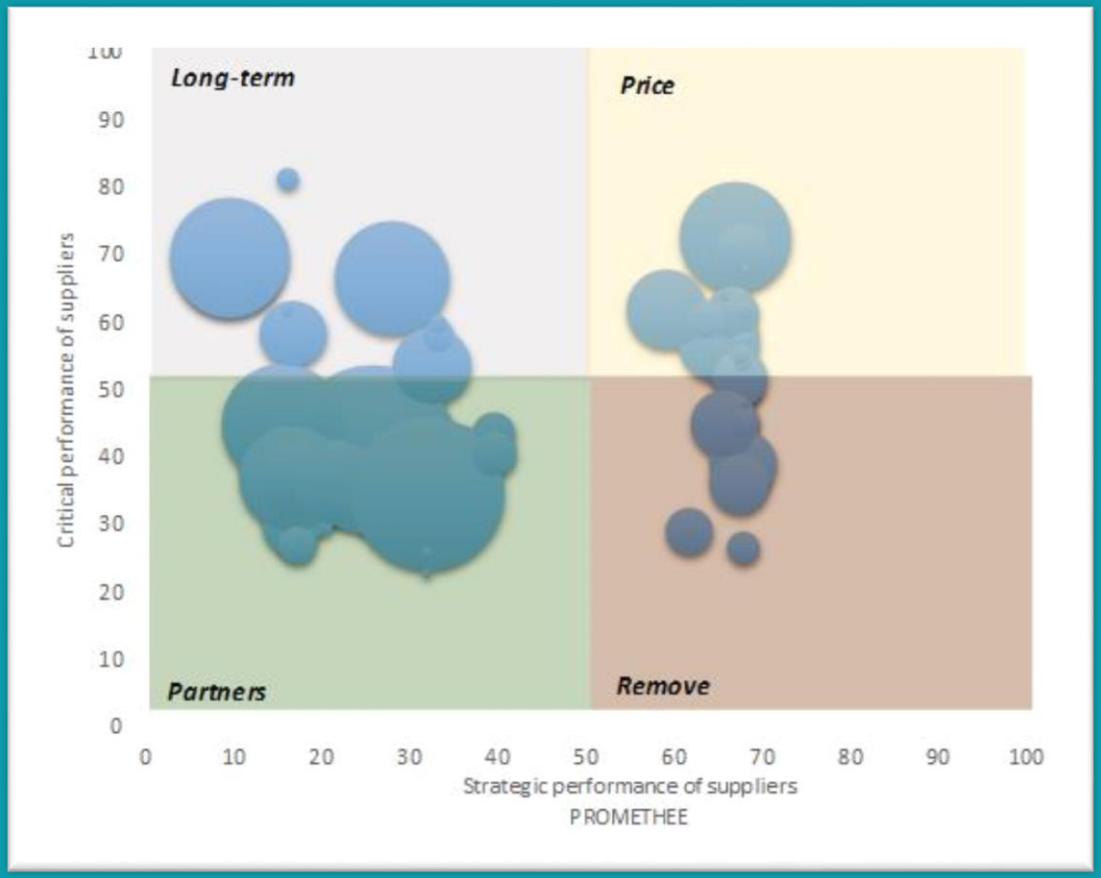
Classifying suppliers with PROMETHEE



Classification of suppliers according to their critical and strategic performance. PROMETHEE.

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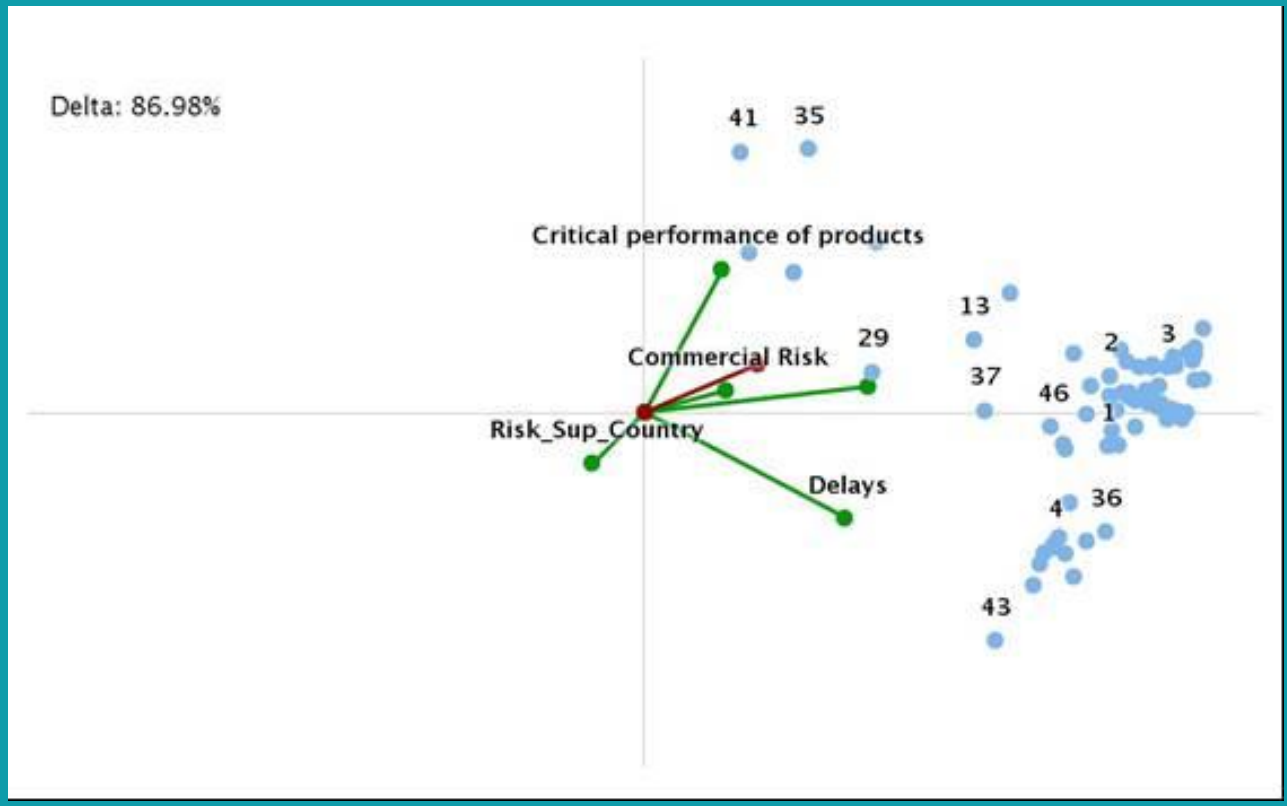
GAIA plane of suppliers: MAUT



