

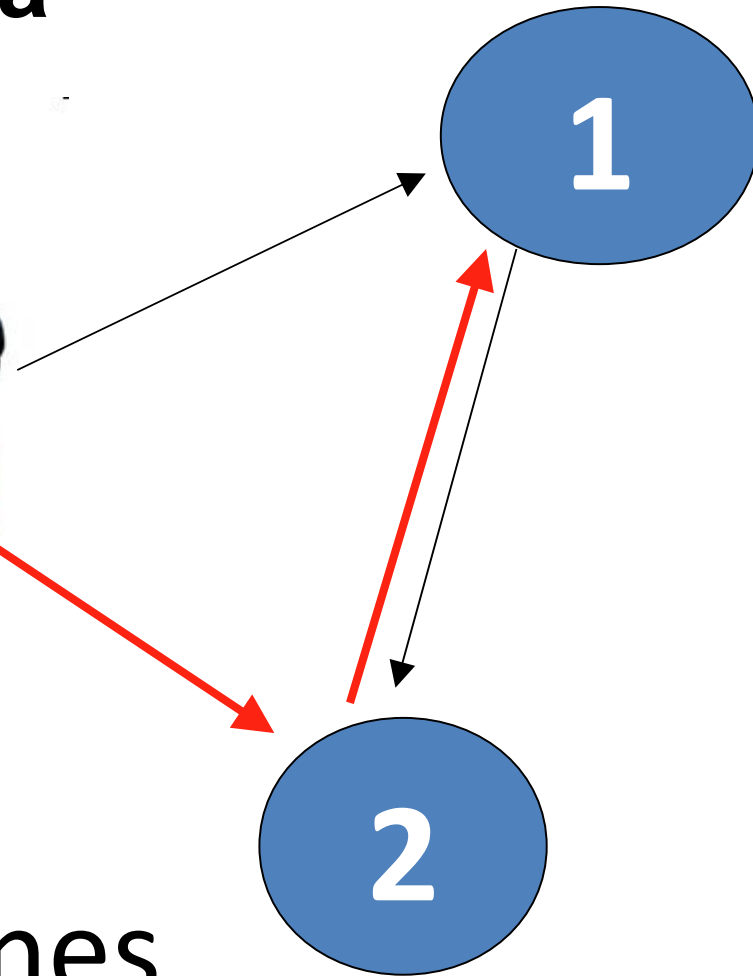
# Optimización: decisiones más inteligentes

