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Automated reasoning for supplier performance appraisal in supply chains

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Outline

1. Industrial Case
2. Flowsort™ method
3. The LSP evaluation process
4. Numerical example
5. Conclusions & further research

Case

- The case involves a supplier evaluation process of Logistics Services Providers (LSP) in a major Company (Enaex) producing and distributing chemical products to mining companies in Chile and Peru.
- This Company (1st among 5 competitors) was experimenting loss of customers due to failures in the logistics processes in hands of external providers (e.g., transportation, warehousing, packaging, purchasing, etc.).

Case

- 10% of customers representing a 13,3% of total revenue in 2010 were lost due to some kind of delivery problems.
- 14% of deliveries had some type of failure: transportation delays (43%); damaged packaging (42%); stockouts (11%); missing certificates and labeling (4%).

Case

- Instead of a regular ranking of suppliers, a request was made in order to classify in which category a supplier should be included.
- The Categories (C_k) of LSP were defined as:
  - C_1: Suppliers to be maintained,
  - C_2:Promising suppliers (improvement required),
  - C_3:Suppliers to be changed (dismissed).

Flow Sort

- $A = (a_1, a_2, \ldots, a_n)$: the set of *n* actions (LSPs) to be sorted.
- Set G of *q* criteria, g_j (j = 1, ..., q) to be maximized (e.g. Economics, Service, Quality, in our case).
- The categories to which the actions must be assigned are denoted by $C_1, C_2, \ldots, C_k$. *(e.g., Maintain, Promising, Dismiss)*
- These categories are delimited by two boundaries, in the case of limiting profiles.

Flow Sort

- Flowsort method requires for each criterion g_i to have predefined reference profiles; that is, intervals $[v_k - v_{k+1})$ which are associated to the categories **C**.

- Initially these intervals can be given according to the analysts' experience, but ideally it should be inferred from statistical distributions.

Flow Sort

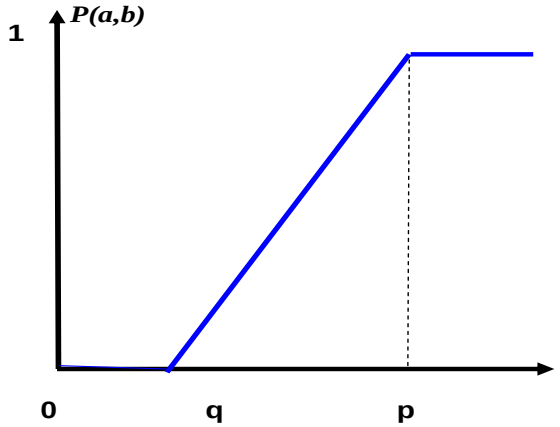
- We used for all the criteria g_i the profile
  { 1.00; 2.00; 3.00; 4.00 }

- Where 1.00 and 4.00 are the lowest and the highest level, respectively.

Criterion	Dismiss	Promising	Maintain
g_i	[1.00 - v_2)	[v_2 - v_3)	[v_3 – 4.00]

Flow Sort

- The Categories are ordered as $C_1 > .. > C_h > C_l > .. > C_k$, where $C_h > C_k$, with $h < l$, which denotes that C_h is preferred to C_l.
- $R = (r_i..., r_{k+1})$ *is* the set of limiting profiles in the case when a category is defined by an upper and lower limit.
- $\pi(x,y)$*:* the preference degree of action *x* over action *y (as in* PROMETHEE) (Brans & Mareschal `99).