Global visual analysis for critical performance of suppliers obtained by MAUT. D-Sight CDM

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Classifying suppliers with MAUT

Classification of suppliers according to their critical and strategic performance. MAUT.

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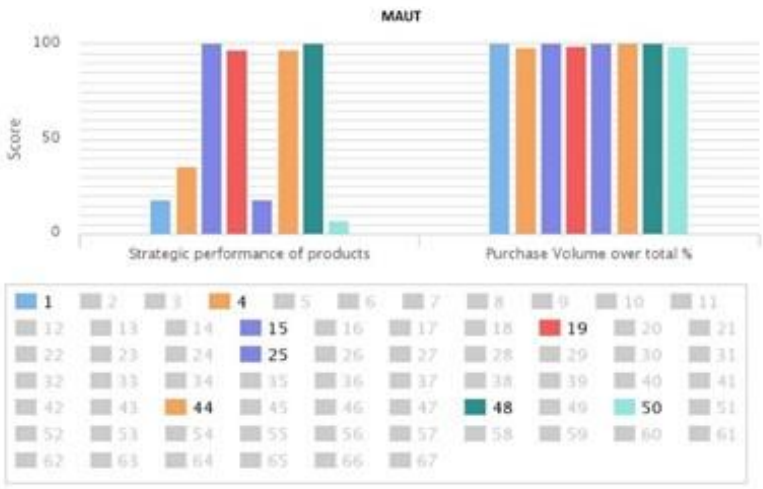
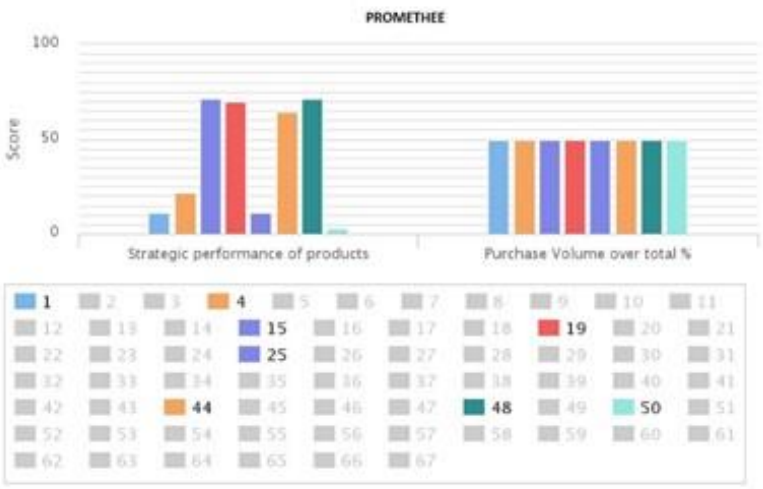
Strategic performance of some suppliers

MAUT



PROMETHEE



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Criteria in the literature for supplier evaluation

- Safety and environmental regulations
- Delivery time
- Purchase volume
- Delays

New criteria for supplier evaluation

- **Critical criteria:** mainly related to the market
  - Critical performance of products and several risk factors (commercial, supplier country and supplier billing).
- **Strategic criteria:** internal operations and decisions of the factory
  - Strategic performance of products: contact with the final product, stopping the production of the factory, affect the image of the company

Partners

Long term contract

Price

Remove

PROMETHEE and MAUT

➢ **MAUT**

- Qualifying suppliers for one product

➢ **PROMETHEE/MAUT**

- Evaluating products from one or several suppliers
- Classifying and selecting the best suppliers
- Monitoring suppliers regularly

PROMETHEE and MAUT

➢ **MAUT**

- Weights of criteria
- Supplier´s own performance: **utility functions**
- **Compensatory**

➢ **PROMETHEE**

- Weights of criteria
- **Preference functions:** pairwise comparison between suppliers
- **Non-compensatory**
- Rank reversal problem

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Limitations

- This approach does not permit obtaining the best suppliers and the optimal allocation of products to suppliers simultaneously.
- This is only possible by applying linear and integer programming, but these approaches can only optimize one objective.

- **Mathematical programming and MCDM approach are complementary**
- To develop mathematical programming models for very critical and strategic products, as well as for suppliers with a high strategic score.

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Future work

This multiple criteria system can be applied in other factories of Roquette group and other companies by defining their appropriate criteria.

This multiple criteria system will be applied for suppliers of **technical products** that represent a very high number (8,000) and have great diversity of applications.

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