Javier Arbex

IBM ILOG Optimization & Supply Chain



# Distribución física



2 opciones

# Distribución física



1-2-3

1-3-2

2-1-3

2-3-1

3-1-2

3-2-1

1

3

2

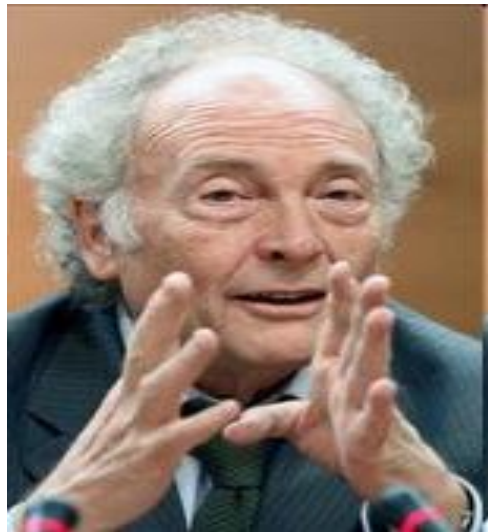
6 posibilidades

# Distribución física



403.291.461.126.606.  
000.000.000.000

# Distribución física



99,9999 %

403.291.461.126.606.  
000.000.~~000.000~~

# Optimización

Una decisión *un poco mejor*

vale mucho dinero

# Ordenamiento del tráfico ferroviario

2.000.000 viajeros /  
día

30 “  
↓

16.000 horas



# Gestión de turnos



1% utilización = 650.000 euros /  