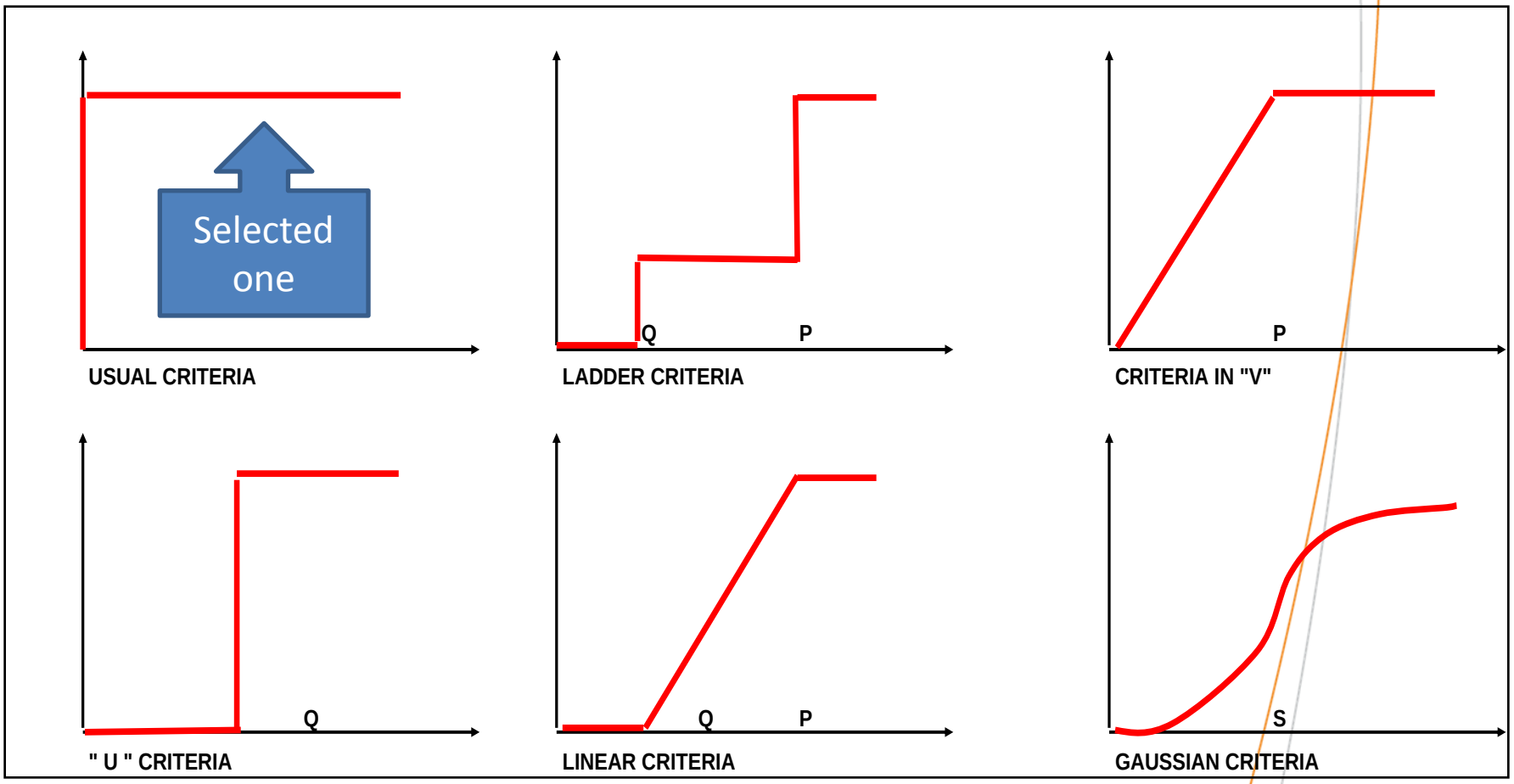


$$\pi(a,b) = \sum_{j=1}^{k} w_j \; P_j(a,b)$$

- In the Preference function, the X-axis represents the *difference* w.r.t. a criterion g_j between two elements *a* and *b*.

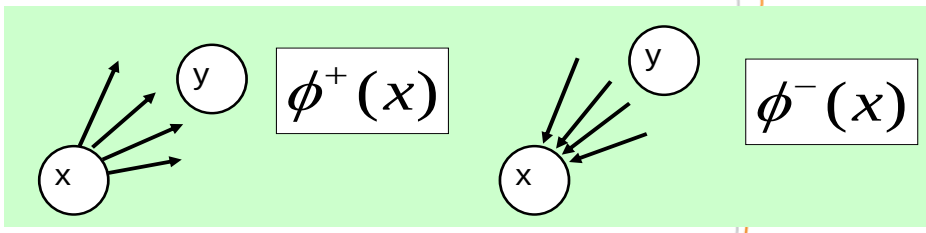
- w_j is the *j-th criterion's weight.*

Preference Functions



Positive flow (dominance) (Brans et Mareschal, 2005):

$$\phi^+_{\dot{R}_i} = \frac{1}{|\dot{R}_i| - 1} \sum_{y \in \dot{R}_i} \pi(x, y)$$



Negative flow (weakness):

$$\phi^-_{\dot{R}_i} = \frac{1}{|\dot{R}_i| - 1} \sum_{y \in \dot{R}_i} \pi(y, x)$$

Flujo neto: $\phi_{\dot{R}_i} = \phi^+_{\dot{R}_i} - \phi^-_{\dot{R}_i}$

Flowsort classification rule
(Nemery & Lamboray, 2008)

$$C_{\phi^+}(a_i) = C_h, \quad if\ \phi^+_{R_i}(r_h) \geq \phi^+_{R_i}(a_1) > \phi^+_{R_i}(r_{h+1})$$

$$C_{\phi^-}(a_i) = C_h, \quad if\ \phi^-_{R_i}(r_h) < \phi^-_{R_i}(a_1) \leq \phi^-_{R_i}(r_{h+1})$$

LSP Evaluation process

- The classification considers as main criteria three factors (Martínez, 2007): Economics (C1), Service (C2), and Quality (C3).
- A survey was conducted among the managers responsible for the selection and evaluation of suppliers in order to determine the most important aspects.
- We selected two sub-criteria for each main factor giving a 2x2 matrix per criterion.

LSP Evaluation process

Criteria	Weight	Quadrants	Level
Economics	0,40	High Price, cash payment Low price, cash payment High Price, credit Low price, credit	1 2 3 4
Service	0,35	Long lead time, low warranty Long lead time, high warranty Short lead time, low warranty Short lead time, high warranty	1 2 3 4
Quality	0,25	No certification, low quality With certification*, low quality No certification, high quality With certificación, high quality	1 2 3 4

* ISO 9001:2008

LSP Evaluation process

Criteria	KPI used	Ideal
Economics	Cost per sq. meter of storage Cost per kg. stored Cost per kg. transported Payment days on invoices	$2-$5/m2 $1-$10/100kg $1-$20$/100kg >30 Days
Service	Mean tardiness over due date Reaction time to info reqs. Tardy orders over total Damaged packaging	< 2 Days < 1 Day < 4% < 4%
Quality	Certification (implementation) Percentage of claims	100% <4%

LSP Evaluation process

Prov-ider	Economics (C1)	Service (C2)	Quality (C3)
1	4,0	1,0	1,0
2	4,0	3,0	1,0
3	3,4	3,0	3,0
4	3,4	4,0	3,0
5	3,0	4,0	3,0
6	1,0	3,0	1,0
7	1,0	1,0	1,0
8	1,0	2,0	1,0
9	1,4	3,0	3,0

Category definition

Supplier to Maintain	**supplier which maintains positive performance and optimal characteristics in order to remain as an LSP. The assessment for this type of provider must be every six months or once a year to check if performance is maintained**
Promising Supplier	supplier which maintains average relative performance, i.e., it possesses some positive features and some others not so satisfactory, which makes them potential candidates for improvement. These types of providers require a monthly evaluation and performance monitoring. In case of failure, measures should be taken according to the existing contract (warnings, penalties, etc.). Should this supplier improve its performance then take appropriate action to maintain it as an LSP.
Supplier to be Changed	Supplier which has negative rates or low performance. These types of providers are required to be monthly evaluated and reviewed the existing contract due to the potential losses it can produce to the company.

