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Purchasing management by using a hybrid multiple criteria approach based on PROMETHEE method

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INTERNATIONAL MCDA WORKSHOP ON PROMETHEE

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Purchasing management by using a hybrid multiple criteria approach based on PROMETHEE method



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Presentation

1. Introduction
2. Objectives and methodology
3. Criticality and strategic indices of products
4. Criticality and strategic indices of suppliers
5. Results
6. Conclusions and future work



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MCDM for supplier evaluation and selection

The most recent literature review (Ho, Xu and Dey, 2010):

- **Individual and integrated approaches:**
 - Data Envelopment Analysis
 - Mathematical programming: Linear and integer programming, Goal programming and multiobjective programming
 - Analytic Hierarchy Process and Analytic Network Process
 - Fuzzy set theory
 - Simple multi-attribute rating technique
 - Genetic algorithms

➤ The supplier selection problem





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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

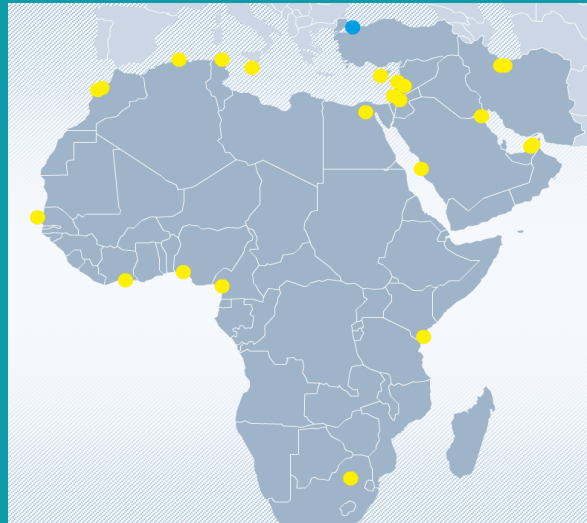
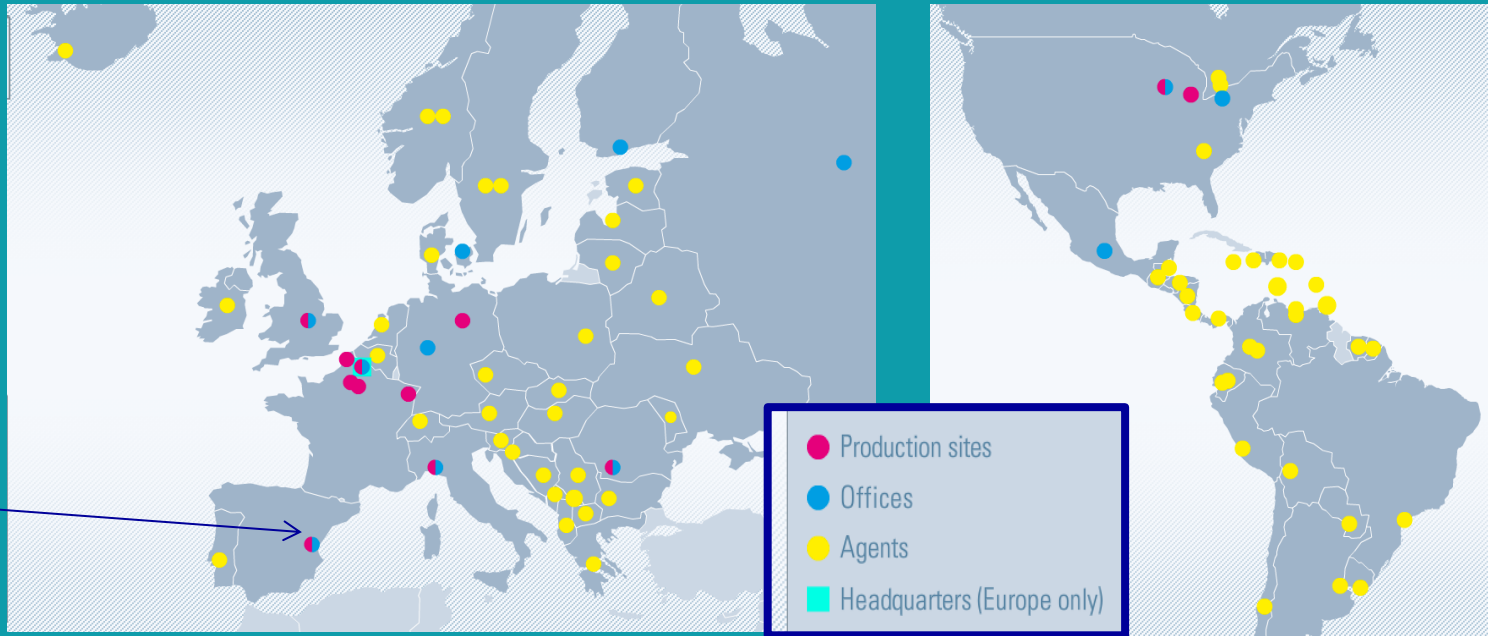


The Company: Roquette group



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(Spain)



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The problem: purchasing management

- Roquette Spain has implemented purchasing and warehouse management module of the SAP ERP software
- This system does not provide techniques to analyse and evaluate the high number of products and suppliers.
- **Previous system was only based on acquired products**
 - The products were analysed according to their risks without taking into account their suppliers.
 - Assessments are carried out quarterly and data from last three years are used.





The problem: purchasing management

- The previous methodology has some **drawbacks**:
 - Criteria measured in different units are aggregated.
 - The weights of criteria were assigned after trial and error tests.
 - Very different products were able to obtain the same number for criticality.
- The company was interested in developing a new system of purchasing management:
 - ✓ Products
 - ✓ Suppliers



Purchasing management by using a hybrid multiple criteria approach based on PROMETHEE method



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Objectives

- To develop a multiple criteria methodology to evaluate suppliers of Roquette Laisa Spain in order to establish the best relationship with each of them:
 - Partners
 - Long term contracts
 - Market policies
 - Elimination

This objective has been achieved in close collaboration with the personnel in the purchasing department of the company.