año





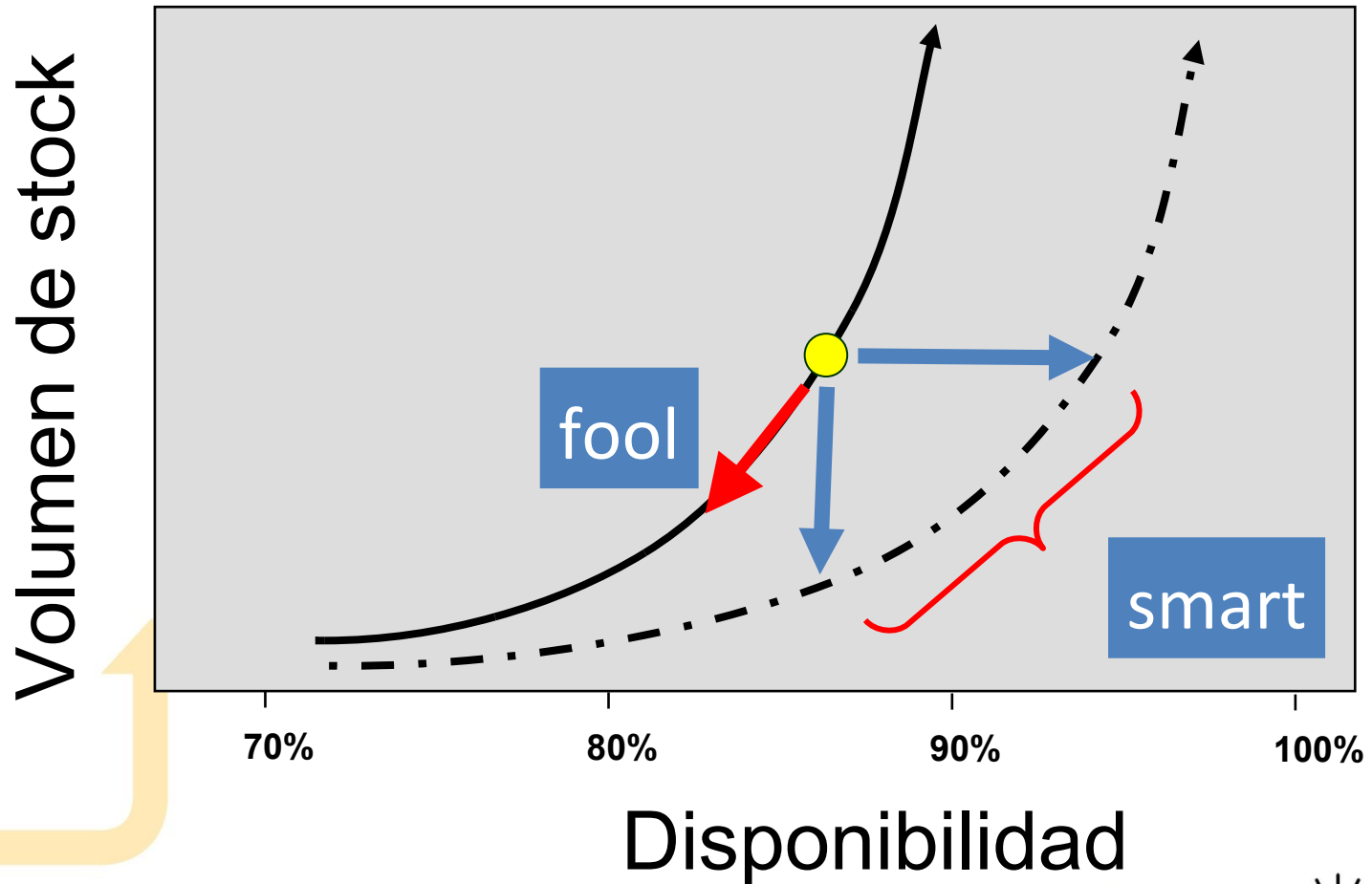
# Gestión de turnos



2.386 controladores  
49 centros de  
control

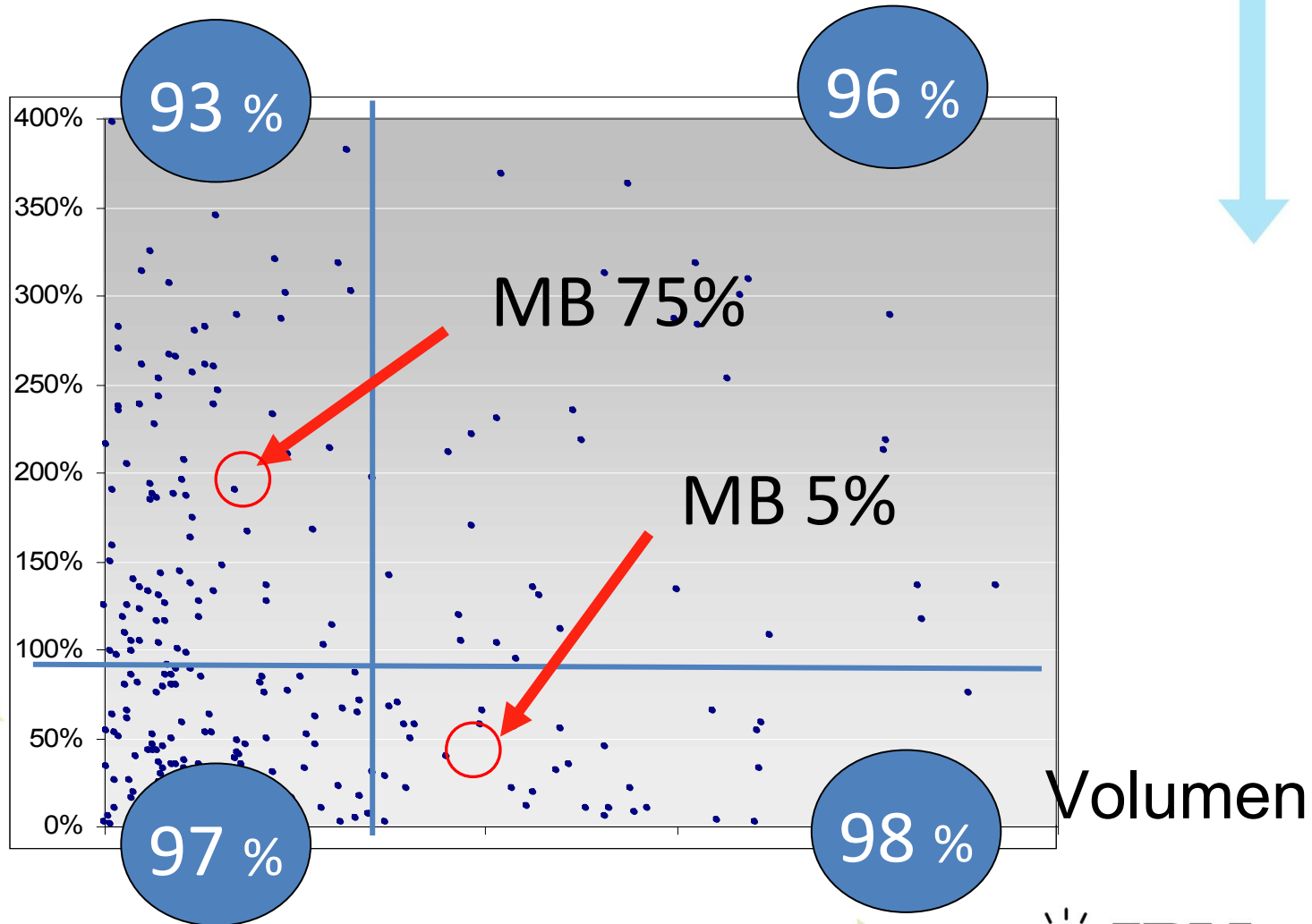


# Gestión de inventarios



# Gestión de inventarios

Volatilidad



# Gestión del dinero en efectivo



Euro 6000	16.000
4B	12.000
Servired	<hr/>
32.000	60.000

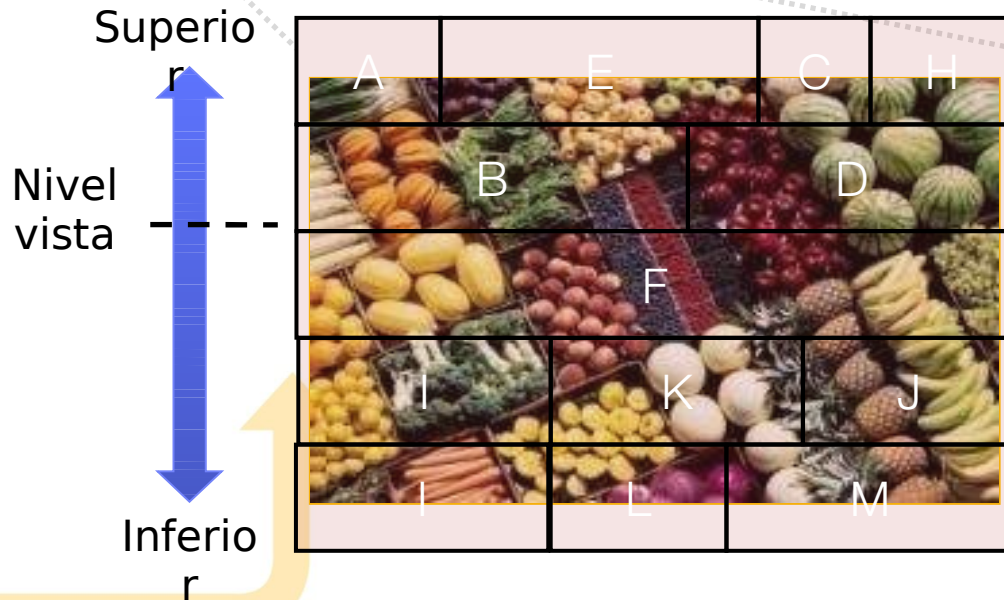
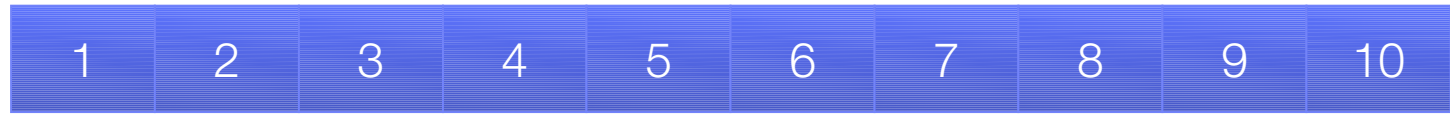
¿100 millones?

# Gestión del dinero en efectivo

Coste de Oportunidad  
Coste de Reposición  
Coste de Seguridad  
Nivel de Servicio  
Marco Regulatorio