Numerical Example (Excel)

Step 3: Application of Flowsort Method

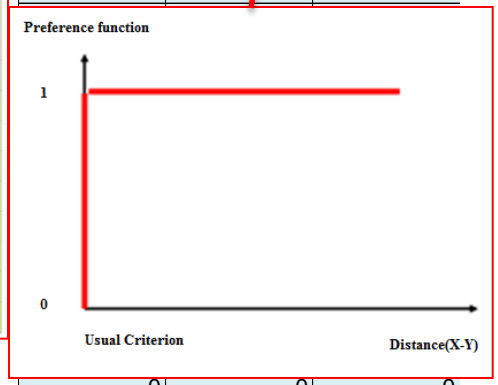
Difference between Score level and R_i

	C1	C2	C3
E1-R1	0	-3	-3
E1-R2	1	-2	-2
E1-R3	2	-1	-1
E1-R4	3	0	0
E2-R1	0	-1	-3
E2-R2	1	0	-2
E2-R3	2	1	-1
E2-R4	3	2	0
E3-R1	-0,6	-1	-1
E3-R2	0,4	0	0
E3-R3	1,4	1	1
E3-R4	2,4	2	2
E4-R1	-0,6	0	-1
E4-R2			
E4-R3			
E4-R4			
E5-R1			
E5-R2			
E5-R3			
E5-R4			
E6-R1			
E6-R2			
E6-R3			
E6-R4			
E7-R1			
E7-R2	-2	-2	-2
E7-R3	-1	-1	-1
E7-R4	0	0	0
E8-R1	-3	-2	-3
E8-R2	-2	-1	-2
E8-R3	-1	0	-1
E8-R4	0	1	0
E9-R1	-2,6	-1	-1
E9-R2	-1,6	0	0
E9-R3	-0,6	1	1
E9-R4	0,4	2	2

Provider	Economics (C1)	Service (C2)	Quality (C3)
1	4,0	1,0	1,0
2	4,0	3,0	1,0
3	3,4	3,0	3,0
4	3,4	4,0	3,0
5	3,0	4,0	3,0
6	1,0	3,0	1,0
7	1,0	1,0	1,0
8	1,0	2,0	1,0
9	1,4	3,0	3,0

Preference Function P(x,y) - Type II with p=0

C1	C2	C3
0	0	0
1	0	0
1	0	0
1	0	0
0	0	0
1	0	0
1	1	0
1	1	0
0	0	0
1	0	0
1	1	1
1	1	1
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	1	0
0	0	0
0	0	0
0	1	1
1	1	1



$$\pi(x,y) = \sum_{j=1}^{q} w_j P(x,y)$$

$\pi(E_i,r_j)$	Value
π(E1,r1)	0,000
π(E1,r2)	0,400
π(E1,r3)	0,400
π(E1,r4)	0,400
π(E2,r1)	0,000
π(E2,r2)	0,400
π(E2,r3)	0,750
π(E2,r4)	0,750
π(E3,r1)	0,000
π(E3,r2)	0,400
π(E3,r3)	1,000
π(E3,r4)	1,000
π(E4,r1)	0,000
π(E4,r2)	0,750
π(E4,r3)	1,000
π(E6,r1)	0,000
π(E6,r2)	0,000
π(E6,r3)	0,350
π(E6,r4)	0,350
π(E7,r1)	0,000
π(E7,r2)	0,000
π(E7,r3)	0,000
π(E7,r4)	0,000
π(E8,r1)	0,000
π(E8,r2)	0,000
π(E8,r3)	0,000
π(E8,r4)	0,350
π(E9,r1)	0,000
π(E9,r2)	0,000
π(E9,r3)	0,600
π(E9,r4)	1,000

Numerical Example (Excel)

Step 3: Application of Flowsort Method

Difference between Score level and R_i

	C1	C2	C3
E1-R1	0	-3	-3
E1-R2	1	-2	-2
E1-R3	2	-1	-1
E1-R4	3	0	0
E2-R1	0	-1	-3
E2-R2	1	0	-2
E2-R3	2	1	-1
E2-R4	3	2	0
E3-R1	-0,6	-1	-1
E3-R2	0,4	0	0
E3-R3	1,4	1	1
E3-R4	2,4	2	2
E4-R1	-0,6	0	-1
E4-R2	0,4	1	0
E4-R3	1,4	2	1
E4-R4	2,4	3	2
E5-R1	-1	0	-1
E5-R2	0	1	0
E5-R3	1	2	1
E5-R4	2	3	2
E6-R1	-3	-1	-3
E6-R2	-2	0	-2
E6-R3	-1	1	-1
E6-R4	0	2	0
E7-R1	-3	-3	-3
E7-R2	-2	-2	-2
E7-R3	-1	-1	-1
E7-R4	0	0	0
E8-R1	-3	-2	-3
E8-R2	-2	-1	-2
E8-R3	-1	0	-1
E8-R4	0	1	0
E9-R1	-2,6	-1	-1
E9-R2	-1,6	0	0
E9-R3	-0,6	1	1
E9-R4	0,4	2	2

Preference Function P(x,y) - Type II with p=0

C1	C2	C3
0	0	0
1	0	0
1	0	0
1	0	0
0	0	0
1	0	0
1	1	0
1	1	0
0	0	0
1	0	0
1	1	1
1	1	1
0	0	0
1	1	0
1	1	1
1	1	1
0	0	0
0	1	0
1	1	1
1	1	1
0	0	0
0	0	0
0	1	0
0	1	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	1	0
0	0	0
0	0	0
0	1	1
1	1	1