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Multiple Criteria based Methodology

PRODUCTS

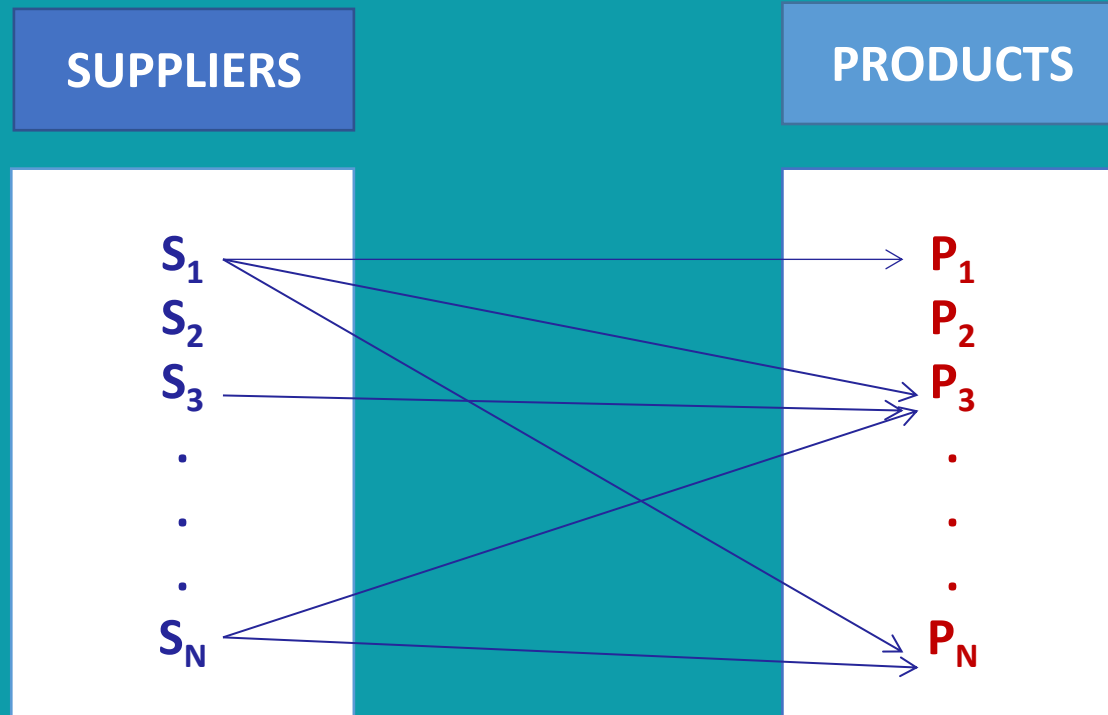
P_1
 P_2
 P_3
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·
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 P_N

- Chemical products
- Packaging products
- Technical products

SUPPLIERS



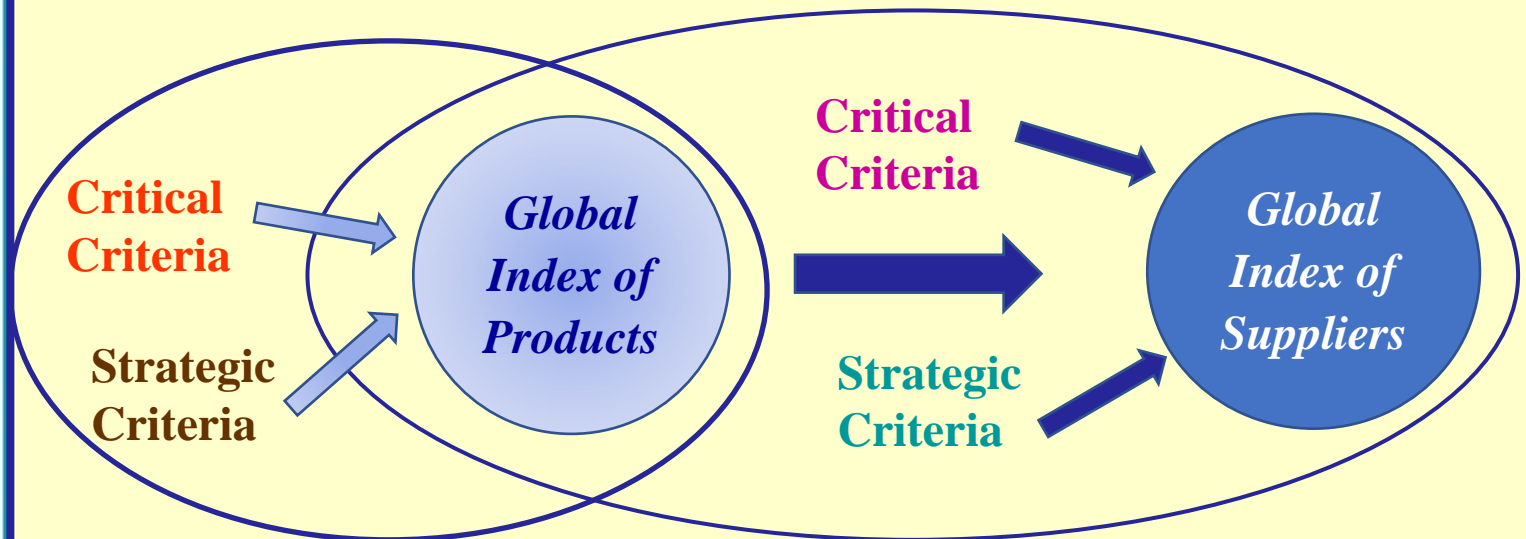
Multiple Criteria based Methodology





Multiple Criteria based Methodology

AHP: to weight the criteria (group decision making)