# Exposición eficiente del surtido en tienda



2.500 €  
m<sup>2</sup>

4.000 € IBM

# Diseño de cadena de suministro



35 %

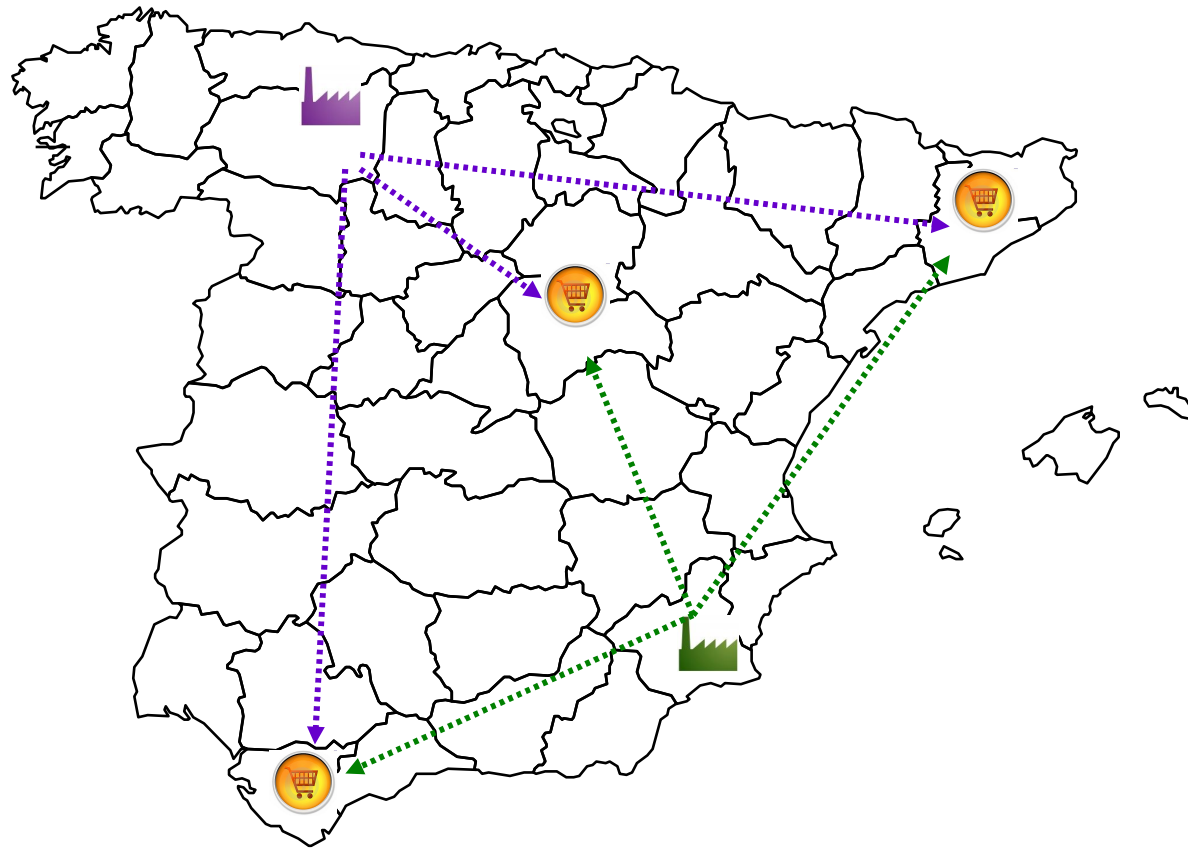
1% mayor eficiencia



17% incremento beneficio

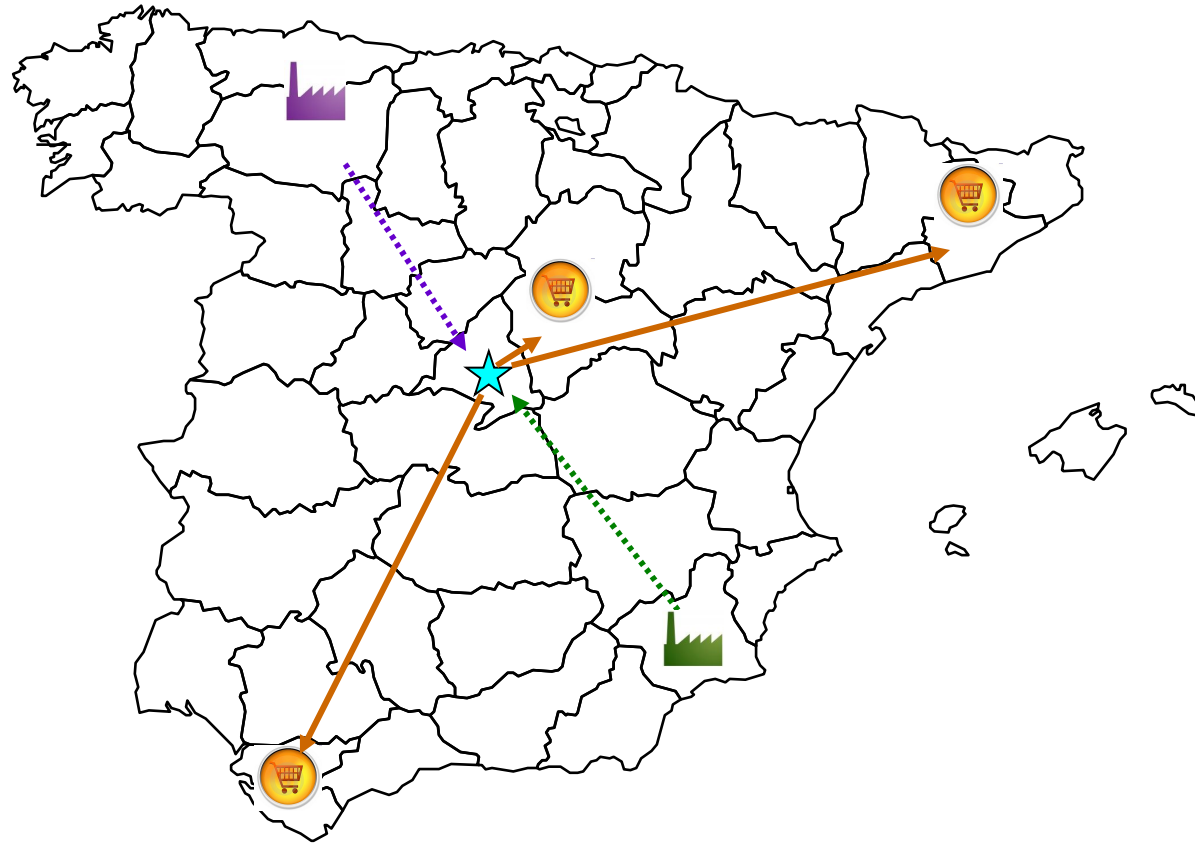


# Diseño de cadena de suministro

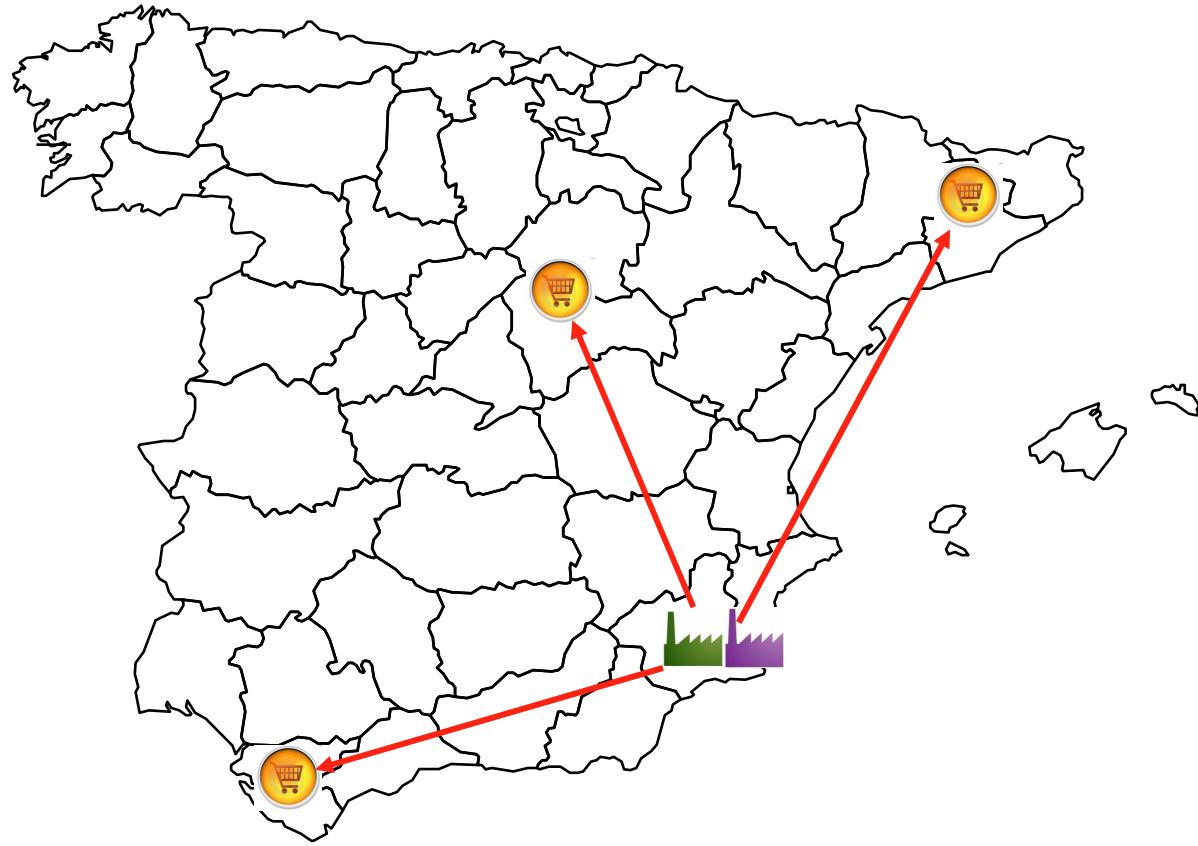