$\pi(E_i,r_j)$	Value
π(E1,r1)	0,000
π(E1,r2)	0,400
π(E1,r3)	0,400
π(E1,r4)	0,400
π(E2,r1)	0,000
π(E2,r2)	0,400
π(E2,r3)	0,750
π(E2,r4)	0,750
π(E3,r1)	0,000
π(E3,r2)	0,400
π(E3,r3)	1,000
π(E3,r4)	1,000
π(E4,r1)	0,000
π(E4,r2)	0,750
π(E4,r3)	1,000
π(E4,r4)	1,000
π(E5,r1)	0,000
π(E5,r2)	0,350
π(E5,r3)	1,000
π(E5,r4)	1,000
π(E6,r1)	0,000
π(E6,r2)	0,000
π(E6,r3)	0,350
π(E6,r4)	0,350
π(E7,r1)	0,000
π(E7,r2)	0,000
π(E7,r3)	0,000
π(E7,r4)	0,000
π(E8,r1)	0,000
π(E8,r2)	0,000
π(E8,r3)	0,000
π(E8,r4)	0,350
π(E9,r1)	0,000
π(E9,r2)	0,000
π(E9,r3)	0,600
π(E9,r4)	1,000

Numerical Example (Excel)

R1-E1	0	3	3	0	1	1	π(R1,E1)	0,600
R1-E2	0	1	3	0	1	1	π(R1,E2)	0,600
R1-E3	0,6	1	1	1	1	1	π(R1,E3)	1,000
R1-E4	0,6	0	1	1	0	1	π(R1,E4)	0,650
R1-E5	1	0	1	1	0	1	π(R1,E5)	0,650
R1-E6	3	1	3	1	1	1	π(R1,E6)	1,000
R1-E7	3	3	3	1	1	1	π(R1,E7)	1,000
R1-E8	3	2	3	1	1	1	π(R1,E8)	1,000
R1-E9	2,6	1	1	1	1	1	π(R1,E9)	1,000
R2-E1	-1	2	2	0	1	1	π(R2,E1)	0,600
R2-E2	-1	0	2	0	0	1	π(R2,E2)	0,250
R2-E3	-0,4	0	0	0	0	0	π(R2,E3)	0,000
R2-E4	-0,4	-1	0	0	0	0	π(R2,E4)	0,000
R2-E5	0	-1	0	0	0	0	π(R2,E5)	0,000
R2-E6	2	0	2	1	0	1	π(R2,E6)	0,650
R2-E7	2	2	2	1	1	1	π(R2,E7)	1,000
R2-E8	2	1	2	1	1	1	π(R2,E68)	1,000
R2-E9	1,6	0	0	1	0	0	π(R2,E69)	0,400
R3-E1	-2	1	1	0	1	1	π(R3,E1)	0,600
R3-E2	-2	-1	1	0	0	1	π(R3,E2)	0,250
R3-E3	-1,4	-1	-1	0	0	0	π(R3,E3)	0,000
R3-E4	-1,4	-2	-1	0	0	0	π(R3,E4)	0,000
R3-E5	-1	-2	-1	0	0	0	π(R3,E5)	0,000
R3-E6	1	-1	1	1	0	1	π(R3,E6)	0,650
R3-E7	1	1	1	1	1	1	π(R3,E7)	1,000
R3-E8	1	0	1	1	0	1	π(R3,E8)	0,650
R3-E9	0,6	-1	-1	1	0	0	π(R3,E9)	0,400
R4-E1	-3	0	0	0	0	0	π(R4,E1)	0,000
R4-E2	-3	-2	0	0	0	0	π(R4,E2)	0,000
R4-E3	-2,4	-2	-2	0	0	0	π(R4,E3)	0,000
R4-E4	-2,4	-3	-2	0	0	0	π(R4,E4)	0,000
R4-E5	-2	-3	-2	0	0	0	π(R4,E5)	0,000
R4-E6	0	-2	0	0	0	0	π(R4,E6)	0,000
R4-E7	0	0	0	0	0	0	π(R4,E7)	0,000
R4-E8	0	-1	0	0	0	0	π(R4,E8)	0,000
R4-E9	-0,4	-2	-2	0	0	0	π(R4,E9)	0,000

Final Results

r4 <=	**Φ(+) Ei**	< r3	Cambiar	r4 >=	**Φ(-) Ei**	> r3	Cambiar	
r3 <=	**Φ(+) Ei**	< r2	Prometedor	r3 >=	**Φ(-) Ei**	> r2	Prometedor	
r2 <=	**Φ(+) Ei**	< r1	Mantener	r2 >=	**Φ(-) Ei**	> r1	Mantener	

Resultados Flow Sort		r1	r2	r3	r4	Ei	Clasificacion
	Φ(+)	0,900	0,650	0,400	0,000	0,300	Cambiar
	Φ(-)	0,000	0,350	0,600	0,850	0,450	Prometedor
R1	**Φ(neto)**	0,900	0,300	-0,200	-0,850	-0,150	Prometedor
	Φ(+)	0,900	0,563	0,313	0,000	0,475	Prometedor
	Φ(-)	0,000	0,350	0,688	0,938	0,275	Mantener
R2	**Φ(neto)**	0,900	0,213	-0,375	-0,938	0,200	Prometedor
	Φ(+)	1,000	0,500	0,250	0,000	0,500	Mantener
	Φ(-)	0,000	0,350	0,750	1,000	0,250	Mantener
R3	**Φ(neto)**	1,000	0,150	-0,500	-1,000	0,350	Mantener
	Φ(+)	0,913	0,500	0,250	0,000	0,688	Mantener
		00			1,000	0,163	Mantener
		13			-1,000	0,525	Mantener
		13			0,000	0,588	Mantener
		00			1,000	0,163	Mantener
		0,913	0,163	-0,500	-1,000	0,425	Mantener
	Φ(+)	1,000	0,663	0,413			
	Φ(-)						
R6	**Φ(neto)**				-0,838	-0,400	Cambiar
	Φ(+)				0,000	-	Cambiar
	Φ(-)				0,750	0,750	Cambiar
R7	**Φ(neto)**	1,000	0,500	0,000			
	Φ(+)	1,000	0,750	0,413			
	Φ(-)	0,000	0,250	0,500			
R8	**Φ(neto)**	1,000	0,500	-0,088	-0,838	-0,575	Cambiar
	Φ(+)	1,000	0,600	0,350	0,000	0,400	Prometedor
	Φ(-)	0,000	0,250	0,650	1,000	0,450	Prometedor
R9	**Φ(neto)**	1,000	0,350	-0,300	-1,000	-0,050	Prometedor