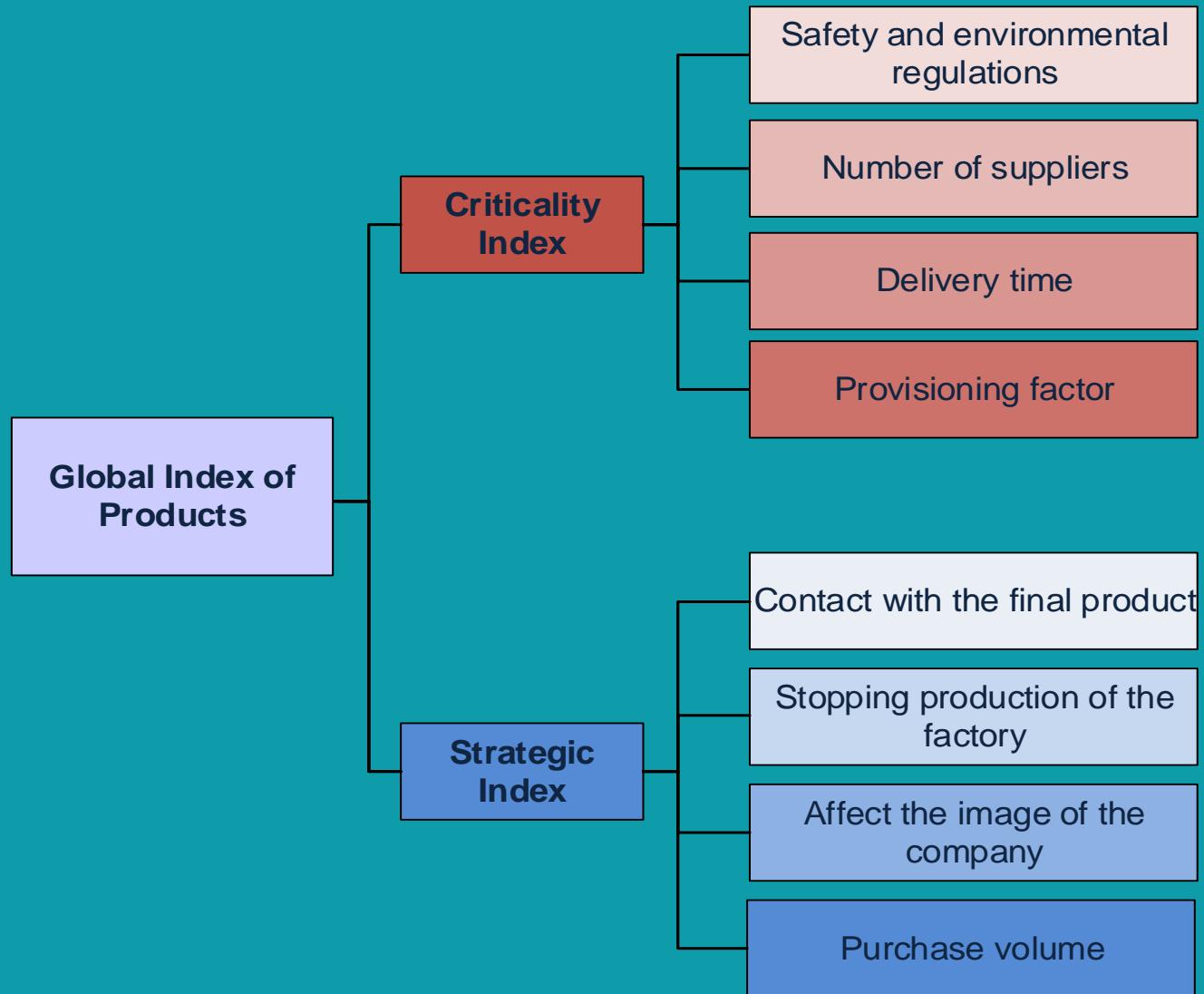


PROMETHEE: to obtain the Global Index of Products and Suppliers

First-step: Criticality and strategic indices of products



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AHP: critical criteria weights

Pairwise comparison matrix of **critical** criteria

Criticality Index	Safety and environmental regulations	Number of suppliers	Delivery time	Provisioning factor
Safety and environmental regulations	1	3	7	8
Number of suppliers	0,33	1	6	9
Delivery time	0,14	0,17	1	2
Provisioning factor	0,13	0,11	0,50	1