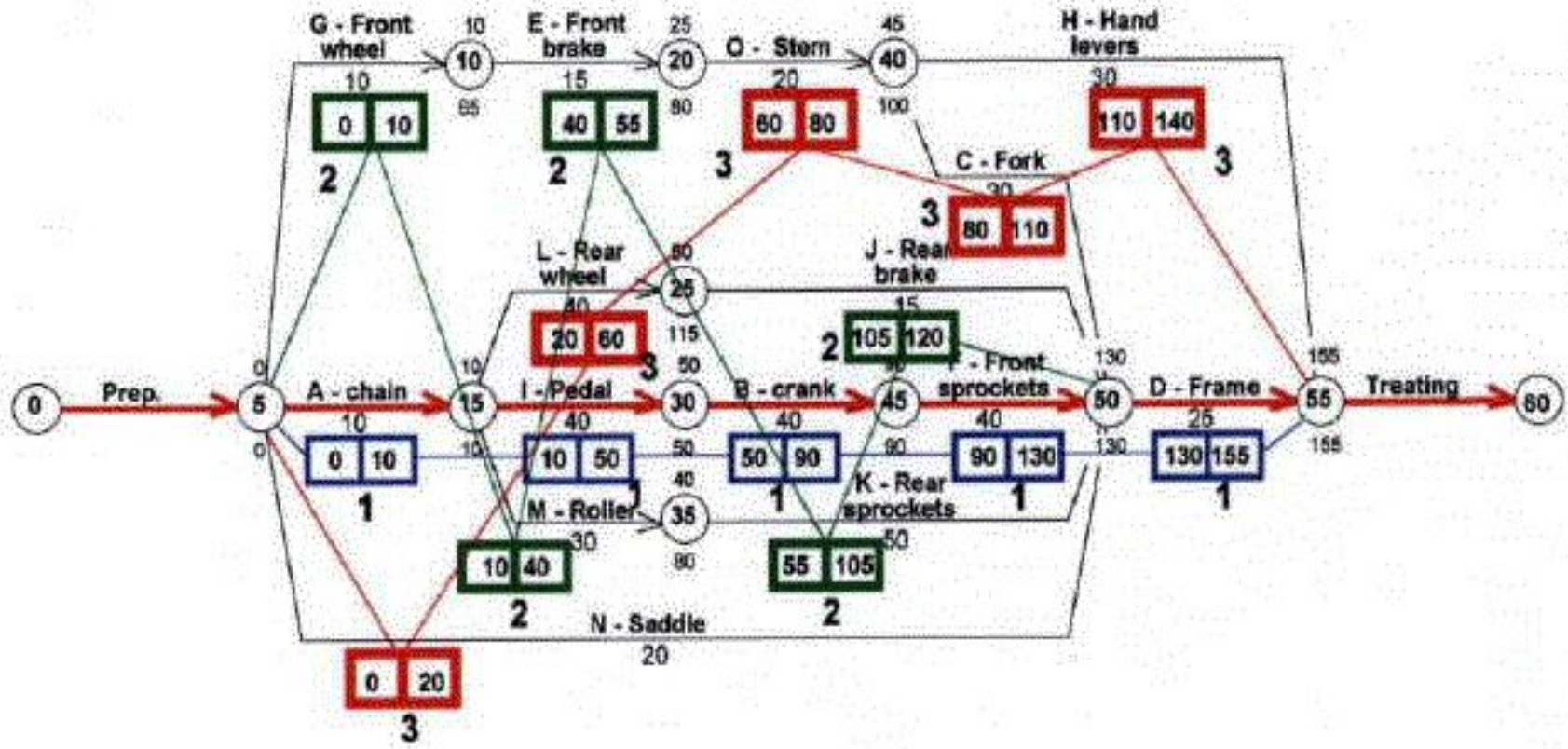
# Diseño de cadena de suministro



# Diseño de cadena de suministro



# Planificación de la producción



# Planificación de la producción

Recursos finitos

Restricciones

hete

Cambio de planes

Balance de líneas

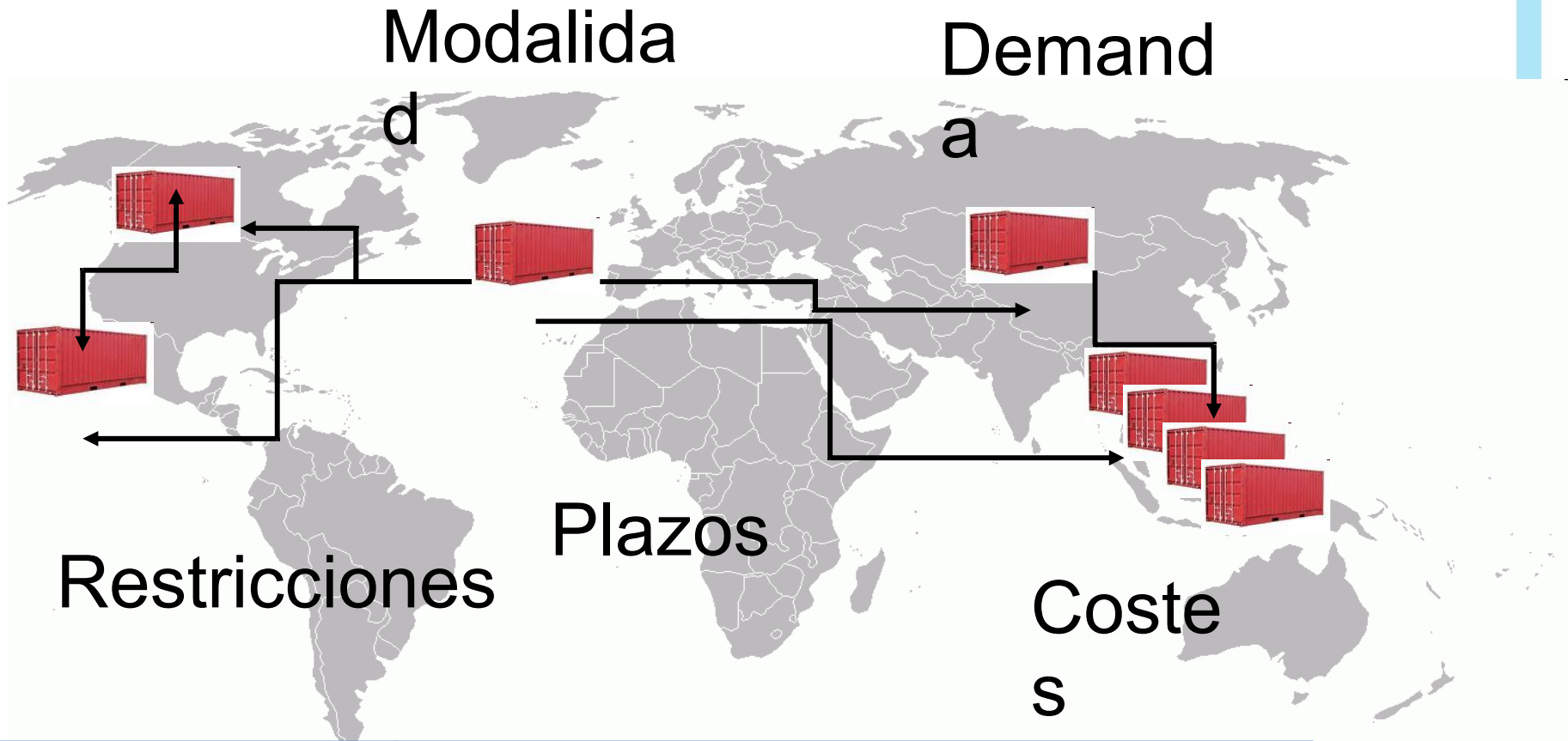
Factor humano

Averías