$$\phi^{+}_{\dot{R}_i} = \frac{1}{\left|\dot{R}_i\right| - 1} \sum_{y \in \dot{R}_i} \pi(x, y)$$

$$\phi^{-}_{\dot{R}_i} = \frac{1}{|\dot{R}_i| - 1} \sum_{y \in \dot{R}_i} \pi(y, x)$$

$$\phi_{\dot{R}_i} = \phi^{+}_{\dot{R}_i} + \phi^{-}_{\dot{R}_i}$$

$$C_{\phi^+}(a_i) = C_h, if \phi^{+}_{R_i}(r_h) \geq \phi^{+}_{R_i}(a_1) > \phi^{+}_{R_i}(r_{h+1})$$

$$C_{\phi^-}(a_i) = C_h, if \phi^{-}_{R_i}(r_h) < \phi^{-}_{R_i}(a_1) \leq \phi^{-}_{R_i}(r_{h+1})$$

Final Results

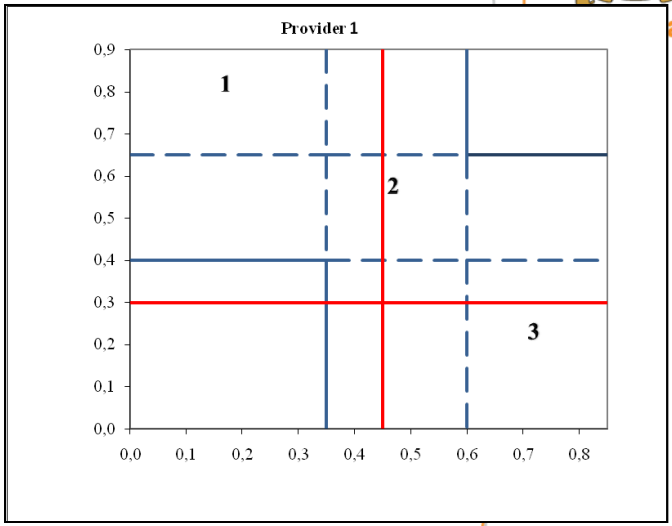
r4 <=	**Φ(+) Ei**	< r3	Cambiar	r4 >=	**Φ(-) Ei**	> r3	Cambiar
r3 <=	**Φ(+) Ei**	< r2	Prometedor	r3 >=	**Φ(-) Ei**	> r2	Prometedor
r2 <=	**Φ(+) Ei**	< r1	Mantener	r2 >=	**Φ(-) Ei**	> r1	Mantener

Resultados Flow Sort		r1	r2	r3	r4	Ei	Clasificacion
	Φ(+)	0,900	0,650	0,400	0,000	0,300	Cambiar
	Φ(-)	0,000	0,350	0,600	0,850	0,450	Prometedor
R1	**Φ(neto)**	0,900	0,300	-0,200	-0,850	-0,150	Prometedor
	Φ(+)	0,900	0,563	0,313	0,000	0,475	Prometedor
	Φ(-)	0,000	0,350	0,688	0,938	0,275	Mantener
R2	**Φ(neto)**	0,900	0,213	-0,375	-0,938	0,200	Prometedor
	Φ(+)	1,000	0,500	0,250	0,000	0,600	Mantener
	Φ(-)	0,000	0,350	0,750	1,000	0,250	Mantener
R3	**Φ(neto)**	1,000	0,150	-0,500	-1,000	0,350	Mantener
	Φ(+)	0,913	0,500	0,250	0,000	0,688	Mantener
	Φ(-)	0,000	0,438	0,750	1,000	0,163	Mantener
R4	**Φ(neto)**	0,913	0,063	-0,500	-1,000	0,525	Mantener
	Φ(+)	0,913	0,500	0,250	0,000	0,588	Mantener
	Φ(-)	0,000	0,338	0,750	1,000	0,163	Mantener
R5	**Φ(neto)**	0,913	0,163	-0,500	-1,000	0,425	Mantener
	Φ(+)	1,000	0,663	0,413	0,000	0,175	Cambiar
	Φ(-)	0,000	0,250	0,588	0,838	0,575	Prometedor
R6	**Φ(neto)**	1,000	0,413	-0,175	-0,838	-0,400	Cambiar
	Φ(+)	1,000	0,750	0,500	0,000	-	Cambiar
	Φ(-)	0,000	0,250	0,500	0,750	0,750	Cambiar
R7	**Φ(neto)**	1,000	0,500	0,000	-0,750	-0,750	Cambiar
	Φ(+)	1,000	0,750	0,413	0,000	0,088	Cambiar
	Φ(-)	0,000	0,250	0,500	0,838	0,663	Cambiar
R8	**Φ(neto)**	1,000	0,500	-0,088	-0,838	-0,575	Cambiar
	Φ(+)	1,000	0,600	0,350	0,000	0,400	Prometedor
	Φ(-)	0,000	0,250	0,650	1,000	0,450	Prometedor
R9	**Φ(neto)**	1,000	0,350	-0,300	-1,000	-0,050	Prometedor