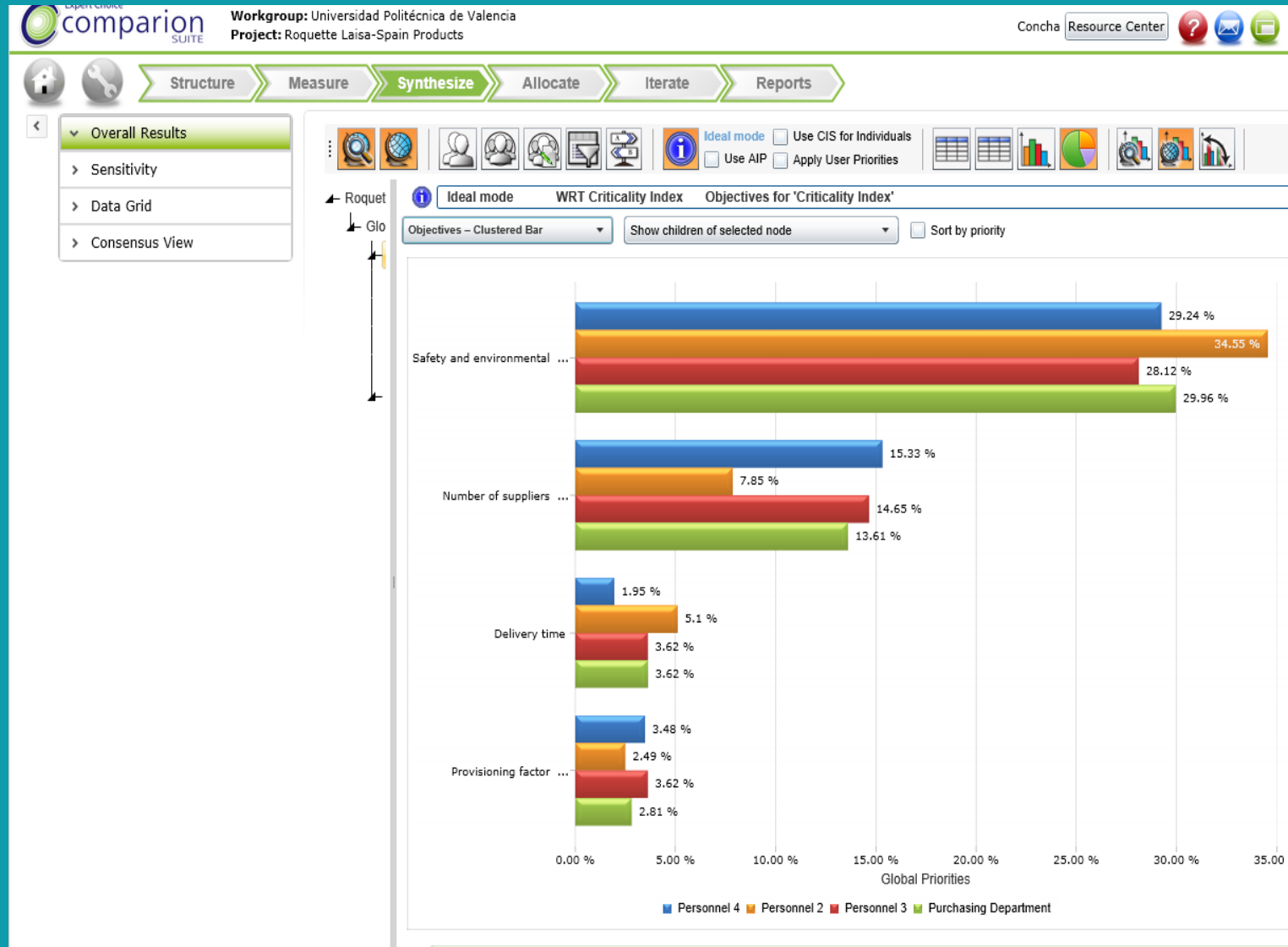


Criticality index of products: weights of criteria



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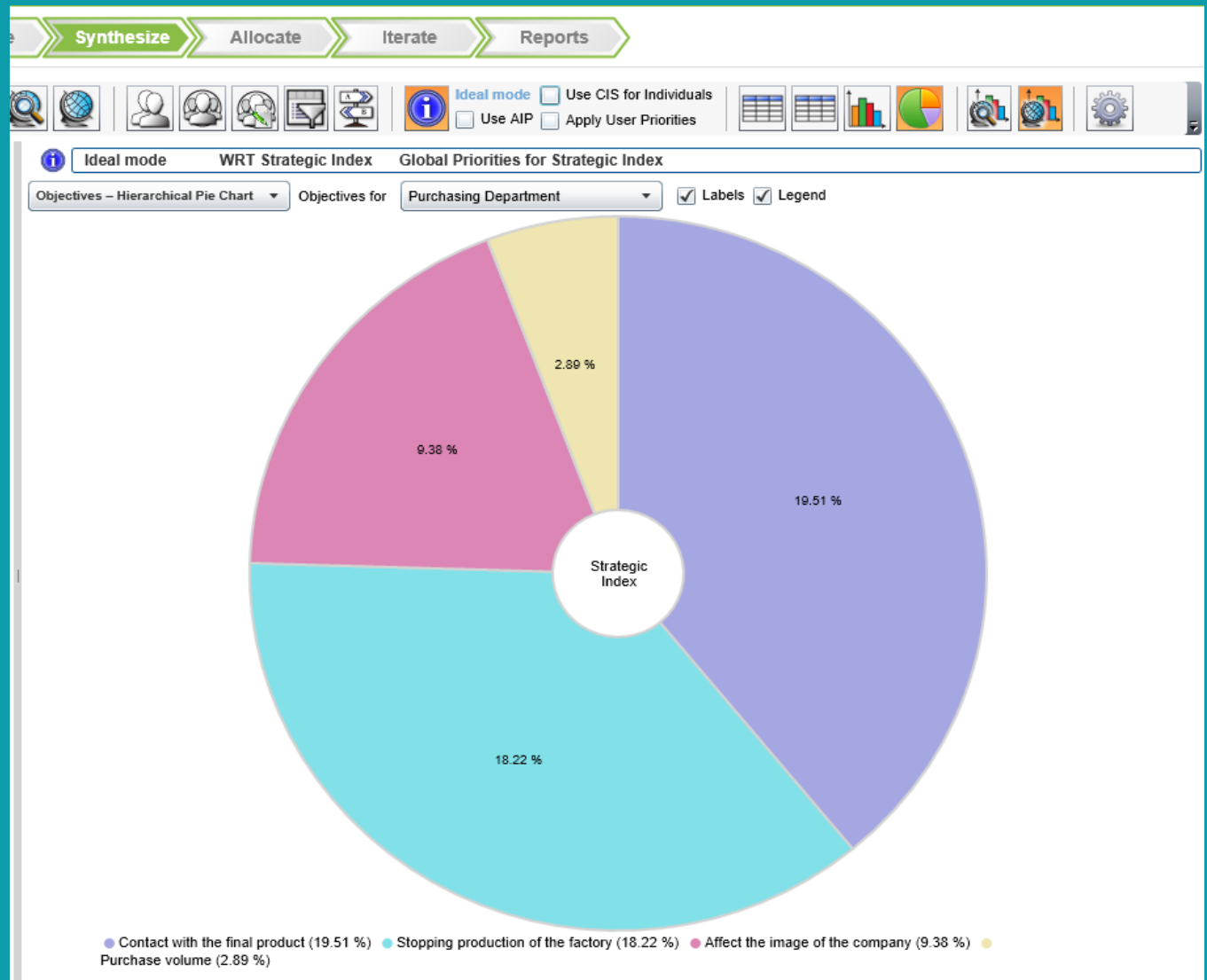
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Strategic index of products: weights of criteria



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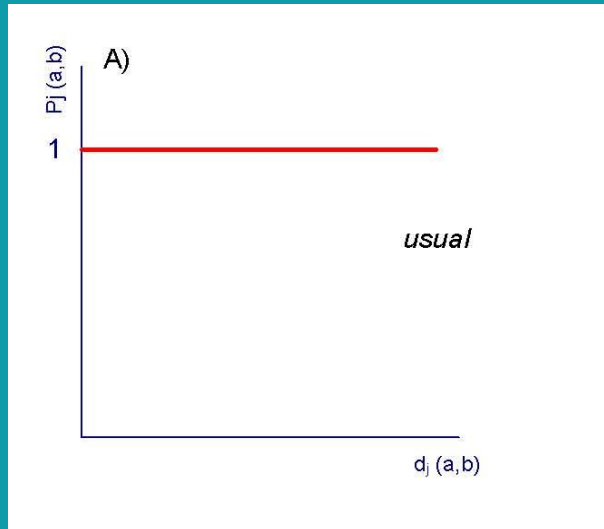


PROMETHEE II: Evaluation Table

	EVALUATION CRITERIA							
PRODUCTS	Purchase volume	Provisioning factor	Safety and environment regulations	Product affects the image	Contact with the final product	Stopping production	Delivery time	Number of suppliers
18670066	386.823,97	42	1	5	5	3	45	5
20020340	551.293,73	93	1	5	5	3	45	4
20030395	1.602.302,68	11	1	3	2	2	7	4
18670015	6.670,28	2	1	5	5	3	30	1
20042800	116.265,63	5	1	3	2	2	30	3



PROMETHEE II: Preference functions

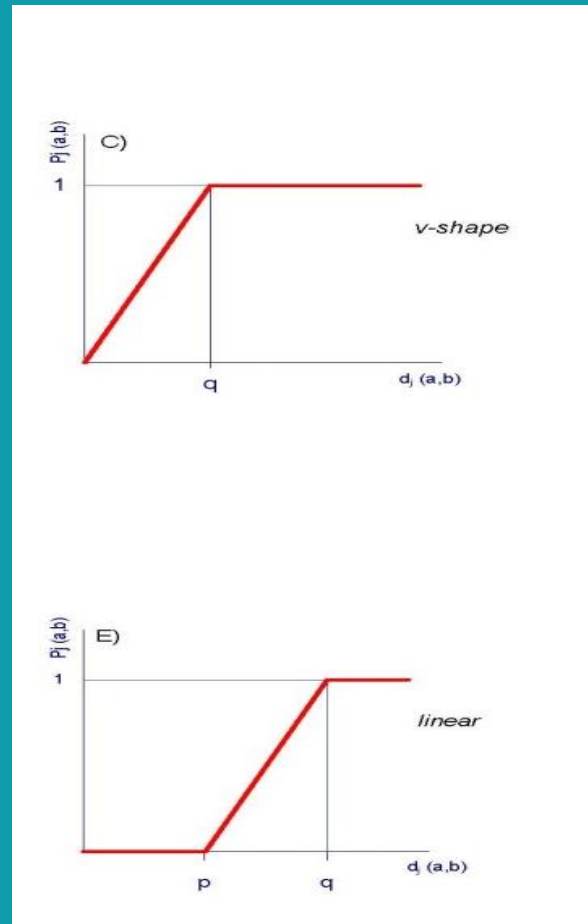


- Safety and environmental regulations
- Contact with the final product
- Stopping production of the factory
- Affect the image of the company