... ..



# Logística inversa



Sólo Barcelona: 2,7 millones de TEU / año



# Fijación dinámica de descuentos



# Contención económica del impacto ambiental



# Optimización del binomio riesgo-beneficio

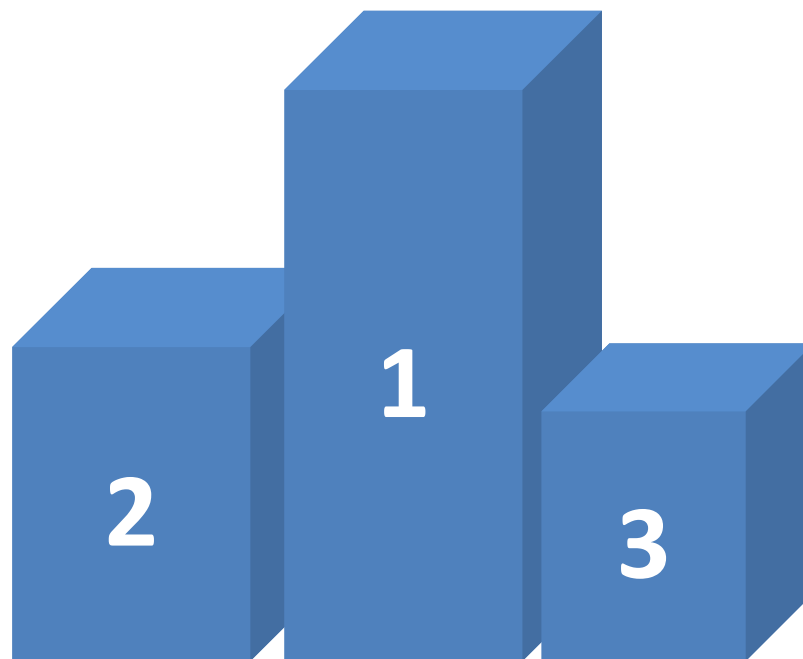




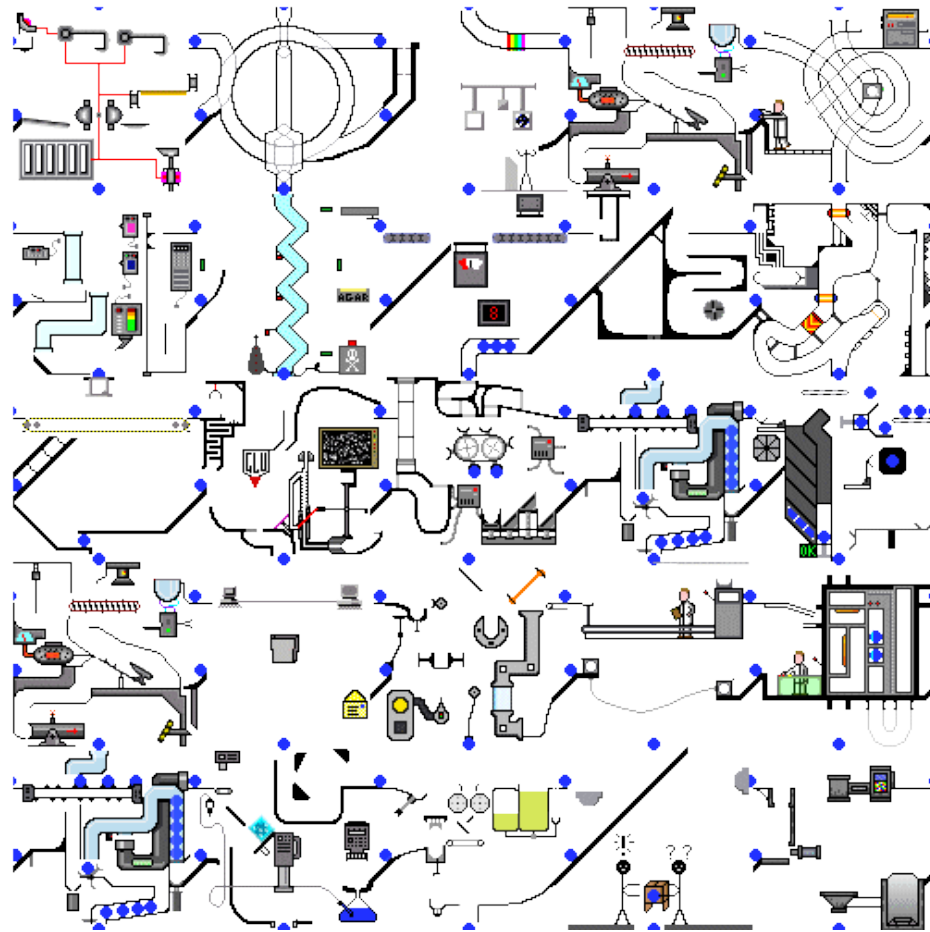
# Uso eficiente de los recursos hídricos