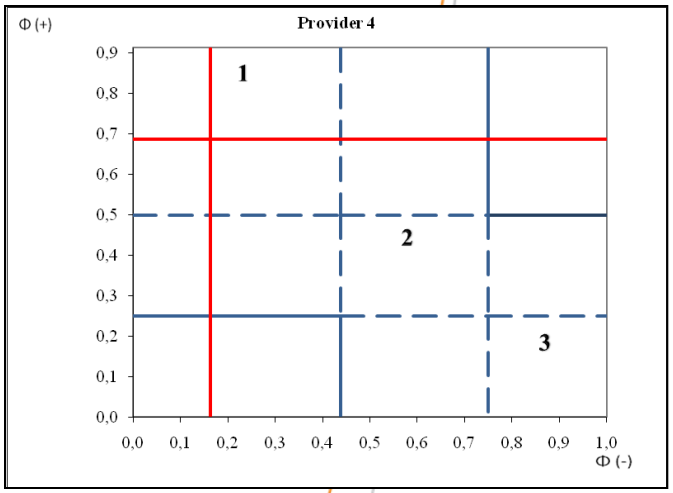
Summary of Results

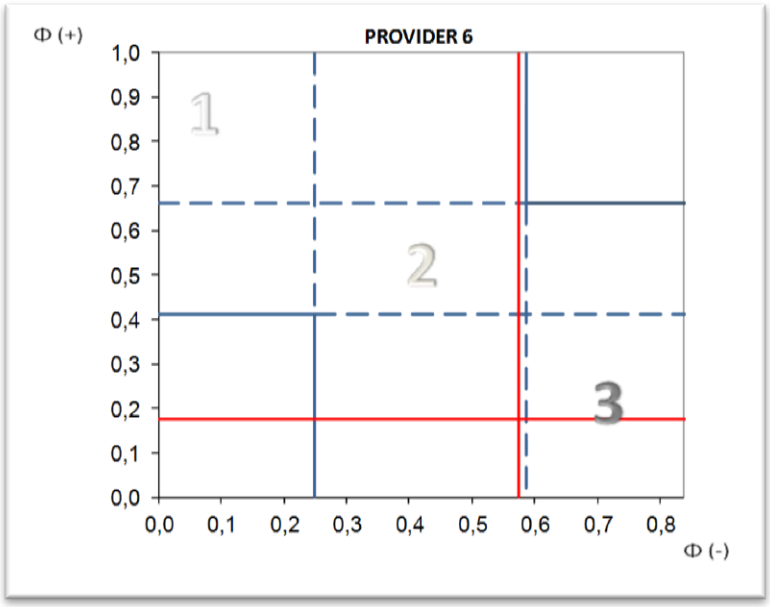
		Ei	Sorting
	ϕ(+)	0,300	Change
	ϕ(-)	0,450	Promising
R1	ϕ(net)	-0,150	Promising
	ϕ(+)	0,475	Promising
	ϕ(-)	0,275	Maintain
R2	ϕ(net)	0,200	Promising
	ϕ(+)	0,600	Maintain
	ϕ(-)	0,250	Maintain
R3	ϕ(net)	0,350	Maintain
	ϕ(+)	0,688	Maintain
	ϕ(-)	0,163	Maintain
R4	ϕ(net)	0,525	Maintain
	ϕ(+)	0,588	Maintain
	ϕ(-)	0,163	Maintain
R5	ϕ(net)	0,425	Maintain
	ϕ(+)	0,175	Change
	ϕ(-)	0,575	Promising
R6	ϕ(net)	-0,400	Change
	ϕ(+)	0	Change
	ϕ(-)	0,750	Change
R7	ϕ(net)	-0,750	Change
	ϕ(+)	0,088	Change
	ϕ(-)	0,663	Change
R8	ϕ(net)	-0,575	Change
	ϕ(+)	0,400	Promising
	ϕ(-)	0,450	Promising
R9	ϕ(net)	-0,050	Promising