PROMETHEE II: Preference functions



- Number of suppliers
- Delivery time
 - $q = 80$ days
- Provisioning factor

- Purchase volume
 - $p = 50000$ euros
 - $q = 1000000$ euros

The PROMETHEE II Complete Ranking



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Criticality and strategic indices of products (D-Sight)

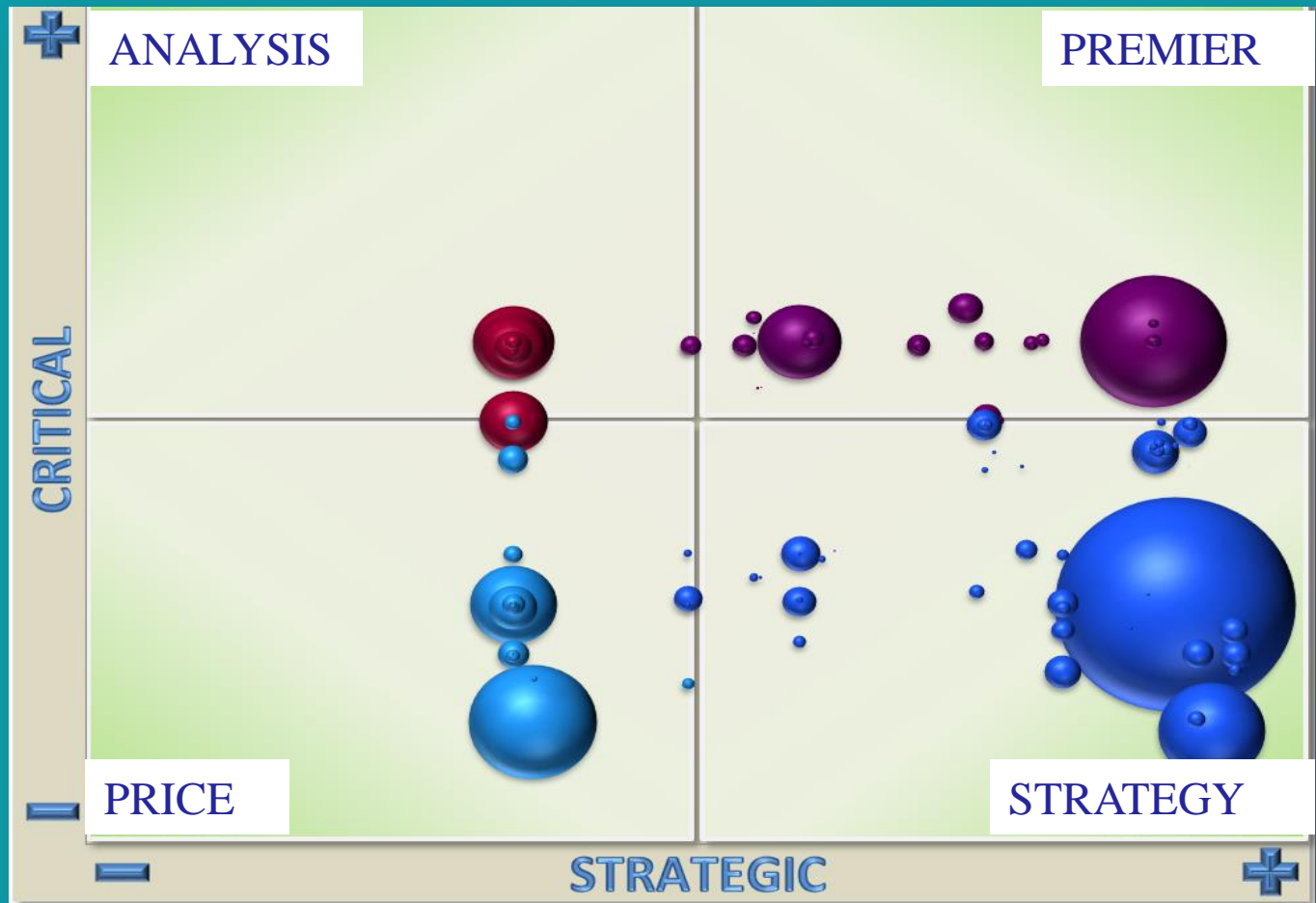
Products	Criticality index	Strategic index	Billing (euros)
18670015	46,37	37,57	4,656.98
20042800	52,29	60,62	96,307.10
18670066	52,44	36,10	297,134.91
20020340	51,28	35,78	465,748.47
20030395	53,42	59,32	1370,447.75