# ¿Qué tiene que ver esto con Usted?



# ¿Qué tiene que ver esto con Usted?



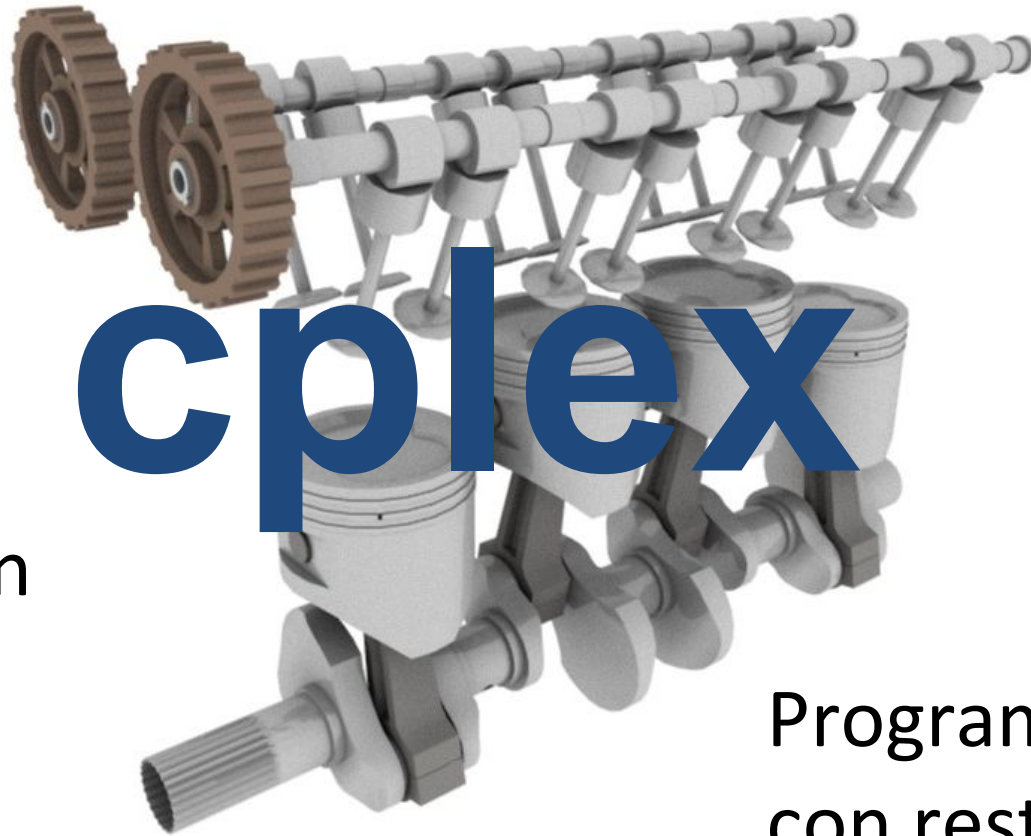
# ¿Qué tiene que ver esto con Usted?



# IBM ILOG Soluciones de Optimización



# IBM ILOG Soluciones de Optimización



Programación  
matemática

Programación  
con restricciones



# IBM ILOG cplex

The screenshot displays the ILOG OPL Development Studio IDE interface. The main window shows the OPL code for a scheduling problem. The code includes a cumulative function, an objective function to minimize the maximum worker length, and constraints for task scheduling. The interface also shows a project browser on the left, a solution table for 'Solution with objective 8', and a performance graph at the bottom right.

```
36 cumulatFunction group[g in Groups] =
37   sum (w in workers[g]) pulse(worker[w], 1)
38   - sum (<t,g> in optTasks) pulse(opttasks[<t,g>], 1);
39
40
41
42
43 execute {
44   cp.param.FailLimit = 5000;
45 }
46
47 minimize max(w in Workers) lengthOf(worker[w]);
48
49 subject to {
50   forall(t in Tasks) /* starts of Tasks */
51     startOf(tasks[t]) == start[t];
52
53   forall(t in Tasks)
54     alternative(tasks[t], all(<t,g> in optTasks) opttasks[<t,g>]);
55
56   forall(g in Groups) {
57     0 <= group[g];
58     group[g] <= maxUnusedWorkers[g];
59   }
60 };
61
62 execute {
```

Name	Value
durations	[7 3 8 3 1 2 1 1]
Groups	{'g1' 'g2' 'g3'}
maxUnusedWorkers	[2 1 1]
mayperform	{{'g1' 'g2'} {'g1' 'g3'} {'g2' 'g3'}}
optTasks	{<'masonry' 'g1'> <'masonry' 'g2'> <'masonry' 'g3'>}
start	[0 7 7 7 10 10 11 15 15 17]

Statistic	Value
CP	
Constraints	29
Variables	35
Memory usage	533348
Choice points	224
Number of solutions	9
Number of branches	315
Number of fails	112
Objective	8

The performance graph shows the Objective value (green line) decreasing over time (seconds). The Solution value (yellow squares) and Proven solution value (red square) are also plotted. The x-axis ranges from 0.15 to 0.24 seconds, and the y-axis ranges from 10 to 15.