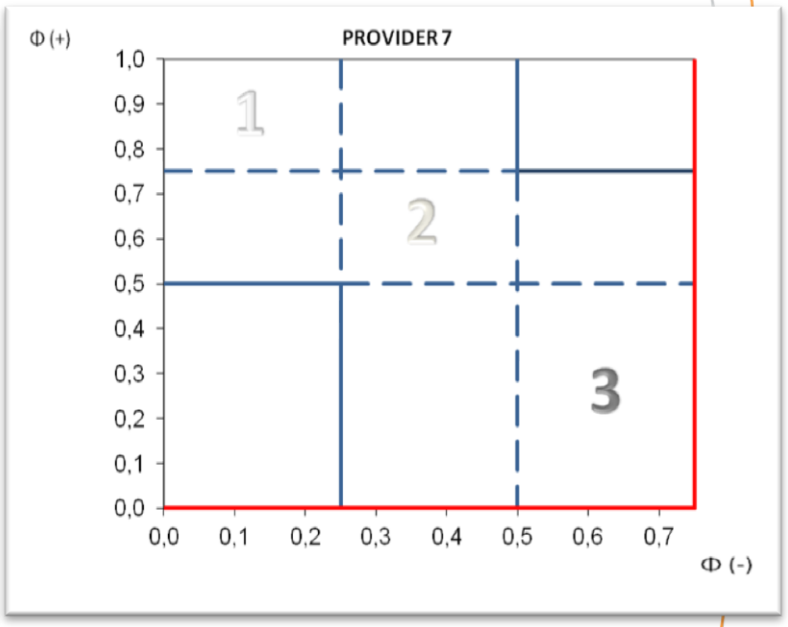
P1 - Ambiguous case



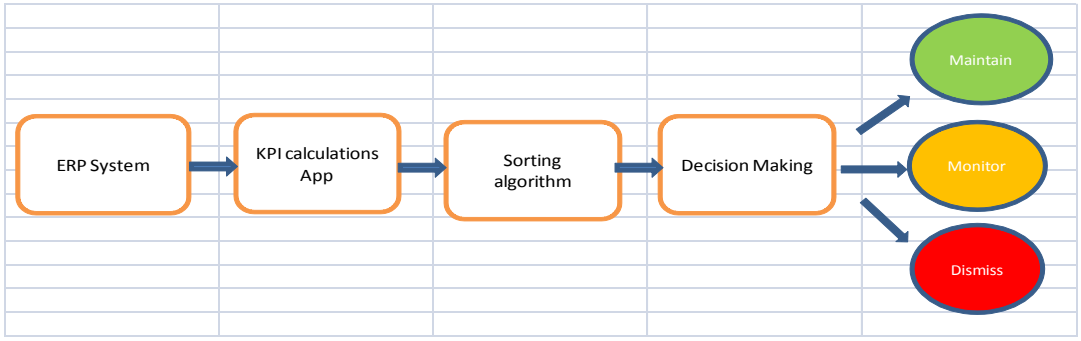
P4 - Neat case



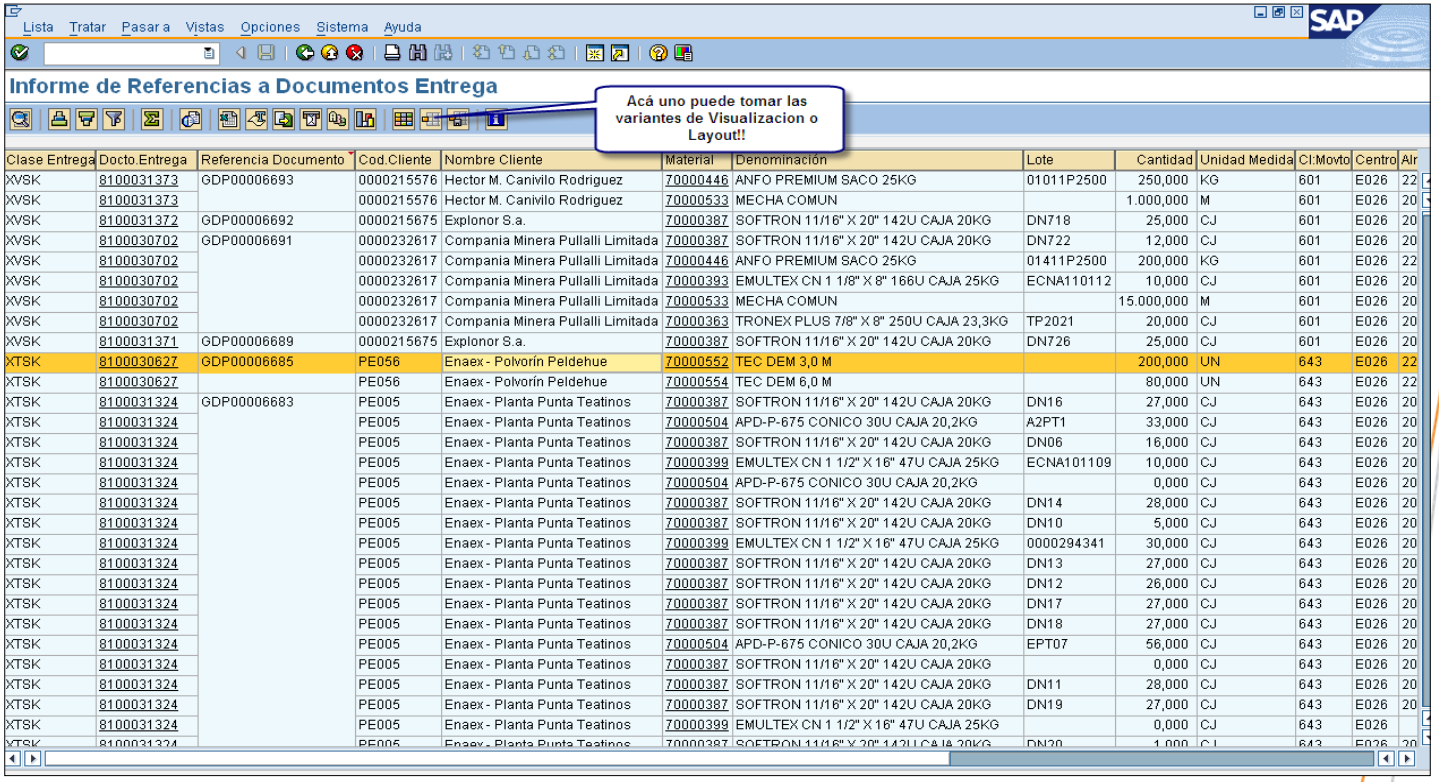




Provider 6 also decided based on net flow.
Provider 7 not ambiguous and to be dismissed by all means.