The PROMETHEE II Complete Ranking of products

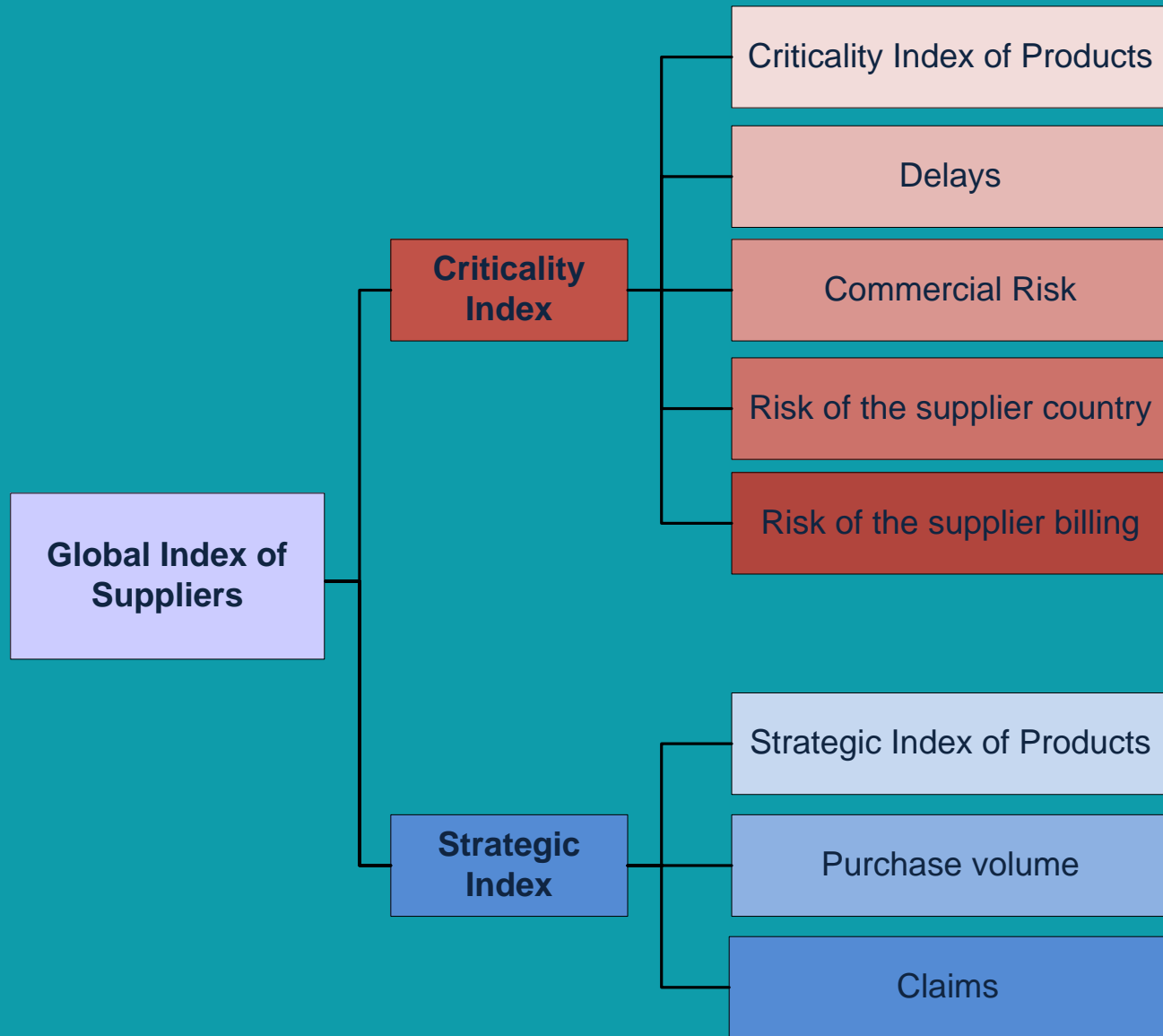


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Criticality and strategic indices of products



Second-step: criticality and strategic indices of suppliers



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Second-step: criticality and strategic indices of suppliers



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AHP: critical criteria weights

An example of pairwise comparison matrix

Criticality Index	Criticality Index of Products	Delays	Commercial Risk	Risk of the supplier country	Risk of the supplier billing
Criticality Index of Products	1	5	3	7	7
Delays	0,20	1	0,33	5	5
Commercial Risk	0,33	3,00	1	3	3
Risk of the supplier country	0,14	0,20	0,33	1	1
Risk of the supplier billing	0,14	0,20	0,33	1,00	1



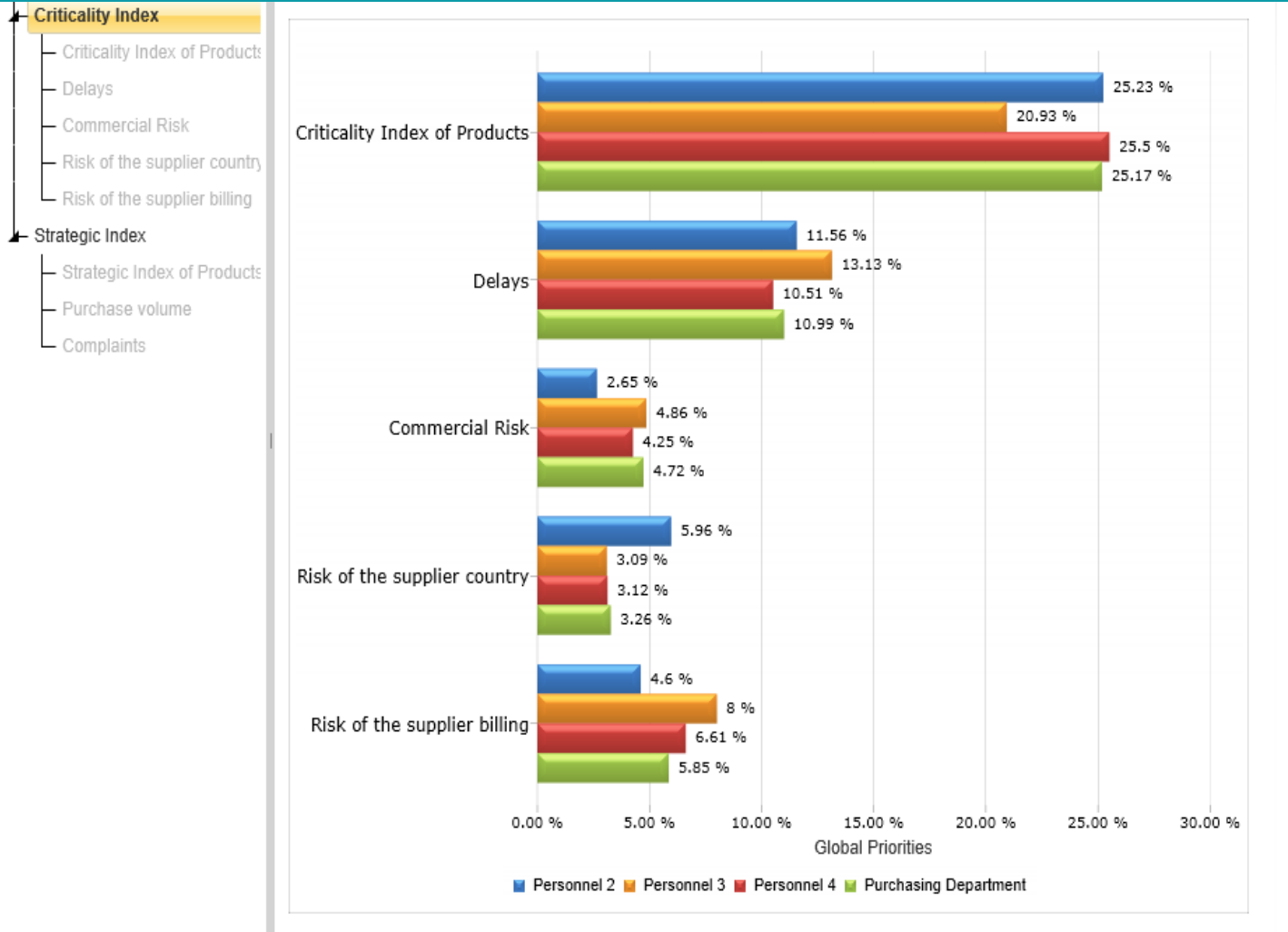
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Second-step: criticality and strategic indices of suppliers