## Optimization Programming Language



# ODM (Optimization Decision Manager)

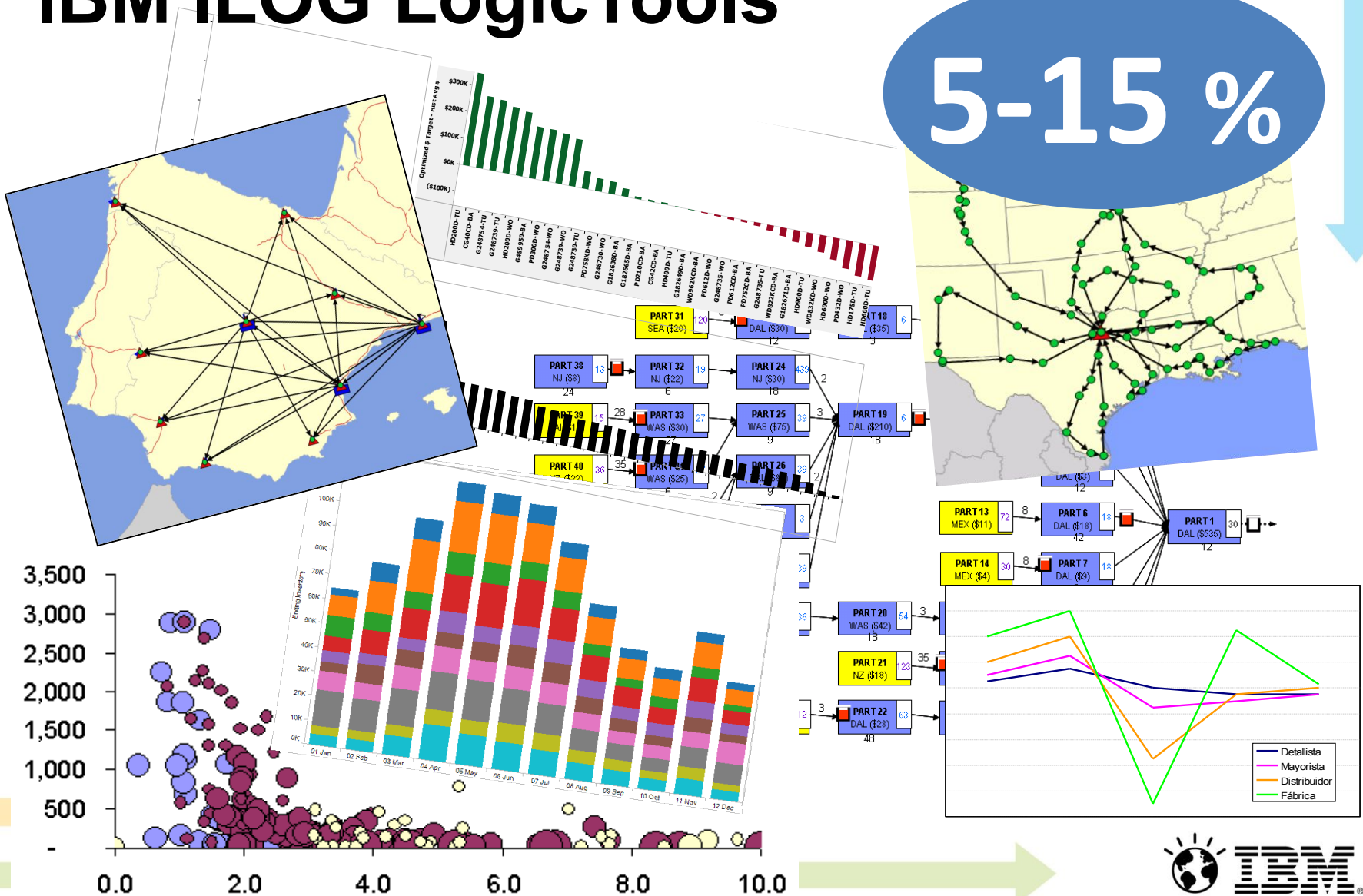
The image displays several overlapping screenshots of the IBM Optimization Decision Manager (ODM) software interface, illustrating its capabilities in project management, resource allocation, and energy optimization.

- Top Left:** A screenshot of a project management interface showing a Gantt chart with tasks (Task 1 through Task 10) and their dependencies. A sidebar on the left lists various project elements like "Project 1" through "Project 9".
- Top Right:** A screenshot of a network flow model. It features a map of the United States with numerous nodes and connecting lines representing supply and demand flows. A sidebar on the left lists "Scenario Explorer" items such as "New Default Scenario", "Analysis", "Goals", "Requirements", "Input Data", "Staff", "Department", "Department Assignments", "Forced Assignments", "Demand by Shifts", "Demand by Shifts Pivot Table", "Charts", "Nurses Chart", "Minimum Demand by Day", "Maximum Demand by Day", "Rules", "Department Assignments", "Worked Hours", and "Assignments".
- Middle Left:** A screenshot of a "Nurse Scheduling" interface. It shows a Gantt chart for nurse assignments and a table of nurse details. The table includes columns for Name, Seniority, Qualification, and Pay Rate. The "Nurses" table is filtered to show 32 rows.
- Middle Right:** A screenshot of a "Minimum Demand by Day" chart. It is a bar chart showing demand levels for Consultation (blue) and Emergency (red) services from Monday to Sunday. The Y-axis ranges from 0 to 30.
- Bottom Left:** A screenshot of a "Nurses" table with columns for Name, Seniority, Qualification, and Pay Rate. The table lists 13 nurses: Anne, Isabelle, Patricia, Patrick, Suzanne, Vickie, Cathy, David, Debbie, Gloria, and Janice.
- Bottom Right:** A screenshot of a "Unit Commitment Demo" dashboard. It displays key performance indicators (KPIs) and charts:
  - Summary:** Fuel Cost: \$10,487,610.77; Start Up Cost: \$550.00; Ecological Cost: \$3,206,395.00.
  - Reserve Levels:** Minimum Spinning Reserve: 100 MWh; Maximum Spinning Reserve: 561 MWh; Average Spinning Reserve: 360 MWh.
  - Energy Production:** A pie chart showing 221,432 MWh.
  - Production Cost:** A pie chart showing \$10,488,160.77.
  - Ecological Cost:** A pie chart showing \$3,206,395.00.
  - Operating Max Generation:** A bar chart showing generation levels for Coal, Diesel, and Gas.
  - Capacity Max Generation:** A bar chart showing capacity levels for Coal, Diesel, and Gas.
  - Average Cost per MWh:** A bar chart showing cost levels for Coal, Diesel, and Gas.



# IBM ILOG LogicTools

5-15 %



# ¿Cómo reconocer una oportunidad?

- Complejidad
- Ámbito
- Restricciones
- Incertidumbre
- «*Siempre lo hemos hecho así*»

# El próximo éxito es el suyo

Samsung - reducción ciclo fab  
50%

MºDe  
planificación

Fonterra – eliminación 4000  
viajes/año

Grant Mayo  
cartera

Miller Coors – 300M\$ rediseño de red

reducción 10%  
10 M\$

Whirl M\$

SNCF - aumento de ingresos 16  
M€/año







**Gracias por su atención**

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