Implementation with commercial ERP software



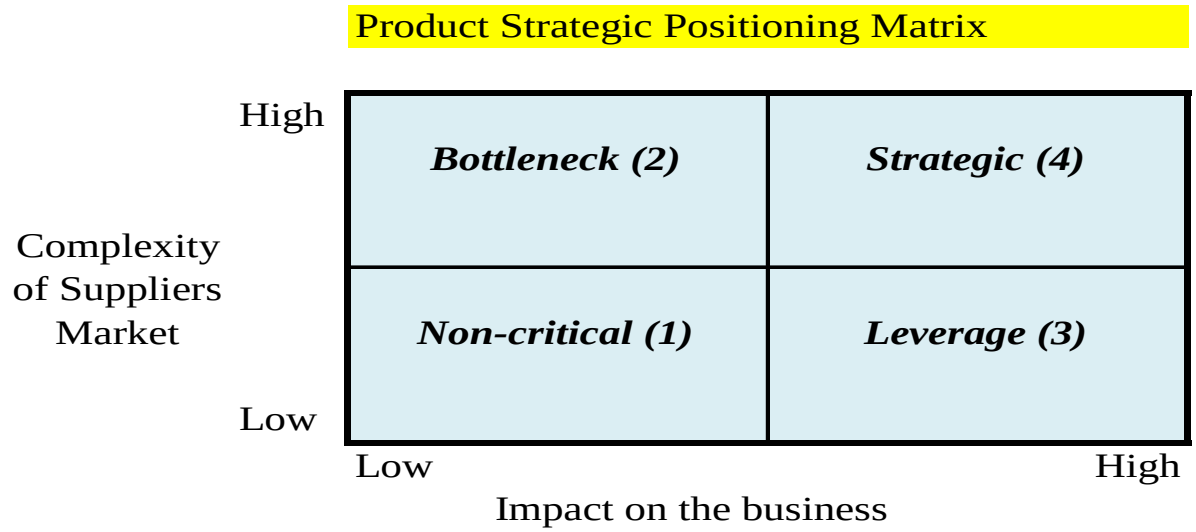
Clase Entrega	Docto.Entrega	Referencia Documento	Cod.Cliente	Nombre Cliente	Material	Denominación	Lote	Cantidad	Unidad Medida	Cl.Movto	Centro	Alr
XVSK	8100031373	GDP00006693	0000215576	Hector M. Canivilo Rodriguez	70000446	ANFO PREMIUM SACO 25KG	01011P2500	250,000	KG	601	E026	22
XVSK	8100031373		0000215576	Hector M. Canivilo Rodriguez	70000533	MECHA COMUN		1.000,000	M	601	E026	20
XVSK	8100031372	GDP00006692	0000215675	Explonor S.a.	70000387	SOFTRON 11/16" X 20" 142U CAJA 20KG	DN718	25,000	CJ	601	E026	20
XVSK	8100030702	GDP00006691	0000232617	Compania Minera Pullalli Limitada	70000387	SOFTRON 11/16" X 20" 142U CAJA 20KG	DN722	12,000	CJ	601	E026	20
XVSK	8100030702		0000232617	Compania Minera Pullalli Limitada	70000446	ANFO PREMIUM SACO 25KG	01411P2500	200,000	KG	601	E026	22
XVSK	8100030702		0000232617	Compania Minera Pullalli Limitada	70000393	EMULTEX CN 1 1/8" X 8" 166U CAJA 25KG	ECNA110112	10,000	CJ	601	E026	20
XVSK	8100030702		0000232617	Compania Minera Pullalli Limitada	70000533	MECHA COMUN		15.000,000	M	601	E026	20
XVSK	8100030702		0000232617	Compania Minera Pullalli Limitada	70000363	TRONEX PLUS 7/8" X 8" 250U CAJA 23,3KG	TP2021	20,000	CJ	601	E026	20
XVSK	8100031371	GDP00006689	0000215675	Explonor S.a.	70000387	SOFTRON 11/16" X 20" 142U CAJA 20KG	DN726	25,000	CJ	601	E026	20
XTSK	8100030627	GDP00006685	PE056	Enaex - Polvorín Peldehue	70000552	TEC DEM 3,0 M		200,000	UN	643	E026	22
XTSK	8100030627		PE056	Enaex - Polvorín Peldehue	70000554	TEC DEM 6,0 M		80,000	UN	643	E026	22
XTSK	8100031324	GDP00006683	PE005	Enaex - Planta Punta Teatinos	70000387	SOFTRON 11/16" X 20" 142U CAJA 20KG	DN16	27,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000504	APD-P-675 CONICO 30U CAJA 20,2KG	A2PT1	33,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000387	SOFTRON 11/16" X 20" 142U CAJA 20KG	DN06	16,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000399	EMULTEX CN 1 1/2" X 16" 47U CAJA 25KG	ECNA101109	10,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000504	APD-P-675 CONICO 30U CAJA 20,2KG		0,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000387	SOFTRON 11/16" X 20" 142U CAJA 20KG	DN14	28,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000387	SOFTRON 11/16" X 20" 142U CAJA 20KG	DN10	5,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000399	EMULTEX CN 1 1/2" X 16" 47U CAJA 25KG	0000294341	30,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000387	SOFTRON 11/16" X 20" 142U CAJA 20KG	DN13	27,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000387	SOFTRON 11/16" X 20" 142U CAJA 20KG	DN12	26,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000387	SOFTRON 11/16" X 20" 142U CAJA 20KG	DN17	27,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000387	SOFTRON 11/16" X 20" 142U CAJA 20KG	DN18	27,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000504	APD-P-675 CONICO 30U CAJA 20,2KG	EPT07	56,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000387	SOFTRON 11/16" X 20" 142U CAJA 20KG		0,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000387	SOFTRON 11/16" X 20" 142U CAJA 20KG	DN11	28,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000387	SOFTRON 11/16" X 20" 142U CAJA 20KG	DN19	27,000	CJ	643	E026	20
XTSK	8100031324		PE005	Enaex - Planta Punta Teatinos	70000399	EMULTEX CN 1 1/2" X 16" 47U CAJA 25KG		0,000	CJ	643	E026	

Conclusions

- The task of deciding whether a LSP should or not continue providing services to a company may be a complex process since many criteria are present at the moment of making the decision.
- In order to perform a well documented and fair process, better decision models are required.
- The new method FlowSort (tm)has proven to be an effective tool in solving this problem, along with a structured method based on key indicators for LSPs.

Further Work

- Sensitivity analysis
- Comparisons with other MCDM techniques and methods such as rough sets, SVM.
- Use of Kralijc's strategic positioning matrix for developing category providers and strategy portfolio.



- Each category in Kraljic's matrix implies different supply strategies. Where *(n)* is the complexity.
- Non-critical applies to low total expenses, commodity items, abundant suppliers, automated purchasing.
- Strategic applies to very high expenses, custom-made items, risky supply market, Strategic Alliances.

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Thank you for your Attention!