Results of criteria weights for criticality index of suppliers

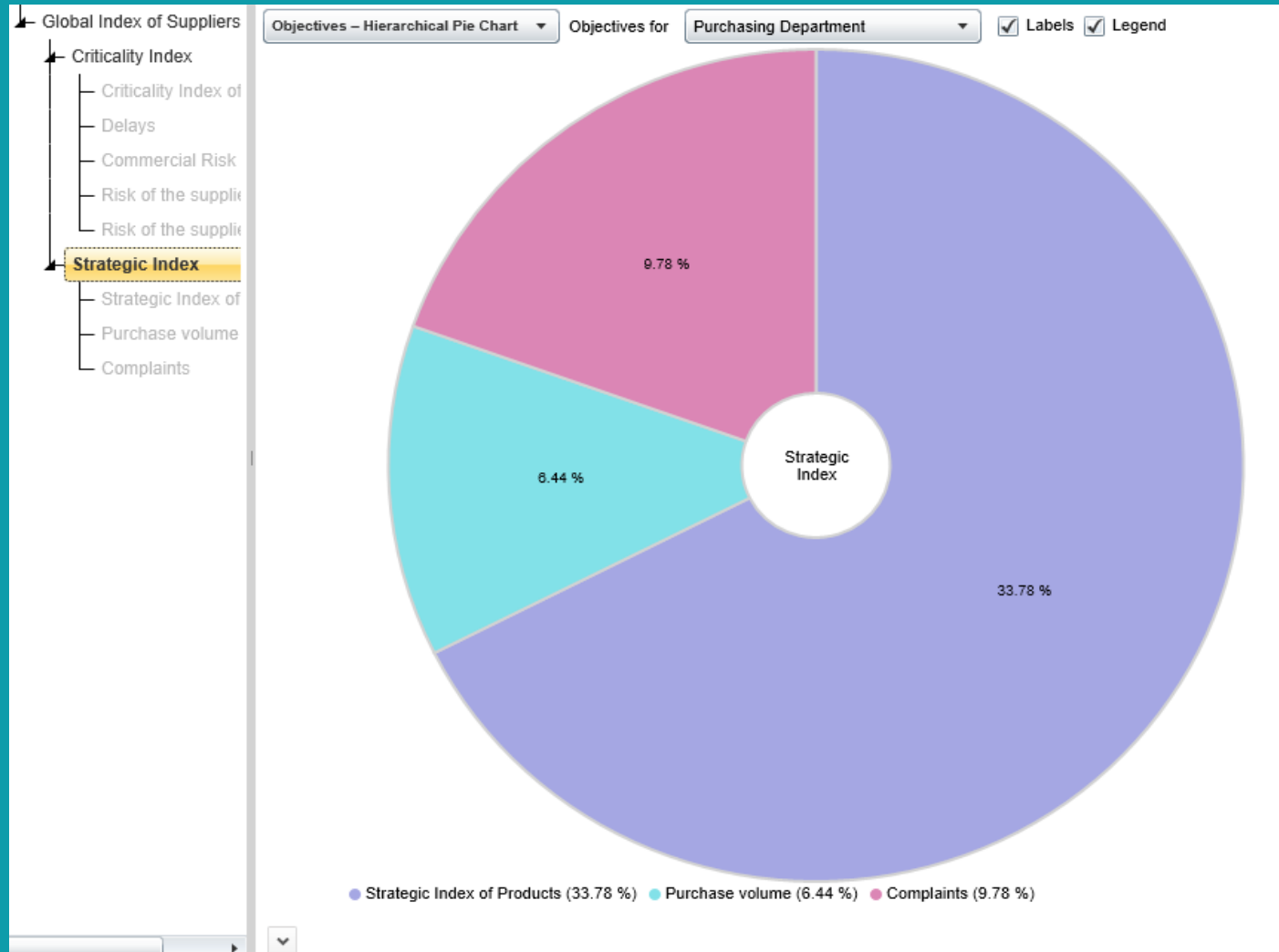


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Second-step: criticality and strategic indices of suppliers

Global results of criteria weights for strategic index of suppliers



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Second-step: criticality and strategic indices of suppliers



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PROMETHEE II: Evaluation Table

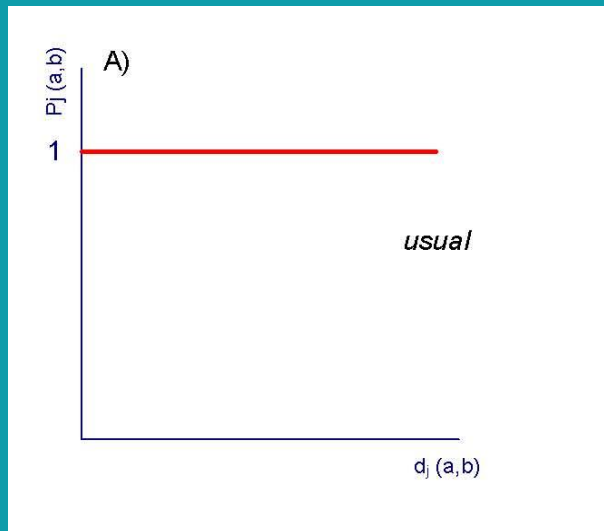
SUPPLIERS	EVALUATION CRITERIA							
	Claims	Purchase volume of supplier	Risk of the supplier billing	Risk of the supplier country	Commercial Risk	Delays	Strategic index of products	Criticality index of products
302563	1	0,15	3,25	B	0	15	36,17	52,68
304061	0	4,36	15,48	B	0	0	61,40	53,93
304422	0	0,06	0,00	B	0	0	36,10	52,44
304438	1	3,79	24,50	B	0	0	59,32	53,42
304573	2	2,84	1,48	B	0	262	37,41	52,38
304601	1	1,49	1,44	B	0	85	61,11	51,76



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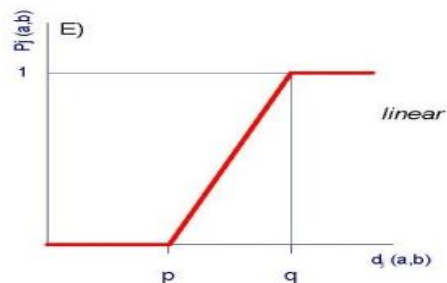
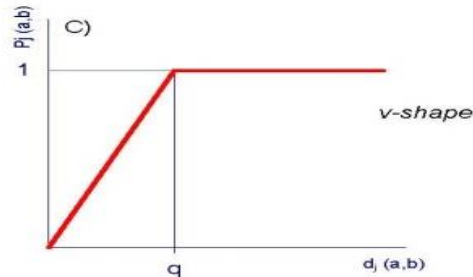
PROMETHEE II: Preference functions



- Criticality Index of Products
- Strategic Index of Products
- Commercial Risk
- Risk of the supplier country



PROMETHEE II: Preference functions



- Delays
 $q = 80$ days
- Claims

- Risk of the supplier billing
 $q = 2.3\%$
 $p = 20\%$
- Purchase volume

The PROMETHEE II Complete Ranking



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Criticality and strategic indices of suppliers (D-Sight)

SUPPLIERS	CRITICALITY INDEX	STRATEGIC INDEX	BILLING
351454	56,95	58,96	337,50
351121	41,93	39,51	153.440,00
351110	37,12	33,79	19.160,00
349878	44,93	41,72	6.422,76
346534	59,89	63,16	305.852,00
346380	39,54	34,50	71.335,70
345835	62,77	65,94	20.246,60

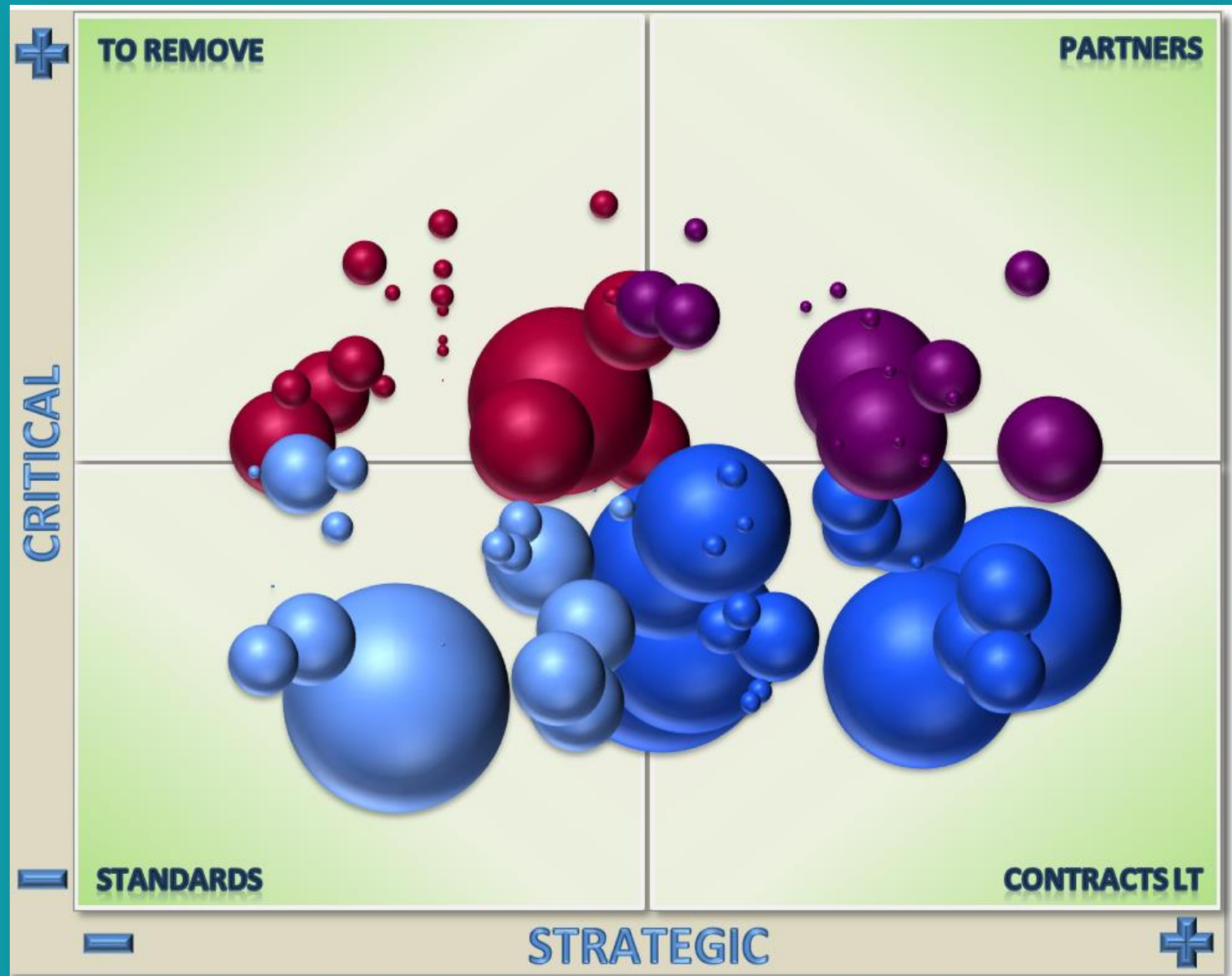


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Second-step: criticality and strategic indices of suppliers



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*Purchasing management by using a hybrid multiple criteria approach based on **PROMETHEE** method*



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Conclusions

- ❖ We have analysed and modified the majority of criteria used in the company to evaluate the products purchasing.
- ❖ We have also changed the performance measures of criteria that were being used and are still in use in order to evaluate products.
- ❖ The purchasing department has implemented a group decision making by using AHP method in order to weight the criteria in the evaluation of products and suppliers.
- ❖ We have designed two indices for suppliers by using the **PROMETHEE** method in order to evaluate how critical and strategic they are.



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Conclusions

- ❖ The criticality index are mainly related to the market while the strategic index is due to internal operations and decisions of the factory.
- ❖ This methodology has been implemented in the Spanish factory that has overcome drawbacks of the previous one. For example, two different products could have the same criticality value. This is not the case when using PROMETHEE.
- ❖ This new methodology has been implemented since the last year for the suppliers of
 - Chemical products
 - Packaging products



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Future work

- ❖ This methodology can be implemented in other factories of Roquette group and other companies by defining their appropriate criteria.
- ❖ We are applying this methodology (ongoing work) for suppliers of **technical products** that represent a very high number (8,000) and have great diversity of applications.
- ❖ Materials for technical products: electrical, electronic, pneumatic, mechanical, hydraulic, etc.. For example, in spare parts we have to consider if parts are for critical machines, safety issues, cost of materials, etc.





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